United States Patent

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[54] FOOD HEATING AND DISPENSING MACHINE

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[73] Assignee: **Ven-Dog International**, Fullerton, Calif.

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[52] U.S. Cl. ..... **221/150 HC**, 99/357, 221/192, 221/268

[51] Int. Cl. **G07f 11/00**

[58] Field of Search ..... 221/150 HC, 150 A, 192, 268; 99/357; 137/625.13, 625.11, 625.21, 625.46

[56] **References Cited**

UNITED STATES PATENTS

3,534,676	10/1970	Rubino	221/150 X
3,224,643	12/1965	White	221/150 A
1,446,381	2/1935	Dent	221/192
3,319,655	5/1967	Palmer	137/625.11 X
2,079,041	5/1937	Ryan et al.	137/625.21

FOREIGN PATENTS OR APPLICATIONS

398,260	2/1966	Switzerland	49 C/30/01

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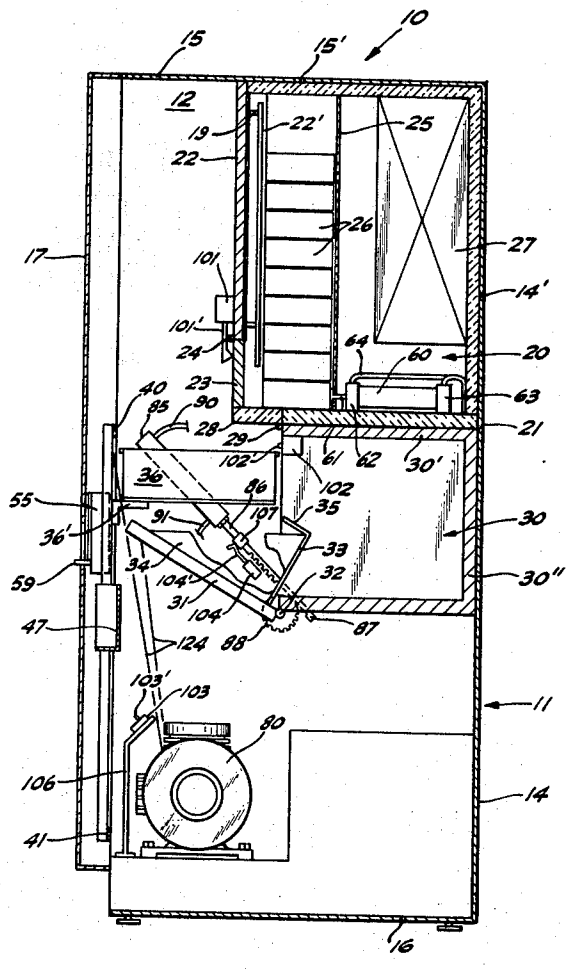
[57] **ABSTRACT**

A food heating and dispensing machine including a cabinet having a refrigeration zone at the upper end thereof, the refrigeration zone enclosing a plurality of vertically disposed storage racks adapted to receive boxes containing food items such as hotdogs. Positioned immediately below the refrigeration zone is a conventional microwave oven having a front door pivotable about a horizontal axis at the bottom of the oven. A plurality of pneumatic cylinders are positioned behind the storage racks so as to selectively force one of the boxes out of one of the racks, such box falling into the oven. After being heated in the oven, the oven door conveys the boxed food item to a delivery bin. According to one embodiment of the invention, the delivery bin comprises an elevator which operates, under the control of the oven door, to deliver the food item at the same height as the oven door.

17 Claims, 13 Drawing Figures



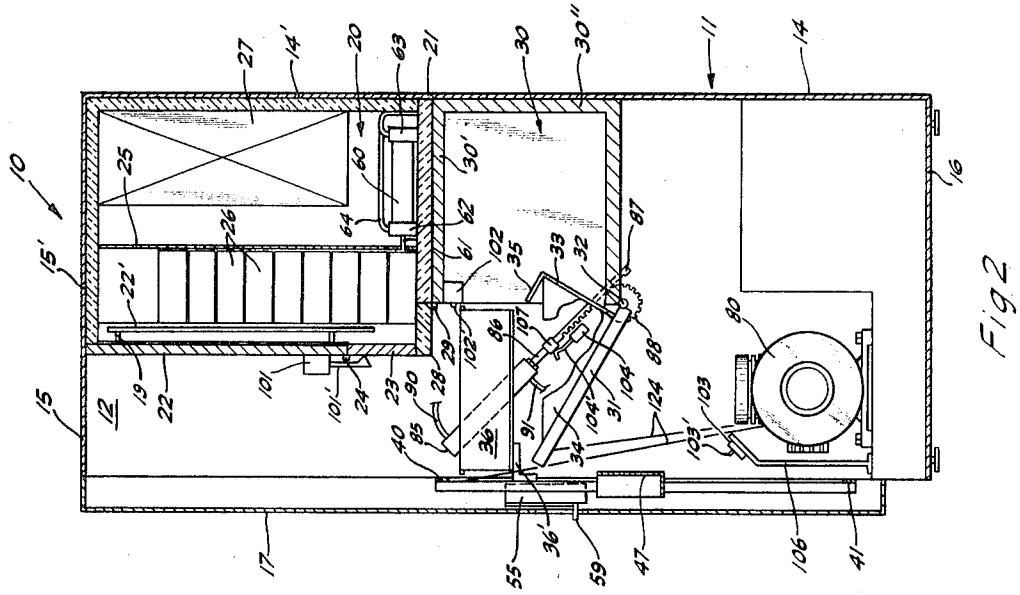


Fig 2

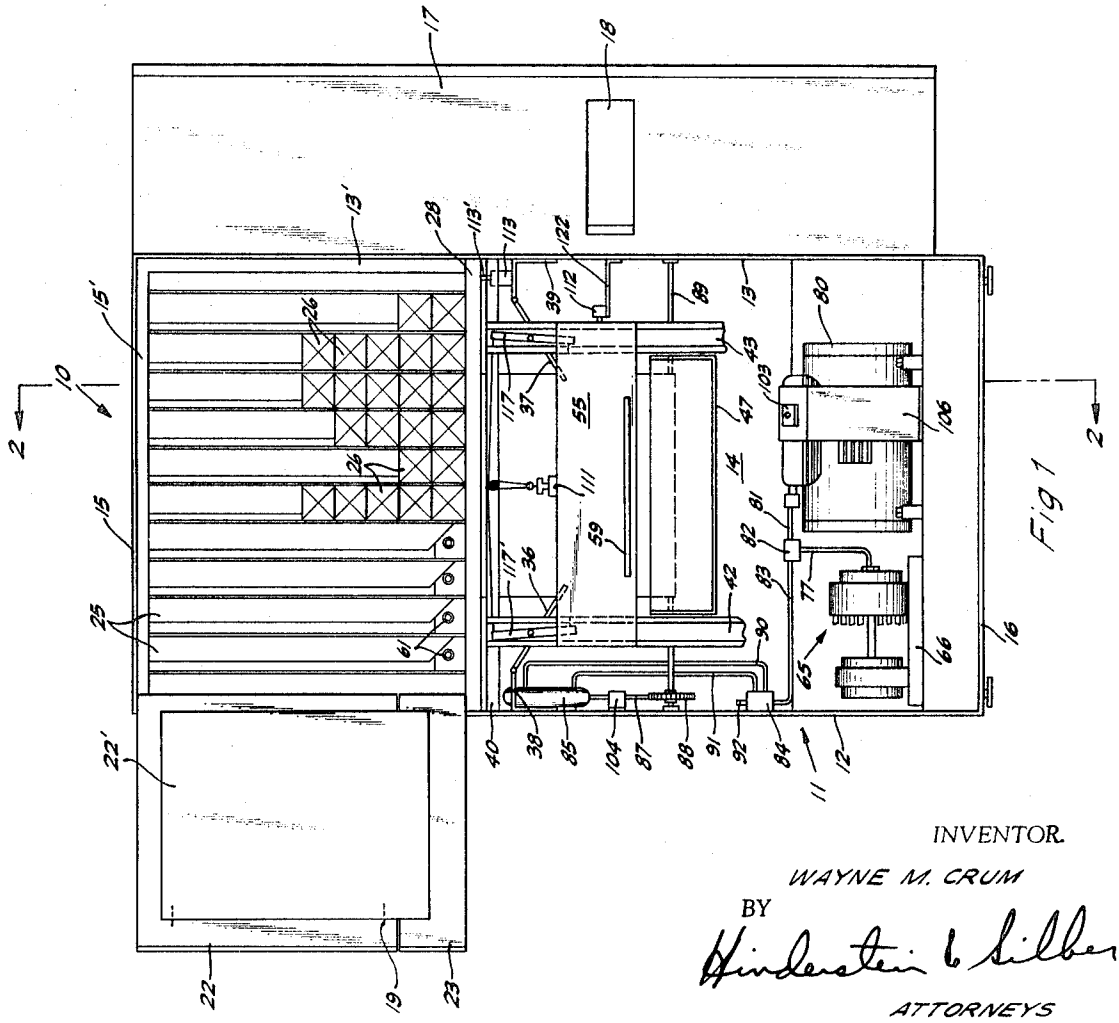


Fig 1

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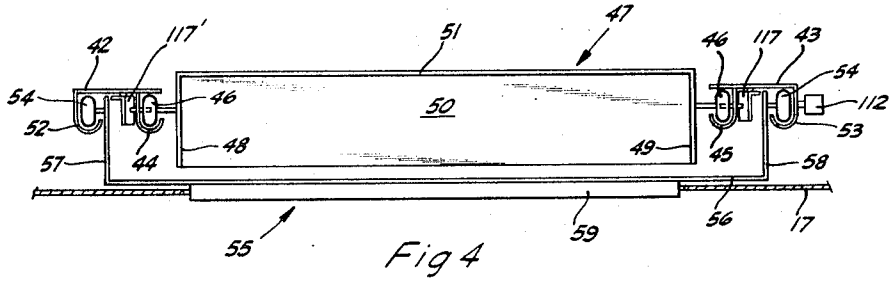

Fig 4

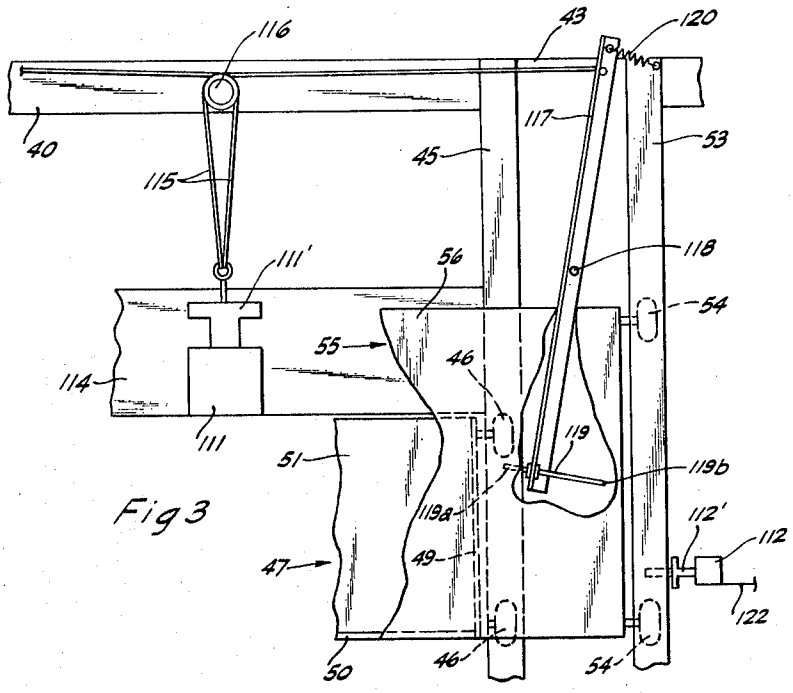

Fig 3

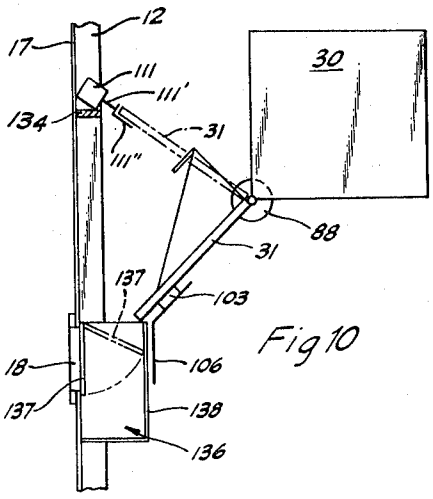

Fig 10

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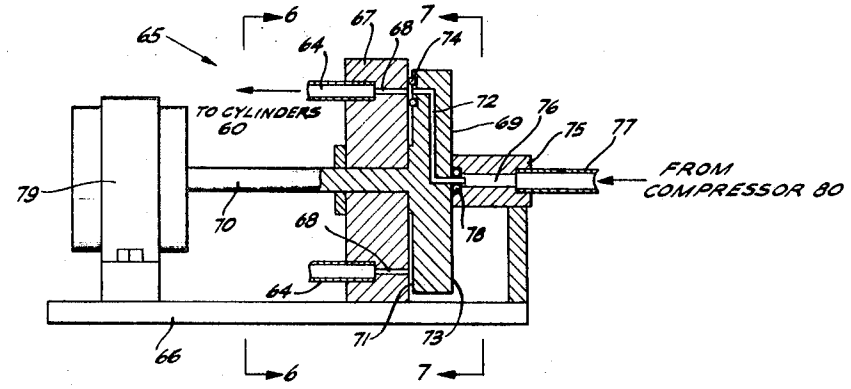

Fig 5

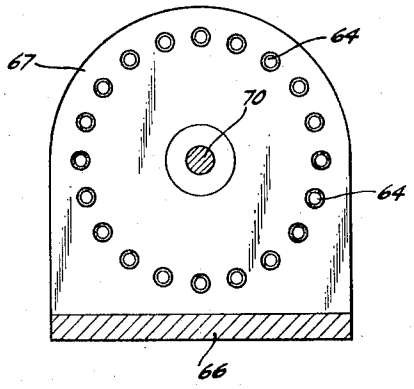

Fig 6

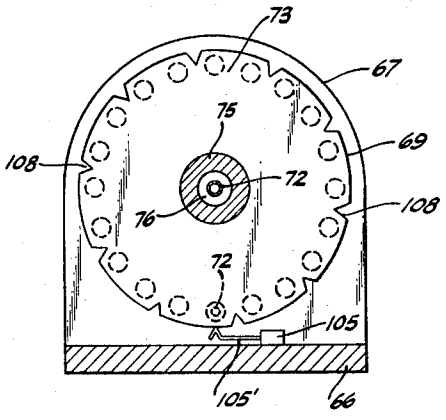

Fig 7

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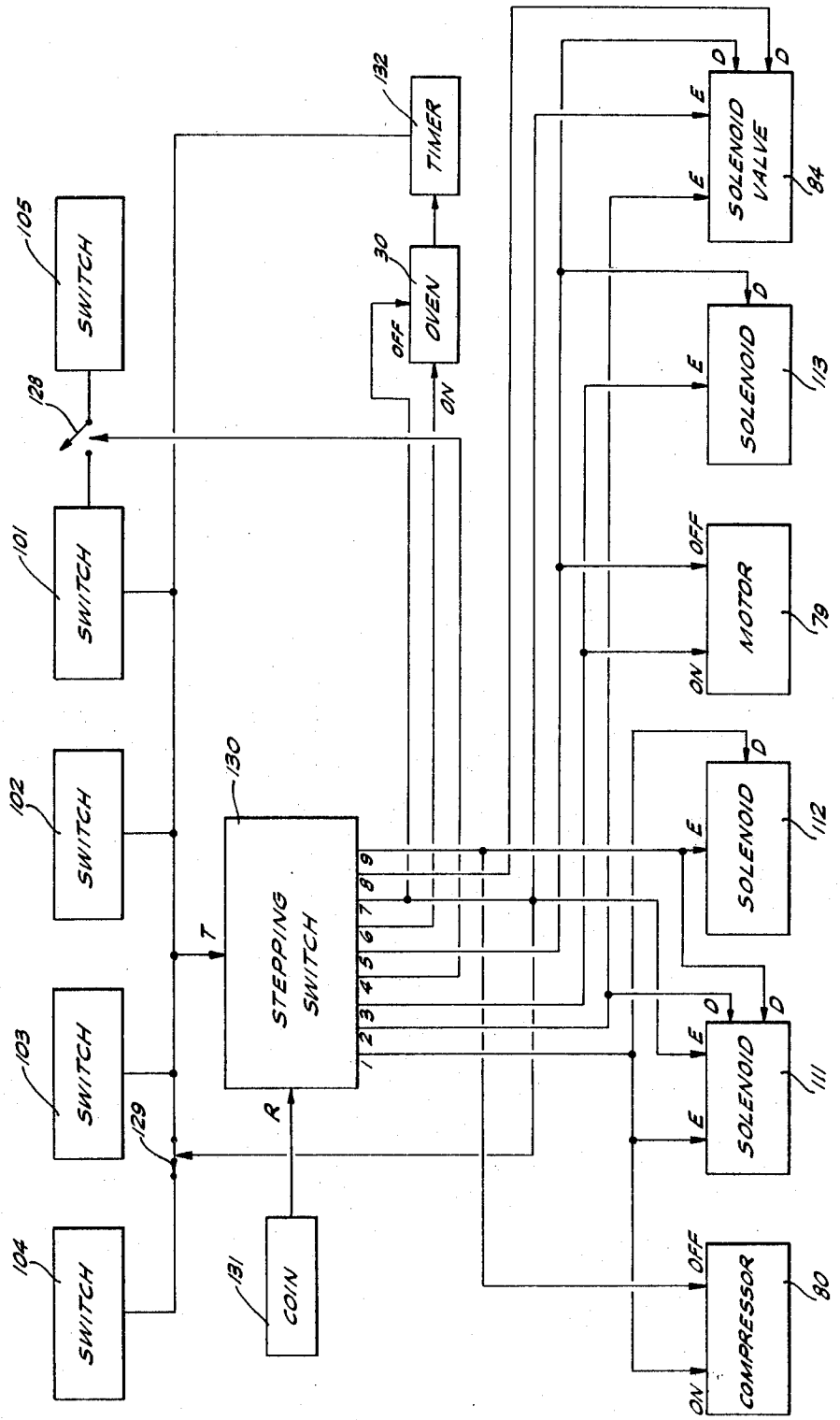

Fig 8

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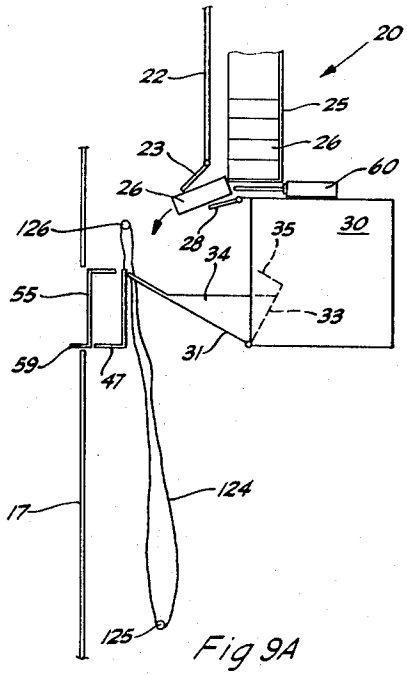

Fig 9A

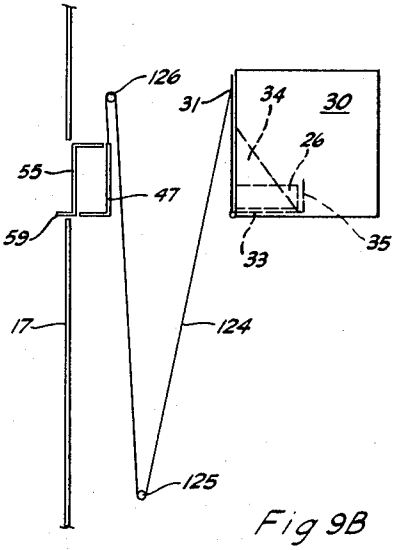

Fig 9B

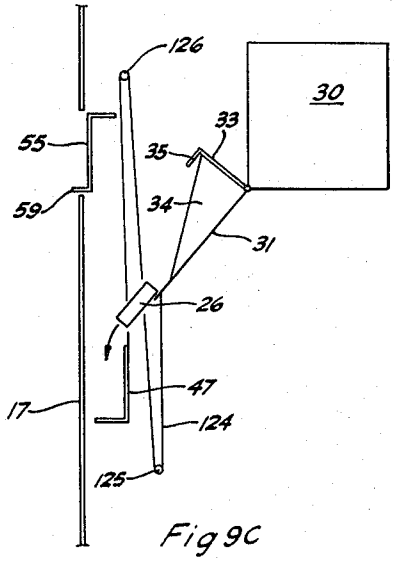

Fig 9C

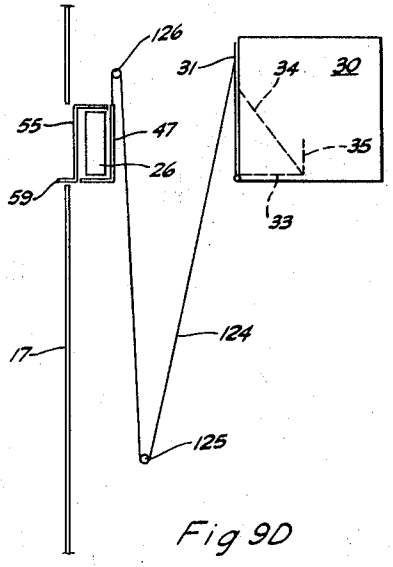

Fig 9D

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FOOD HEATING AND DISPENSING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a food heating and dispensing machine and, more particularly, to a vending machine for automatically conveying a food item from a refrigerated zone to a cooking chamber and from such cooking chamber to the purchaser after it is heated.

2. Description of the Prior Art

Coin-operated machines for the dispensing of various kinds of foods and beverages are old and well known. Different types of machines are available for dispensing either hot or cold beverages, or both, or hot or cold food items, or both. In the dispensing of heated food items, initially, vending machines kept the food continuously heated. However, where a food item is stored in a dispensing machine for a period of time in a heated condition, the food item is often delivered to the purchaser in a soggy, unpalatable and unappetizing condition. As a result, such machines have been generally unpopular except in those rare circumstances where there is sufficient turnover to prevent the food from becoming soggy.

In order to overcome this serious disadvantage in the dispensing of heated food items, it has been suggested that the food items be stored in a refrigerated zone and not heated until purchased. In accordance with this idea, many dispensing machines have been designed in which the food item is automatically or manually conveyed from a refrigerated zone into a heating chamber and then delivered to the purchaser.

In spite of the fact that a wide variety of dispensing machines embodying such principle of operation have been designed, none of such machines have received any substantial degree of commercial acceptance for a wide variety of reasons. In the first instance, substantial problems have been encountered in conveying the food item from the refrigerated zone into the heating chamber and then conveying the heated item from the heating chamber to a delivery bin. The resulting structure invariably included complex mechanical arrangements including motors, gears, cams, etc., and required specially constructed ovens. As a result, it has been difficult, if not impossible, to provide a vending machine at a reasonable price. In addition to the initial cost of the complex configuration of motors, gears, cams, etc., such elements are not highly reliable so that there have been substantial servicing problems, rendering the machines impractical. In addition, because of the problems that have been encountered in conveying the food item from the heating chamber to the delivery bin, the purchaser has often been required to remove the food items from the oven himself, or the delivery system has been such that there is no isolation between the delivery bin and the oven. Both situations have created substantial safety problems, in that the purchaser is subjected to the hazards of direct contact with the heating oven. Since the most practical method for heating the food is to use a microwave oven, this represents a serious problem since the purchaser may well be subjected to the energy of such oven in the event of a malfunction thereof.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a novel approach to the problem of automatically conveying a food item from a refrigerated zone to a heating chamber, cooking such food item, and conveying such food item from the heating chamber to a delivery bin. The present dispensing machine is extremely simple in construction and uses highly reliable, efficient components. As a result, the present machine is capable of being produced at a reasonable, commercial price and has a minimum of service requirements. The present machine completely isolates the heating chamber from the delivery bin so that there is no chance of contact between the purchaser and any of the internal mechanisms of the machine. The present dispensing machine is therefore completely safe and presents no hazard to the purchaser.

Briefly, the present food heating and dispensing machine includes a cabinet having a refrigeration zone at the upper end thereof, the refrigeration zone enclosing a plurality of vertically disposed storage racks adapted to receive boxes containing food items such as hotdogs. Positioned immediately below the refrigeration zone is a conventional microwave oven having a front door pivotable about a horizontal axis at the bottom of the oven. A plurality of pneumatic cylinders are positioned behind the storage racks so as to selectively force one of the boxes out of one of the racks, such box falling into the oven. After being cooked in the oven, the oven door conveys the boxed food item to a delivery bin. According to one embodiment of the invention, the delivery bin comprises an elevator which operates, under the control of the oven door, to deliver the food item at the same height as the microwave oven.

It is therefore an object of the present invention to provide a novel food heating and dispensing machine.

It is a further object of the present invention to provide a machine for automatically conveying a food item from a refrigerated zone to a heating chamber and subsequently conveying the food item from the heating chamber to a delivery bin.

It is a still further object of the present invention to provide an automatic food heating and dispensing machine which is simple and trouble free.

It is another object of the present invention to provide an automatic food heating and dispensing machine which uses highly reliable pneumatic cylinders to convey food items from a refrigerated zone to a heating chamber.

It is still another object of the present invention to provide an automatic food heating and dispensing machine which utilizes a standard, commercially available, microwave oven.

Another object of the present invention is the provision of an automatic food heating and dispensing machine in which the purchaser is completely and safely isolated from the heating apparatus.

Still other objects, features and attendant advantages of the present invention will become apparent to those skilled in the art from a reading of the following detailed description of the preferred embodiments constructed in accordance therewith, taken in conjunction with the accompanying drawings wherein like numerals designate like parts in the several figures and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of a first embodiment of food heating and dispensing machine constructed in accordance with the present invention;

FIG. 2 is a side elevation view taken along the line 2—2 in FIG. 1;

FIG. 3 is an enlarged, front elevation view of a portion of the apparatus of FIG. 1;

FIG. 4 is a reduced, top plan view of the apparatus of FIG. 3;

FIG. 5 is a sectional view of the air valve used in the embodiment of FIG. 1;

FIG. 6 is a view taken along the line 6—6 in FIG. 5;

FIG. 7 is a view taken along the line 7—7 in FIG. 5;

FIG. 8 is a block diagram showing the operation of the apparatus of FIGS. 1–7;

FIGS. 9A–9D are schematic representations of portions of the apparatus of FIGS. 1–7 showing the sequence of operation; and

FIG. 10 is a partial, side elevation view of a second embodiment of food heating and dispensing machine constructed in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and, more particularly, to FIGS. 1–4 thereof, a first embodiment of automatic food heating and venting machine, generally designated 10, includes a

cabinet 11, having sides 12 and 13, a back 14 and a top and bottom 15 and 16, respectively. Hinged at the front edge of side 13 is a front door 17 having a generally rectangular opening 18 therein through which the heated food item may be reached by the purchaser, as will be explained more fully hereinafter.

Vending machine 10 includes several major assemblies. Located at the top of cabinet 11 is a refrigerated zone, designated 20. Refrigerated zone 20 is enclosed by sides 12' and 13', a top 15' and a back 14', which are secured to sides 12 and 13, top 15 and back 14, respectively, of cabinet 11, and a bottom 21. The front of refrigerated zone 20 is enclosed by a door 22 hinged at one side thereof to side 12'. The bottom of door 22 includes a flap 23 which is connected by hinges 24 thereto so that flap 23 may swing outwardly from refrigerated zone 20, for reasons which will appear more fully hereinafter. In addition, the front edge of bottom 21 includes a flap 28 which is connected by hinges 29 thereto so that flap 28 may swing downwardly from zone 20.

Positioned in refrigerated zone 20 is a plurality of vertically disposed, side-by-side, storage racks 25, each of which is adapted to receive a plurality of stacked boxes 26 containing food items to be heated and dispensed. Storage racks 25 are positioned toward the front of refrigerated zone 20 so that suitable refrigeration apparatus 27 may be mounted at the back of refrigerated zone 20.

Spaced directly below refrigerated zone 20 is an oven, generally designated 30, which is, preferably, a standard, commercially available, microwave oven having a generally rectangular shape including a front door 31 which is pivotable about a horizontal axis 32 aligned with the front edge of the bottom wall of oven 30. As shown in FIG. 2, oven 30 is positioned directly below refrigerated zone 20, and the top wall 30' of the former in contact with bottom 21 of the latter and with the back wall 30'' of oven 30 secured to back 14 of cabinet 11. For reasons which will appear more fully hereinafter, oven door 31 includes a shelf 33 which extends into oven 30 in a direction perpendicular to door 31, shelf 33 being enclosed by side panels 34 and a back panel 35.

With door 31 in the position shown in FIG. 2, and with flaps 23 and 28 open, one of boxes 26 may be pushed out of one of storage racks 25, whereupon it will fall into oven 30, landing on door 31 and shelf 33. In order to insure that the boxes at the extreme sides of refrigerated zone 20 fall into oven 30, there is provided a pair of flaps 36 and 37 which are connected by hinges to brackets 38 and 39, respectively, connected to sides 12 and 13, respectively, of cabinet 11. The free ends of flaps 36 and 37 ride on the top of oven door 31 between a substantially horizontal position and an inclined position in contact with stops 36' and 37', respectively, as oven door 31 moves between a closed position and the partially open position shown in FIG. 2. In this manner, when one of boxes 26 is ejected from the side-most storage racks 25, it will slide on either flap 36 or 37 into oven 30.

Secured between sides 12 and 13 of cabinet 11, adjacent front door 17, are a pair of spaced, horizontally disposed support members 40 and 41. Extending between support members 40 and 41 are a pair of spaced, vertically disposed guide members 42 and 43, the spacing between guide members 42 and 43 being slightly greater than the width of door 31 of oven 30, for reasons which will appear more fully hereinafter.

Referring now primarily to FIGS. 3 and 4, guide members 42 and 43 include inner channels 44 and 45, respectively, which support wheels 46 connected to the sides 48 and 49 of a generally rectangular elevator, designated 47. Elevator 47 includes, in addition to sides 48 and 49, a bottom 50 and a back 51, elevator 47 being open at the front and top thereof. Elevator 47 is adapted to move vertically with wheels 46 riding in channels 44 and 45.

Guide members 42 and 43 include outer channels 52 and 53, respectively, which support wheels 54 connected to the sides 57 and 58 of a door, designated 55. Door 55 is a substantially U-shaped member having a front 56 as well as sides 57 and 58. Wheels 54, connected to sides 57 and 58, ride in channels 52 and 53 so that door 55 may move vertically in the same direction as elevator 47. Furthermore, door 55 includes a handle 59 which extends through opening 18 in front door 17 of cabinet 11.

According to the present invention, refrigerated zone 20 provides a location for the storage of food items in a cold condition to insure freshness. Oven 30 provides a location for the rapid heating of such food items. Lastly, elevator 47, selectively closed by door 55 and front 17 of cabinet 11, provides a delivery bin for delivery of the heated food item to the purchaser. The remaining apparatus in food heating and dispensing machine 10 is operative to automatically control the movement of boxes 26 from storage racks 25 to elevator 47 via oven 30. In accordance with the present invention, the conveying of boxes 26 is achieved in a simple, reliable and efficient manner by the use of pneumatic cylinders in combination with a novel air valve. More specifically, and with reference to FIGS. 1 and 2, refrigerated zone 20 includes a plurality of pneumatic cylinders 60, one for each of storage racks 25, each of cylinders 60 controlling a reciprocating piston 61. The actuation of pistons 61 is controlled by selectively conducting air to the opposite ends 62 and 63 of cylinders 60 via tubes 64. Cylinders 60, only one being shown in FIG. 2, are horizontally positioned and spaced along bottom 21 of refrigerated zone 20, so that a piston 61 is aligned with the center of the bottom box 26 in each of storage racks 25. In this manner, by selectively actuating any of cylinders 60, whereby the corresponding piston 61 extends outwardly from end 62 thereof, any one of the bottom row of boxes 26 in storage racks 25 may be pushed through flaps 23 and 28 into oven 30. In order to insure that only the bottom box in the selected column is pushed through flaps 23 and 28, refrigeration zone 20 may include a plate 22' secured to door 22 by arms 19 and held directly in front of all of boxes 26 except those in the bottom row.

Referring now to FIGS. 1, 2 and 5–7, the selective actuation of cylinders 60 is controlled by a novel air valve, generally designated 65. Air valve 65 includes a stationary base 66 on which is mounted a disc-like stationary member 67, member 67 operating as the stator of air valve 65. Stator 67 includes a plurality of passageways 68 extending therethrough, parallel to the axis thereof. As shown in FIG. 6, passageways 68 are arranged in a circular pattern around stator 67. The number of passageways 68 in stator 67 is exactly equal to twice the number of cylinders 60. In addition, passageways 68 are connected, via tubes 65, to the opposite ends 62 and 63 of cylinders 60. More specifically, a first passageway 68 is connected via one of tubes 64 to back end 63 of a first cylinder 60. The next consecutive passageway 68 is connected to the front end 62 of the same cylinder 60. The next two passageways 68 are connected to ends 63 and 62, respectively, of the next cylinder 60 and so on, so that alternate passageways 68 are connected to ends 63 of consecutive cylinders 60, the remaining alternate passageways 68 being connected to ends 62 of consecutive cylinders 60.

The flow of air through passageways 68 is controlled by a rotor 69 which is rotatably mounted on a shaft 70 which extends through stator 67. Rotor 69 is a disc-shaped member having a first surface 71 which is spaced slightly from one side of stator 67. Rotor 69 has a passageway 72 extending therethrough, from surface 71 to its other surface 73. Passageway 72 exits surface 73 coaxially with the axis of rotor 69, whereas passageway 72 exits from surface 71 at a point spaced from the axis of rotor 69 by an amount equal to the spacing of passageways 68 from the axis of stator 67. Accordingly, and as shown in FIGS. 5 and 7, passageway 72 through rotor 69 is adapted to be aligned with any one of passageways 68 in stator 67. An air-tight joint between any of passageways 68 and passageway 72 is provided by means of an O-ring 74 positioned in surface 71 of rotor 69 surrounding passageway 72.

Air is conducted into passageway 72 via a stationary member 75 mounted on base 66 of air valve 65. Stationary member 75 has a passageway 76 therethrough which is adapted to connect a tube 77 with passageway 72. An air-tight joint between rotor 69 and member 75 is provided by an O-ring 78 surrounding passageway 76 in member 75, adjacent surface 73 of rotor 69.

In operation, rotor 69 is adapted to be driven at a slow speed by a motor 79 connected to shaft 70. As rotor 69 rotates, air coming through tube 77 is conducted via passageways 76 and 72 into selected ones of passageways 68 and therefrom into tubes 64 for conduction to cylinders 60. All other tubes 64 are vented to the atmosphere due to the spacing between member 67 and surface 71 of rotor 69. By connecting tube 77 with one of tubes 64 which is connected to an end 63 of a cylinder 60, the corresponding piston 61 may be extended to force the lower box 26 in the corresponding storage rack 25 out of refrigerated zone 20. As rotor 69 rotates to the next passageway 68, end 63 of the same cylinder 60 is vented and air is conducted via tubes 77 and 64 to end 62 of the same cylinder 60 whereby the corresponding piston 61 is withdrawn. When piston 61 is withdrawn, the boxes 26 in the corresponding storage rack 25 move downwardly for the next cycle.

Alternatively, single-acting cylinders, in which a spring is used to retract the piston, may be used. In this case, the number of passageways would be reduced by one-half since the pistons would retract automatically as soon as rotor 69 rotates past passageway 68.

Referring now to FIGS. 1 and 2, air for valve 65 is provided by a compressor 80 positioned at the lower end of cabinet 11. The outlet of compressor 80 is conducted via a tube 81 to a junction box 82 where a portion of the air is diverted via tube 77 to air valve 65. The remainder of the air is conducted from junction box 82 via a tube 83 to a solenoid valve 84. Solenoid valve 84 controls the operation of an additional pneumatic cylinder 85 secured to wall 12 of cabinet 11. Cylinder 85 is operative to control the opening and closing of door 31 of oven 30. More specifically, cylinder 85 controls a piston 86 having connected to the end thereof a toothed rack 87. The teeth of rack 87 are adapted to engage the teeth of a gear 88 connected to a shaft 89 aligned with axis 32 of front door 31 and connected thereto, so that rotation of shaft 89 rotates door 31 about axis 32. The opening and closing of door 31 is controlled by selectively applying air to the opposite ends of cylinder 85. More specifically, solenoid valve 84 includes a first outlet connected via a tube 90 to one end of cylinder 85 and a second outlet connected via a tube 91 to the other end of cylinder 85. Solenoid valve 84 also includes a vent outlet 92.

In operation, when solenoid valve 84 is de-energized, it connects inlet tube 83 with tube 90 and connects tube 91 to vent 92. In this position, cylinder 85 operates to extend piston 86 outwardly therefrom thereby tending to close oven door 31. On the other hand, when solenoid valve 84 is energized by a suitable electrical signal, it connects inlet tube 83 with tube 91 and connects tube 90 to vent 92. In this position, cylinder 85 operates to retract piston 86 thereby tending to open oven door 31.

The remaining elements of vending machine 10 comprise a plurality of switches 101 through 105 for sensing various functions within machine 10 and a plurality of solenoids 111–113 for controlling various operations of machine 10. More specifically, and as shown in FIGS. 1 and 2, switch 101 is mounted on door 22 of refrigerated zone 20 and includes an arm 101' positioned to sense the opening and closing of flap 23. Switch 102 is mounted on the top or side of oven 30 and includes an arm 102' positioned to sense the closing of front door 31 of oven 30. Switch 103 is mounted on a bracket 106 secured to the bottom of cabinet 11 and includes an arm 103' mounted to be contacted by door 31 of oven 30 when door 31 is in its fully open position. Switch 104 is mounted on side 12 of cabinet 11 and includes an arm 104' which cooperates with a sleeve 107 secured to piston 86 of cylinder 85. Sleeve 107 is positioned on piston 86 in such a manner that it contacts arm 104' of switch 104 when door 31 of oven 30 is in its partially open position, as shown in FIG. 2, ready to receive one of boxes 26 from refrigerated zone 20.

As shown in FIG. 7, switch 105 is positioned on base 66 of air valve 65 and includes an arm 105' which is adapted to cooperate with a plurality of notches 108 in rotor 69. Notches 108 are equally spaced around the circumference of rotor 69, the number of notches 108 being equal to one-half the number of passageways 68. As shown in FIG. 7, the angular orientation of notches 108 is such that arm 105' of switch 105 engages one of notches 108 when passageway 72 is half-way between adjacent passageways 68, as will be explained more fully hereinafter.

Referring now to FIG. 3, solenoid 111 is mounted on a support member 114 which extends between guide members 42 and 43. Solenoid 111 includes a movable arm 111' which is adapted to be pulled into solenoid 111 when solenoid 111 is energized by a suitable electrical signal. Arm 111' is connected via cords 115 and a pulley 116 to first ends of a pair of identical lever arms 117 and 117' (only lever arm 117 being shown in FIG. 3). Lever arm 117 is pivotally connected via a pin 118 to the back of guide member 43, pin 118 being intermediate the opposite ends of lever arm 117. The other end of lever arm 117 supports a rod 119 having a first section 119a extending perpendicular to arm 117 in one direction and a second section 119b extending perpendicular to arm 117 in the opposite direction.

The function of lever arm 117 is to permit or prevent vertical movement of elevator 47 and/or door 55. More specifically, with solenoid 111 de-energized, a spring 120 connected between channel 53 and the first end of lever arm 117 biases arm 117 in the position shown in FIG. 3. In this position, section 119a of rod 119 extends through a hole (not shown) in channel 45 to a position directly below one of wheels 46 of elevator 47. With arm 117 in this position, elevator 47 is prevented from moving downwardly since section 119*a* effectively blocks the path of wheels 46. In this position, however, door 55 is free to move upwardly. On the other hand, when solenoid 111 is energized, pulling arm 111' thereinto, lever arm 117 pivots around pin 118 thereby removing section 119*a* of rod 119 from channel 45. However, in this case, section 119*b* of rod 119 extends through a hole (not shown) in side 58 of door 55 preventing vertical movement of door 55. In addition, any time door 55 is not in its closed position, arm 117 cannot be activated to release elevator 47 since section 119*b* of rod 119 will abut against side 58 of door 55.

Solenoid 112 is mounted via a bracket 122 to side 13 of cabinet 11 and includes an arm 112' which is adapted, when solenoid 112 is de-energized, to extend through an opening (not shown) in channel 53 into the path of wheels 54 thereby preventing door 55 from being raised. On the other hand, when solenoid 112 is energized by a suitable electrical signal, thereby withdrawing arm 112' from channel 53, door 55 may be readily raised.

As shown in FIG. 1, solenoid 113 may be mounted on bracket 39 adjacent side 13 of cabinet 11, solenoid 113 including an actuating arm 113' which is connected to flap 28 at the front end of bottom 21 of refrigerated zone 20. Accordingly, when solenoid 113 is energized by a suitable electrical signal, arm 113' is retracted thereby pulling down flap 28.

The operation of vending machine 10 may be best understood with reference to FIGS. 1–7 and with further reference to FIGS. 8 and 9A–9B which show, in block diagram and schematic form, the electrical apparatus and the sequence of operation, respectively, of vending machine 10. More specifically, the operation of vending machine 10 is controlled by a conventional stepping switch 130 having a trigger input terminal T, a reset input terminal R and a plurality of sequentially activated output terminals 1–9. Stepping switch 130 is operative to sequentially activate output terminals 1–9. Stepping switch 130 is operative to sequentially acitvate out-

put terminals 1–9 upon receiving a suitable triggering signal at trigger input terminal T. Reset input terminal R is connected to the coin receptacle **131** so that stepping switch **130** is reset and energizes output terminal **1** every time a suitable coin is received indicating that a food item in one of boxes **26** is to be purchased. With output terminal **1** of stepping switch **130** energized, a signal is applied: (1) to compressor **80** to turn it on; (2) to solenoid **111** for the energization thereof; and (3) to solenoid **112** for the de-energization thereof. When solenoid **111** is energized, door **55** is locked in place and elevator **47** is released. When solenoid **112** is de-energized, door **55** is locked, this locked condition remaining during the entire cooking cycle. At this point, solenoid valve **84** is de-energized so that the output of compressor **80** is directed into tube **90** whereby door **31** is driven towards its closed position. As will be seen hereinafter, when the cycle is completed, door **30** is closed. However, during the servicing of vending machine **10**, it is conceivable that any of the elements may be left in any position and it is desirable to start the cycle by driving all components to a predetermined position. Accordingly, in position **1** of stepping switch **30**, solenoid **111** is energized to release elevator **47** and solenoid valve **84** is de-energized to close door **30**. As shown schematically in FIGS. 9A–9D, door **31** of oven **30** is connected to elevator **47** via a cord **124** which extends around first and second pulleys **125** and **126**, pulley **125** being connected to bottom **16** of cabinet **11** and pulley **126** being connected to support member **40**. Accordingly, and as shown in FIG. **9D**, when door **31** closes, elevator **47** is elevated to its top-most position.

Switch **102** is positioned to sense the closing of door **31**. As shown in FIG. **8**, switch **102**, as well as switches **101**, **103** and **104**, are connected to the trigger input terminal T of stepping switch **130**. Accordingly, as soon as door **31** closes, stepping switch **130** is sequenced to output position **2**. In this position, solenoid **111** is de-energized, thereby locking elevator **47** in place, and a suitable energizing signal is applied to solenoid valve **84** which thereupon connects inlet tube **83** to tube **91** to open door **31**. Oven door **31** then opens until it contacts the back of elevator **47**, as shown schematically in FIG. **9A**. In this position, sleeve **107** attached to piston **86** contacts arm **104'** of switch **104** sending a triggering signal to terminal T of stepping switch **130** which is sequenced to output position **3**. It should be noted, at this point, that cylinder **85** is still trying to continue opening door **31**, but door **31** is held in its half-open position because its path is blocked by elevator **47**.

In output position **3** of stepping switch **130**, solenoid **113** is energized to open flap **28** and motor **79** is turned on to start the operation of air valve **65**. As rotor **69** begins to turn, passageway **72** encounters one of passageways **68** which is connected to end **63** of one of cylinders **60**, thereby extending the corresponding piston **61** outwardly. The speed of rotation of rotor **69** is slow enough so that piston **61** can be fully extended before passageway **72** passes the corresponding passageway **68**. If the corresponding storage rack **25** contains a box **26** in front of the corresponding cylinder **60**, such box **26** is pushed out of refrigerated zone **20**. As box **26** is pushed forward, it lifts flap **23** connected to front door **22** of refrigerated zone **20**. The lifting of flap **23** triggers switch **101** which causes stepping switch **130** to advance to output position **4**. Output position **4** simply operates to close a switch **128** thereby connecting switches **101** and **105** in series with the trigger input terminal T of stepping switch **130**.

At this point, box **26** has fallen into oven **30** and rests between door **31** and shelf **33**. As soon as box **26** has fallen into oven **30**, flap **23** closes, thereby triggering switch **101**. However, since switches **101** and **105** are now connected in series, stepping switch **130** is not advanced until switch **105** is activated. Accordingly, motor **79** continues to drive rotor **69**. Passageway **72** of rotor **69** next encounters the passageway **68** connected to the end **62** of the same cylinder **60** which was just energized, thereby driving the corresponding piston **61** back into such cylinder **60**. After piston **61** is fully retracted, rotor **69** continues to rotate a short distance until arm **105'** of switch **105** encounters one of notches **108**. This is the reason why notches **108** are spaced halfway between every other ones of passageways **68**. At this time, switches **101** and **105** are both actuated, indicating that a box **26** has been dropped into oven **30** and that the piston **61** has been fully retracted. Stepping switch **130** therefore moves to output position **5** where motor **79** is turned off, where solenoid **113** is de-energized to close flap **28**, and where solenoid valve **84** is de-energized to close oven door **31**.

If the storage rack **25** corresponding to the actuated cylinder **60** is empty, flap **23** will not be actuated and switch **101** will not trigger stepping switch **130** to position **4**. Therefore, stepping switch **130** will be insensitive to arm **105'** falling into one of notches **108** after the corresponding piston **61** has been withdrawn. Accordingly, motor **79** will continue to run and the next cylinder **60** will be actuated. In this manner, consecutive cylinders **60** will be actuated until one is found in which the corresponding storage rack **25** contains a box **26**. It is only when a box is forced through flap **23** that switch **101** triggers stepping switch **130** to output position **4**. As soon as stepping switch **130** reaches output position **4**, however, motor **79** will be de-energized as soon as the corresponding piston **61** has been withdrawn. Additional apparatus including a counter (not shown) may be connected to the output of switch **105**, such counter being operative to count how many cylinders **60** are activated before a box **26** is found. Such apparatus may be operative, upon receiving **10** consecutive signals from switch **105**, indicative of the fact that all of storage racks **25** are empty, to indicate that the machine is empty and to turn off stepping switch **130**.

When a box drops into oven **30** and oven door **31** closes, as represented in FIG. **9B** and as sensed by switch **102**, stepping switch **130** is advanced to output position **6**. In output position **6**, a triggering signal is sent to oven **30** to turn oven **30** on. As soon as oven **30** is turned on to start the cooking cycle, a signal is applied to an oven timer **132** which starts a timing cycle which continues for an amount of time sufficient to cook the food item in box **26**. At the end of this timing cycle, a signal is applied to trigger input terminal T of stepping switch **130** thereby causing stepping switch **130** to be advanced to output position **7**. In output position **7**, oven **30** is turned off, solenoid **111** is energized to release elevator **47**, and solenoid valve **84** is energized to open oven door **31**. At this time, a signal is also applied to open a switch **129** between the output of switch **104** and the trigger input terminal T of stepping switch **130** so that stepping switch **130** is not triggered when door **31** reaches the partially open position. Accordingly, door **31** continues to open until it reaches the full open position, as shown in FIG. **9C**. As door **31** opens, elevator **47** drops under the control of cord **124**. When door **31** reaches the full open position, elevator **47** is positioned to receive box **26** which will now slide from door **31** and shelf **33**. In addition, the full open position of door **31** is sensed by switch **103** which triggers stepping switch **130** to output position **8**. In position **8**, solenoid valve **84** is de-energized, thereby reversing the condition of solenoid valve **84** whereupon door **31** of oven **30** starts to close. As door **31** closes, elevator **47** is raised under the control of cord **124**.

As soon as door **31** of oven **30** closes, as sensed by switch **102**, stepping switch **130** is advanced to its ninth and final output position. At this time, elevator **47** is in its uppermost, delivery position. Therefore, when stepping switch **130** reaches output position **9**, it: (1) turns off compressor **80**; (2) de-energizes solenoid **111** thereby locking elevator **47** and releasing door **55**; and (3) energizes solenoid **112** to remove arm **112'** thereof from channel **53** to release door **55**. Therefore, at this time, the purchaser may elevate door **55** and remove box **26** from elevator **47**.

Referring now to FIG. **10**, there is shown an alternate embodiment of the present invention in which elevator **47** is eliminated thereby substantially simplifying the operation of vending machine **10**. In FIG. **10**, corresponding components have been given the same numerals. In the embodiment of

FIG. 10, guide members 42 and 43, as well as elevator 47 and all parts thereof, and door 55 and all parts thereof have been eliminated. Instead, front door 17 has connected thereto a generally rectangular receptacle 136 which is open at the top thereof. A door 137 is pivotally hinged about a horizontal axis at the top of opening 18 in front door 17. In addition, the height of door 137 relative to the depth of receptacle 136 is such that door 137 contacts the back 138 of receptacle 136 in its full open position. In this manner, door 137 can never be opened by an amount which will permit the purchaser to reach through opening 18 to the inside of vending machine 10.

In the modified form of vending machine 10, as shown in FIG. 10, switches 101–105 and solenoid 113 remain in the same location and retain their same function. The only changes that are required are in the positions of solenoids 111 and 112. More specifically, solenoid 111 is now mounted on a support member 134 which extends between sides 12 and 13 of cabinet 11. Solenoid 111 includes a bracket 111'' connected to arm 111', so that when solenoid 111 is de-energized, and arm 111' is extended, bracket 111'' extends into the path of door 31 at its partially open position. In this manner, solenoid 111 performs the function previously provided by elevator 47 of holding door 31 in its partially open position during the expulsion of a box 26 from refrigerated zone 20. The only other change is in the relocation of solenoid 112 which is now located in receptacle 136 (not shown) to block the opening of door 137.

The operation of the embodiment of FIG. 10 is identical to the operation previously described. With stepping switch 130 reset and in output position 1, solenoid 111 is energized to remove bracket 111'' from the path of door 31 so that door 31 may be closed, if open. In output position 2 of stepping switch 130, solenoid 111 is de-energized to extend bracket 111'' into the path of door 31 to hold door 31 in its partially open position during output positions 3, 4 and 5 of stepping switch 130. When stepping switch 130 reaches output position 7, solenoid 111 is energized to withdraw bracket 111'' so that door 31 may continue to its fully open position. In its fully open position, door 31 drops box 26 into receptacle 136 and triggers switch 103 to close oven door 31. When oven door 31 is closed and stepping switch 130 is triggered to output position 9, solenoid 112 is energized to release door 137 so that the purchaser may remove the heated food item from receptacle 136.

It can therefore be seen that in accordance with the present invention, there is provided a novel approach to the problem of automatically conveying a food item from a refrigerated zone 20 into a heating chamber 30, cooking such food item, and conveying such food item from heating chamber 30 to a delivery bin 47 or 136. The present dispensing machine is extremely simple in construction and uses highly reliable, efficient components. Instead of using a complex configuration of motors, gears, cams, etc., which components are both expensive and create substantial servicing problems, highly reliable pneumatic cylinders are utilized thereby minimizing both the initial cost and the necessity for service. With vending machine 10, the purchaser is completely safe and no hazard is presented. Furthermore, the present vending machine 10 utilizes a standard, conventional, microwave oven 30 having a standard front door pivotable about a horizontal axis, therefore eliminating the requirement for expensive, specially constructed ovens. According to the first embodiment of the present invention, an elevator is provided to raise the food item to a convenient height for delivery to the purchaser, thereby eliminating the usual requirement of forcing the purchaser to bend over to a relatively low point in the machine to remove the cooked item.

While the invention has been described with respect to the preferred physical embodiments constructed in accordance therewith, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. Accordingly, it is to be understood that the invention is not to be limited by the specific illustratiVe embodiments, but only by the scope of the appended claims.

I claim:

1. A food heating and dispensing machine comprising: a cabinet;

means enclosing a refrigerated area at the upper end of said cabinet;

means positioned in said refrigerated area for storing boxes containing food items to be heated and dispensed;

a heating chamber positioned in said cabinet directly below said refrigerated area, said heating chamber including a door pivotable about a horizontal axis positioned adjacent the front edge of the bottom wall of said chamber, said door being positionable in a closed position, extending vertically upwardly, a partially open position which is angularly displaced by 90° or less from said closed position, and a fully open position which is angularly displaced by substantially more than 90° from said closed position, said heating chamber including a shelf secured to said door;

drive means for controlling the position of said door;

means for conveying selected ones of said boxes out of said refrigerated area;

control means for controlling the operation of said drive means, said heating chamber and said conveying means, said control means positioning said door in said partially open position and conveying one of said boxes out of said area, said box falling onto said shelf in said heating chamber, said control means subsequently positioning said door in said closed position and activating said heating chamber whereby said food item is heated, said control means subsequently positioning said door in said fully open position whereby said box slides on said door out of said chamber; and

a delivery bin positioned adjacent the front of said cabinet, said bin being positioned to receive said box for delivery of said food item to a purchaser.

2. A food heating and dispensing machine according to claim 1 wherein said means for storing boxes in said refrigerated area comprises:

a plurality of vertically disposed, side-by-side, storage racks, each of said racks supporting a plurality of vertically aligned ones of said boxes.

3. A food heating and dispensing machine according to claim 2 wherein said means for conveying selected ones of said boxes out of said refrigerated area comprises:

a plurality of pneumatic cylinders, one for each of said storage racks, each of said cylinders controlling a reciprocating piston, said cylinders being positioned relative to said storage racks so that a piston is aligned with the bottom box in each of said storage racks; and

means for selectively actuating any one of said cylinders whereby the corresponding piston extends outwardly pushing one of said boxes out of said refrigerated area.

4. A food heating and dispensing machine according to claim 3 wherein said means enclosing a refrigerated area comprises:

a wall having a flap hinged thereto, said pistons pushing said boxes through said flap on said wall.

5. A food heating and dispensing machine according to claim 4 further comprising:

a switch mounted to sense the opening of said flap on said wall indicating that said box has fallen into said heating chamber, said switch signalling said control means to close said door and to activate said heating chamber.

6. A food heating and dispensing machine according to claim 3 wherein said means for selectively actuating any one of said cylinders is operative to sequentially activate each of said cylinders until one of said boxes is pushed out of said refrigerated area.

7. A food heating and dispensing machine according to claim 3 wherein said drive means comprises:

a pneumatic cylinder, said cylinder controlling a reciprocating piston;

a toothed rack connected to said piston for movement therewith;

a shaft aligned with said horizontal axis and connected to said door;

a gear connected to said shaft, said gear engaging said toothed rack whereby the reciprocation of said piston rotates said door around said shaft.

8. A food heating and dispensing machine according to claim **1** wherein said heating chamber comprises a standard microwave oven having a generally rectangular shape including said front door which is pivotable about an axis aligned with the front edge of the bottom wall thereof.

9. A food heating and dispensing machine according to claim **1** wherein said shelf extends into said oven in a direction perpendicular to said door, said shelf being enclosed at the sides and back thereof to prevent said boxes from falling therefrom.

10. A food heating and dispensing machine according to claim **1** further comprising:

guide means positioned in said cabinet adjacent the front thereof for supporting said delivery bin for movement in a vertical direction between a first position adapted to receive said box as it slides on said door out of said chamber and a second, vertically elevated position adapted for delivery of said food item to a purchaser.

11. A food heating and dispensing machine according to claim **10** further comprising:

means for controlling the vertical position of said delivery bin, said means positioning said bin in said first position when said door is in said fully open position, said means positioning said bin in said second position when said door is in said closed position.

12. A food heating and dispensing machine according to claim **11** wherein said means for controlling the vertical position of said bin comprises:

means connected between said door and said delivery bin so that said bin moves under the control of said door.

13. A food heating and dispensing machine according to claim **10** wherein said cabinet includes a wall at the front thereof, said wall having an opening therein, said opening being aligned with said delivery bin when said bin is in said second position.

14. A food heating and dispensing machine according to claim **13** further comprising:

means for closing said opening in said wall when said delivery bin is not in said second position.

15. A food heating and dispensing machine according to claim **14** wherein said means for closing said opening comprises:

a planar member positioned between said bin and said wall, said guide means supporting said member for movement in a vertical direction between positions adjacent and away from said opening.

16. A food heating and dispensing machine according to claim **1** wherein said cabinet includes a front wall, said wall having an opening therein, and wherein said delivery bin is generally rectangular having a back wall and side and bottom walls connected to said front wall of said cabinet adjacent said opening therein, said delivery bin being open at the top thereof to receive said box which falls thereinto.

17. A food heating and dispensing machine according to claim **16** further comprising:

a door pivotally hinged about a horizontal axis at the top of said opening in said front wall of said cabinet, said door being pivotable inwardly to provide access to said delivery bin, said door contacting said back wall of said delivery bin in its fully open position to deny access to said machine through said opening.

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