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(54) **Apparatus for processing food products**

(57) An apparatus for processing food products (302) comprises a chamber (304) for receiving internally said food products (302) and is provided internally with susceptor means (329) suitable for interacting with microwaves (308) for producing thermal energy to be transferred to said food products (302), said susceptor means being formed by distinct elements (329), mounted on a support (306) for the food products (302).

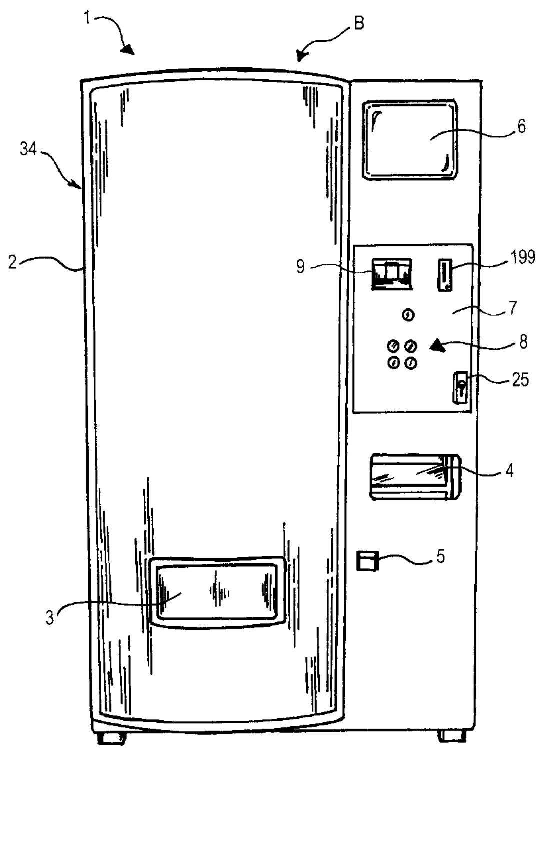

Fig. 1

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Description

[0001] The invention relates to an apparatus for distributing packaged food products.

[0002] Machines are known that are arranged for distributing food products, packaged in sealed containers substantially with the shape of a cylindrical or parallelepipedon tray, comprising a refrigerating unit intended for containing the containers and conserving the food products contained therein at low temperature, a heating unit, comprising an oven, generally a microwave oven, in which the food products are heated before being dispensed into a transfer unit, that conveys the containers between the refrigerating unit and the oven. These machines furthermore contain a selection unit, in which a user can select a desired food product, and a removal opening though which the user can remove the selected food product already heated.

[0003] In the refrigerating unit the containers are arranged in a plurality of stacks, each stack of said plurality of stacks comprising food products of the same variety. The transfer unit comprises for each stack an extracting device that enables a container to be extracted from the bottom of the stack and be placed on a resting plane arranged below the stack. The extracting device is provided with an upper supporting device and with a lower supporting device, controlled to move in relation to one another according to a predefined sequence owing to a cam mechanism, so that the bottom container of the stack is transferred from the upper supporting device to a plate of the lower supporting device and from the latter to the resting plane. The lower supporting device comprises a lever mechanism that enables the plate to be tilted so that the container can slide from the plate to the rest surface.

[0004] The transferring unit furthermore comprises a pushing device arranged to push the container from the rest plane inside the oven.

[0005] A drawback of machines of the known type is that the extracting device comprises rather a complex cam mechanism that requires a great degree of precision both during manufacturing and assembly of the mechanism.

[0006] As the stacks are arranged next to one another, a cam mechanism must also be provided for each stack, thus increasing the complexity of machines of the known type not only from the constructional point of view but also from the point of view of maintenance and production of spare parts. Furthermore, the extracting device also comprises a lever mechanism, which is also rather complex, that can easily get locked in positions that prevent operation of the extracting device.

[0007] Another drawback of machines of the known type is that the extracting device is designed to extract containers having definite dimensions and cannot be used for containers having dimensions other than the design dimensions.

[0008] A further drawback is that the low temperature present in the refrigerating unit may impair the operation of the mechanical and electronic members of the pushing device. Another drawback is that a container extracted from a stack is tilted so that it can run from the plate of the lower supporting device to the base plane; in this way, the food product contained in the container accumulates in an internal zone of the container so that the container is unbalanced or even overturns. Furthermore, the aesthetic appeal of the food product is compromised when the container is removed by the user from the removal opening.

[0009] In known machines, the oven is provided with a door that, driven by a motor, runs parallel to a wall in which a space is obtained that connects the heating unit and the refrigerating unit.

[0010] The door closes the aforementioned space to separate the heating unit from the refrigerating unit, when the oven is operating. This door does not effectively isolate the heating unit from the refrigerating unit. In fact, the door, by running parallel to the wall of the space, slides on seals that are generally associated with a peripheral edge of the space, pulling them in the direction of motion of the door and causes the seals to break after a short operating period of the machine.

[0011] Thus part of the microwaves produced by the oven is lost through gaps that form between the space and the door. As a result, the oven has reduced heating efficiency with significant loss of energy.

[0012] An object of the invention is to improve the distributing machines of packaged food products.

[0013] Another object is to obtain distributing machines of packaged food products that enable the consumption of energy for heating food products to be limited.

[0014] According to the invention, there is provided an apparatus as defined in claim 1.

[0015] The invention may be better understood and implemented with reference to the attached drawings, that illustrate some embodiments thereof by way of non-limitative example, in which:

Figure 1 is a schematic frontal view of a distributing apparatus of meals in a closed configuration;
Figure 2 is a schematic view taken along a horizontal plane of the apparatus in Figure 1 in a closed configuration;
Figure 3 is a perspective and schematic frontal view of the apparatus in Figure 1 in an open configuration;
Figure 4 is a fragmentary perspective view of parts of a refrigerating unit provided in the apparatus in Figure 1;
Figure 5 is partially sectioned and fragmentary frontal view of supporting means provided in the apparatus in Figure 1 and arranged in a supporting configuration for supporting containers containing the meals to be distributed;
Figure 6 is an enlarged detail of the supporting means illustrated in Figure 5;

Figure 7 is a view like the one in Figure 5, illustrating the supporting means in an extraction configuration of a container;
Figure 8 is a fragmentary perspective view of a detail of the supporting means and of a part of a lifting device provided in the apparatus;
Figure 9 is a view like the one in Figure 8, illustrating the supporting means in an extraction configuration and the lifting device in a raised configuration;
Figure 10 is a fragmentary perspective view of a detail of the lifting device in a lowered configuration;
Figure 11 is a fragmentary perspective view of the lifting device;
Figure 12 is a perspective view of closing means of a heating unit with which the apparatus in Figure 1 is provided, the heating unit being shown in an open position;
Figure 13 is a view like the one in Figure 12, illustrating the heating unit in a closed position;
Figure 14 is a perspective view of pushing means provided in the apparatus in Figure 1;
Figure 15 is a view like the one in Figure 14, illustrating parts of the pushing means;
Figure 16 is a frontal view of the pushing means;
Figure 17 is a schematic frontal view of a distributing apparatus of meals;
Figure 18 is a schematic section taken along a horizontal plane showing hatch means of the apparatus in Figure 17 in a closed configuration;
Figure 19 is a section like the one in Figure 18 showing the hatch means in an open configuration;
Figure 20 is a perspective frontal view of the apparatus in
Figure 17 that shows the hatch means in the open configuration;
Figure 21 is a schematic section taken along a vertical plane of dispensing means of cutlery;
Figure 22 shows a flow diagram relating to a method for controlling a heat-conditioning apparatus for food products;
Figure 23 shows a further flow diagram relating to a method for setting a cycle time of a heat-conditioning apparatus for food products;
Figures 24 to 31c show different embodiments of the apparatus according to the invention.

[0016] With reference to Figure 1, an apparatus 1 is shown for distributing packaged food products, in particular meals. As will be disclosed in greater detail below, the foodstuffs that constitute the meals are contained in containers, in particular sealed containers, for example shaped as trays, that are conserved in a refrigerated environment obtained inside the apparatus and are heated before being distributed to a user.

[0017] The apparatus 1 comprises a casing 34 delimited at the front by a hatch 2 that is movable between an open configuration A, shown in Figure 3, in which it is possible to access the inside of the casing 34, and a closed configuration B, shown in Figure 1 in which the inside of the casing is isolated from the external environment.

[0018] The hatch 2 comprises a first opening 3 arranged for dispensing a set of cutlery 38, for example contained in a bag, and a second opening 4 that enables the meal that is ready to be consumed to be extracted from the casing 34. The hatch 2 comprises a screen 6 in which information is displayed on the types of meals that are selectable and on the cost of the latter. The hatch 2 is furthermore provided with a unit 7 comprising a lock 25 arranged to prevent access to the inside of the casing 34 by unauthorised persons, a plurality of pushbuttons 8 that enable the desired meal to be selected, a slit 9 provided with an anti-vandalism lock that is not shown, that permits the introduction inside of a suitable receiving unit of the money that is necessary for purchasing the meal and a recess 199 arranged to house a reader of an electronic key device by means of which it is possible to purchase the aforementioned meal.

[0019] A slit 5 is furthermore provided placed near the second opening 4 through which coins are dispensed if the money inserted by the user exceeds the cost of the selected meal. As shown in Figure 2, the casing 34 comprises walls 16 that delimit an internal zone 40, with a substantially parallelpipedon shape, in which a refrigerating unit 11 and a heating unit 12 are provided that are separated by a wall 17 arranged on a substantially vertical plane. The refrigerating unit 11 is maintained at a temperature noticeably below 0 °C, for example at approximately -18/-20 °C, and comprises a carousel 13 arranged for supporting and distributing containers 51 containing the meals. The containers 51, being stackable one on top of the other, are arranged in the carousel 13 so as to form stacks 61 of containers. The containers 51 of each stack 61 contain meals of the same type.

[0020] The heating unit 12 comprises an oven 14, for example a microwave oven, arranged for defrosting and heating the meals conserved in the refrigerating unit 11. The heating unit 12 and the refrigerating unit 11 are made to communicate by a door 15, associated with an opening 52 obtained in the wall 17 that is movable between an open position E and a closed position F through the action of a driving device, as will be disclosed in detail with reference to Figures 12 and 13.

[0021] A dispensing device 18 of sets of cutlery 38 is associated with the hatch 2.

[0022] The apparatus 1 furthermore comprises a first pusher 53 arranged below the carousel 13 for pushing a container 51 extracted from the carousel 13 inside the oven 14, and a second pusher 54 arranged for pushing the heated meal from the oven 14 to the second opening 4.

[0023] The apparatus 1 furthermore comprises a command and control unit, which is not shown, that runs the distributing operations of the apparatus 1.

[0024] As shown in Figure 3, the refrigerating unit 11 is isolated from the dispensing device 18 through a further hatch 55. The carousel 13 is arranged in an upper zone of the refrigerating unit 11 and a refrigerating exchanger 56 is arranged in a lower zone of the refrigerating unit 11 below the carousel 13.

[0025] The carousel 13 comprises an upper plate 57 and a lower plate 58 fixed together by means of pairs of bars 59 associated with pairs of plates 60. Each pair of bars 59 and the corresponding pair of plates 60 are arranged so as to delimit a substantially parallelpipedon-shaped region, so as to form a hollow column 88 that extends between the lower plate 58 and the upper plate 57. In particular, the carousel 13 comprises four columns 88, each column 88 being intended for being occupied by a respective stack 61 of containers 51. Below the carousel 13 there is provided a base plane 109 that comprises a further opening 110 (Figure 8) for enabling the passage of extracting means, in particular of a lifting device 89 arranged for transferring a container removed from the stack 61 to a zone near the heating unit 12.

[0026] The Figure 4 shows a detail of the carousel 13. The lower plate 58 of the carousel is rotatably supported by a central shaft 62 rotated by a motor that is not shown. The lower plate 58 comprises a hole 63 for each column 88, said hole 63 being substantially rectangular in shape the same as that of a plan shape of the containers 51 and having greater dimensions than those of the plan shape of the containers 51, so that the hole 63 can be traversed by the respective stack 61. The bars of each pair of bars 59 are associated with lesser sides 63a of the hole 63, whilst the plates of each pair of plates 60 are associated with greater sides 63b of the hole 63.

[0027] The apparatus 1 comprises for each stack 61 supporting means 64 associated below with the lower plate 58 and release means 80 associated with each column 88 that enables a container 51 to be freed from the supporting means 64, in particular the container 51 placed at the bottom of the stack 61.

[0028] With reference to Figures 5 and 6, the supporting means 64 comprises a pair of rods 65 arranged below the hole 63 and associated with the greater sides 63b of the hole 63.

[0029] The containers 51 comprise an edge 67 that projects laterally from an opening zone of the container 51 and externally to it, substantially to a support base 68 of the container 51. The pair of rods 65 is arranged so as to interact with opposite sides 66 of the edge 67 for supporting the container 51.

[0030] The supporting means 64 furthermore comprises a pair of distinct supporting elements 69 arranged below the hole 63, each supporting element 69 being associated with a lesser side 63a of the hole 63. Each supporting element 69 is provided with a hollow body 70, by means of which the supporting element 69 is fixed to the lower plate 58, in a central zone of the corresponding lesser side 63a of the hole 63 and below it, and with projecting elements 71 that project from the hollow body 70 from opposite sides of the hollow body 70 and on which rest ends of each rod of the pair of rods 65. At each end of each rod 65 a protrusion 72 is provided, having a cross section with a substantially rectangular shape and comprising a face 73 by means of which the end of the rod 65 rests on the corresponding projecting element 71. In particular, the projecting element 71 is provided with a housing 74 in which the protrusion 72 is housed. The protrusion 72 is traversed by a threaded hole 87 having an axis substantially parallel to the longitudinal extent direction of the housing 74. A threaded shank 76 extends between end walls 75 of the housing 74 and couples with the threaded hole 87, so that the protrusion 72 is interposed between the end walls 75.

[0031] The position of the protrusion 72 - and therefore of the rod 65 associated therewith - with relation to the housing 74, is thus adjustable by tightening the threaded shank 76 in a first rotation direction or in a second rotation direction opposite the first. In fact, by rotating the threaded shank 76, the protrusion 72 moves inside the housing 74 in a first movement direction, in accordance with the first rotation direction or in a second movement direction, opposite the first, in accordance with the second rotation direction.

[0032] By adjusting the position of the protrusion 72 of each rod of the pair of rods 65, it is possible to adapt the supporting means 64 to support containers 51 having dimensions belonging to a certain interval. In particular, the containers distributed by the apparatus 1 can be chosen from a relatively large range of containers that differ by a respective width.

[0033] Figure 5 shows the release means 80 in a supporting configuration H, in which supporting means 64 supports the stack 61.

[0034] In Figure 7, the release means 80 is in an extraction configuration L, in which the supporting means 64 does not support the stack 61 and delivers it to the lifting device 89 provided in the apparatus 1.

[0035] The projecting elements 71, and therefore also the rods of the pair of rods 65, are movable substantially parallel to the lower plate 58 in a first direction G1, in which the rods 65 are moved away from one another, so that the release means 80 moves from the supporting configuration H to the extraction configuration L. The projecting elements 71, and therefore also the rods of the pair of rods 65, are furthermore movable in a second direction G2, opposite direction G1, in which the rods 65 are moved to one another, so that release means 80 moves from the extraction configuration L to the supporting configuration H.

[0036] Each projecting element 71 is partially received and fixed, by means of removable connecting members, in a first cavity 95 obtained in an upper end region of a member 77, which is partially housed in the hollow body 70 and is slidable inside the hollow body 70. The member 77 is provided, in a lower end region thereof, with a second cavity 79 in which a wheel 78 is arranged that is rotatably supported by a pivot 81 fixed to the member 77. The wheel 78 faces a central region of the hollow body 70 comprising a first space 82 obtained in a lower wall 90 of the hollow body 70. Facing the first space 82 a second space 83 is provided obtained in an upper wall 91 of the hollow body 70 and a third space 84, connected to the second space 83, is obtained in the lower plate 58. In the hollow body 70 two members 77 are thus provided that are arranged symmetrically to the central region of the hollow body 70.

[0037] Each member 77 comprises in the lower region thereof a third cavity 97 that is open below that extends substantially parallel to the first cavity 95 and in which an elastic member is housed, in particular a spring 96. The spring 96 is interposed between a side wall 99 of the third cavity and an "L"-shaped plate 98, which on one side of the "L" is received in the third cavity 97 and on a further side of the "L" is fixed outside the lower wall 90 of the hollow body 70.

[0038] In the supporting configuration H (Figure 7), the plate 98 is near a further side wall 100 of the third cavity and the spring 96 is substantially in an extended configuration. In the extraction configuration L, the plate 98 is further from the further side wall 100 and the spring 96 is substantially in a compressed configuration.

[0039] The release means 80 comprises a driving element 85 arranged for driving the member 77 to slide in the hollow body 70. The driving element 85 comprises a stem 86, that is slidable inside the second space 83 and the third space 84 and is provided with a head 112 that, by interacting with the lower plate 58, prevents the driving element 85 from dropping through gravity as it emerges from the hollow body 70. The driving element 85 also comprises a body 93 provided with a tapered portion 92 to which the stem 86 is centrally fixed. The tapered portion 92 comprises two driving surfaces 94 symmetrically tilted with respect to the stem 86, so as to confer on the driving element 85 a wedge shape.

[0040] The driving surfaces 94 are arranged so as to interact through contact with a respective wheel 78.

[0041] In the supporting configuration H, the wheels 78 are in contact with the driving surfaces 94 in a zone of the tapered portion 92 that is nearer the stem 86. In this configuration, the head 112 of the stem 86 rests on the lower plate 58 and the tapered portion 92 is for a greater part outside the hollow body 70.

[0042] As shown in Figure 7, in the extraction configuration L, the wheels 78 are in contact with the driving surfaces 94 in a zone of the tapered portion 92 further from the stem 86 and nearer the body 93. In this configuration, the tapered portion 92 is substantially arranged inside the hollow body 70 and the stem 86 is for a greater part outside the hollow body 70.

[0043] The driving element 85 is provided below with an actuating surface 101 arranged for interacting with a lifting plane 102 connected to the lifting device 89.

[0044] With reference to Figure 11, the lifting device 89 comprises a motor 104 supported by a support 103 with the shape of an upturned "U", arranged below the carousel 13, this support 103 being mounted, through parts thereof that define the legs of the "U", on a base portion 105 of the casing 34. The motor 104, interposed between the parts that define the legs of the "U", controls a nut 107, mounted by means of a suitable support, on the portion that connects together the parts that define the legs of the "U", to rotate coupled with a worm screw 108. The worm screw 108 has an end 106 connected to the lifting plane 102. Through the rotation of the nut 107 within the support thereof, the worm screw can move in a substantially vertical direction indicated by the arrows S, in accordance with the rotation direction of the motor 104, between a lowered position M, shown in Figure 10, in which the lifting plane 102 is further from the column 88 and a raised position N, shown in Figures 7 and 9, in which the lifting plane 102 is nearer the column 88. The lifting device 89 furthermore has a rest position O, shown in Figure 8 in which the lifting plane 102 and the base plane 109 are on the same plane.

[0045] With reference to Figure 8, before a meal has been selected by a user, the lifting device 89 is arranged in the rest position O and the release means 80 is in the supporting configuration H. In this configuration, the actuating surface 101 is at a distance P from the lifting plane 102. When the user selects the meal, the carousel 13 is rotated until the column 88 inside which the stack 61 comprising the chosen meal is housed is positioned above the lifting plane 102 at the further opening 102. Subsequently, as shown in Figure 9, the motor 104 of the lifting device 89 rotates the lifting plane 102 to rise until the lifting plane 102, by interacting with the actuating surface 101, lifts the driving element 85 with a certain force that is directed substantially vertically. The force acting on the driving element 85 is transferred, owing to the tilt of the driving surfaces 94, to the members 77 through the wheels 78. In fact, a component of this force drives the members 77 to slide in the first direction G1. The members 77 move towards the outside of the hollow body 70 and each spring 96 is compressed because when the member 77 moves in the first direction G1, the side wall 99 is moved to the further wall 100. The rods 65 are thus moved away from one another and are thus moved away from the edge 67 of the container 51. The container 51 placed at the bottom of the stack 61 is no longer supported by the supporting means 64, but by the lifting plane 102 that in the meantime is placed in contact with the support base 68 of the container 51 placed at the bottom of the stack 61 before the supporting means 64 has released the container 51. The lifting plane 102, by continuing to rise, then reaches the raised position N. The stack 61 that is initially supported by the supporting means 64 is then transferred to the lifting device 89. The release means 80 thus reaches the extraction configuration L.

[0046] A sensor 111 indicates the presence of a container 51 on the lifting plane 102 in the raised position N and commands the motor 104 to stop and invert rotation direction.

[0047] From this moment, the lifting device 89 starts to descend to move from the raised position N to the lowered position M, illustrated in Figure 10. Whilst the lifting plane 102 is lowered, the stack 61 that is supported by it and also the driving element 85 move with it; through the effect of gravity, the actuating surface 101 remains in contact with the lifting plane 102 until the moment at which the head 112 of the driving element 85 reaches the lower plate 58. Each wheel 78 runs along the respective driving surface 94, to move from a zone of the tapered portion 92 nearer the body 93 to a zone of the tapered portion 92 nearer the stem 86, and each member 77 is driven to slide in the second direction G2 pushed by a reaction of the spring 96, previously compressed when the rods 65 have been moved away. The member 77 is externally provided with an arrest appendage 113 that by cooperating with an end edge 114 of the hollow body 70 stops the member 77 in a position in which the release means 80 has again taken on the supporting configuration H.

[0048] The rods 65 are thus moved to one another until they interact with a container 51 immediately above the container 51 resting on the lifting plane 102. In the meantime, the container 51 resting on the lifting plane 102 is moved away from the stack 61 by the lifting plane 102 and the stack 61 is thus again supported by the supporting means 64.

[0049] With reference to Figure 10, when the lifting device 89 is in the lowered position M, the container 51 extracted from the stack 61 is arranged opposite an inlet space 115 of the oven 14, said inlet space 115 being provided at the opening 52.

[0050] With reference to Figure 11, the lifting device 89 comprises guiding means arranged for guiding the lifting device 89 during the motion thereof between the raised position N and the lowered position M. The guiding means comprises a guiding plate 117 fixed to a side 116 of the lifting plane 102 near the oven 14 and extending from the lifting plane 102 to the base portion 105 substantially orthogonally to the lifting plane 102. The guiding plate 117 comprises two side panels 118 that extend from further sides 119a and 119b of the lifting plane 102 to the base portion 105. The further sides 119a and 119b are adjacent to the side 116 and opposite one another with respect to the side 116. On the further sides 119a and 119b cuts 120 are obtained arranged for being at least partially occupied by small wheels 121 engaged in running in guiding bars 122. The small wheels 121 are rotatably supported on an elongated element 123 (Figures 12 and 13) mounted on the guiding plate 117 on a face thereof facing the oven 14.

[0051] In Figures 12 and 13 there is illustrated the door 15 of the oven 14. The door 15 is provided with a frame 124 comprising a bottom panel 125, in which the inlet space 115 is obtained in an upper zone thereof and two uprights 126 adjacent to the bottom panel 125 and arranged on opposite sides with respect to the bottom panel 125. The door 15 comprises, furthermore, a closing element 127 that extends between the uprights 126, the closing element 127 being interposed between the uprights 126 and having a substantially parallelepipedon shape. The closing element 127 is movable between an open position E, in which it is possible to access the oven 14 from a region external thereto through the inlet space 115 and a closed position F, in which the closing element 127 occupies the inlet space 115 preventing access to the oven 14 from a region external thereto.

[0052] The closing element 127 is driven by a connecting rod-crank mechanism 128, mounted on the bottom panel 125 below the inlet space 115. The connecting rod-crank mechanism 128 comprises a crank 129 rotated by a further motor 130 and a connecting rod 131 hinged at an end thereof to the crank 129 and at a further end thereof to a connecting member 132. The connecting member 132 is fixed to a central portion of a surface 133 of the closing element 127.

[0053] The door 15 comprises further guiding means 135, arranged for guiding the closing element 127 when driven by the further motor 130. The further guiding means 135 comprises distinct protruding elements 136, fixed to opposite side surfaces 134a and 134b of the closing element 127, arranged for being received in recesses 137 obtained on the uprights 126. The side surfaces 134a and 134b of the closing element 127 are adjacent to the surface 133 and substantially orthogonal thereto.

[0054] The recesses 137 comprise a fashioned profile and define a route for the distinct protruding elements 136 when the closing element 127 is driven between the open position E and the closed position F.

[0055] This fashioned profile comprises a first part 138 that is substantially parallel to the extent direction of the uprights 126. When the protruding element 136 interacts with the first part 138, the closing element 127 is guided to move along a trajectory substantially parallel to the bottom panel 125.

[0056] The fashioned profile furthermore comprises a second part 139 that defines a curved trajectory, in particular a circumference arc. When the protruding element 136 interacts with the second part 139, the closing element 127 is guided to move to the bottom panel 125, or to move from the bottom panel 125, according to whether the protruding element 136 runs along the second part 139, with reference to Figures 12 and 13, respectively from left to right or from right to left.

[0057] Owing to the further guiding means 135, the closing element 127 does not move to the inlet space 115 by sliding on edges thereof, but approaches the inlet space 115 frontally. This enables the possibility to be significantly limited that seals on the edges of the inlet space 115 can be deformed or cut by the closing element 127.

[0058] The further guiding means 135 further ensures that the oven 14 can be effectively isolated from the refrigerating unit and that there is no dispersion of the microwaves generated by the oven.

[0059] In an embodiment which is not shown, the second part 139 comprises substantially straight lines and defines a trajectory that is tilted with respect to the first part 138.

[0060] When the lifting device 89 is in the rest position O, the door 15 is in the closed position F.

[0061] Still with reference to Figures 10 and 11, before the lifting device 89 reaches the lowered position M, the further motor 130 drives the connecting rod-crank 128 mechanism, so that when the lowered position M is reached, the closing element 127 has already freed the inlet space 115. This enables the time to be significantly reduced that is taken by the apparatus 1 to distribute the meal.

[0062] The container 51 extracted from the stack 61 corresponding to the selected meal is pushed inside the oven 14 through the inlet space 115 by the first pusher 53. The first pusher 53 is arranged below the base plane 109, inside the refrigerating unit 11 at a distance from the base portion 105 substantially corresponding to the distance between the container 51, supported by the lifting device 89 in the lowered position M, and the base portion 105.

[0063] With reference to Figures 14 to 16, the first pusher 53 comprises an arm 140 provided with a pushing member 141 arranged for pushing the container 51 from the lifting plane 102 inside the oven 14. The arm 140 is movable with reciprocating movement in a direction indicated by the arrows Q between an advanced position, in which the arm 140 is in contact with the container 51, and a retracted position, in which the arm 140 is further from the container 51 to be pushed.

[0064] The arm 140 is driven owing to a chain-drive mechanism 147, comprising a chain 146, closed in a loop, in which a drive gear wheel, which is not shown, driven by a still further motor 144 and a driven gear wheel 143 engage. The chain-drive mechanism 147 is enclosed in a guard 151 surrounding the entire mechanism.

[0065] The arm 140 is supported on a support panel 142 that comprises a first portion 148 outside the guard 151 and to which the arm 140 is connected, a second portion 149, received inside the guard 151 and a third portion 150, that extends inside the guard 151 substantially on the same plane as the first portion 148.

[0066] The second portion 149 projects from the first portion 148 and from the third portion 150 so as to form a "C"-shaped step in the concave portion of the "C" there being housed the drive gear wheel when the arm 140 is in the retracted position.

[0067] A peg 152 protrudes from the chain 146 and is inserted in a slot 153 provided in a central region of the second portion 149. The peg 152, by interacting with the slot 153, drags the support panel 142 and thus enables the arm 140 to be driven.

[0068] In the third portion 150 and in the first portion 148, in an internal zone of the guard 151, wheels 154 are provided, in particular two wheels 154 in the third portion 150 and two wheels in the first portion 148, that by running along internal walls that are not shown of the guard 151 enable the arm 140 to be guided during the reciprocating movement. Once the first pusher 53 has inserted the container 51 into the oven 14, it returns to the retracted position and remains there until a further meal is selected.

[0069] In the oven 14 the food product contained in the container 51 is cooked or merely heated and is moved from the second pusher 54 to the second opening 4, from which it can be removed.

[0070] In the following there is disclosed an apparatus for distributing packaged food products with which a cutlery dispensing device is associated.

[0071] Machines are known that are arranged for conserving meals at low temperature and for distributing these meals after heating them that comprise a unit for distributing meals and a further unit for dispensing cutlery.

[0072] In particular, the unit for distributing meals comprises a conserving refrigerating unit, a transferring unit, a heating unit, a selection unit and an opening for removing a meal. The unit for dispensing the cutlery comprises a device for expelling the cutlery contained therein.

[0073] The machines disclosed above operate in the following manner: a user chooses through the selection unit the desired meal and inserts the quantity of money required to purchase it into a money insertion unit.

[0074] The meal, which is kept at a low temperature in the conservation refrigerating unit, is then conveyed from the transferring unit to the heating unit to be taken to the consumption temperature.

[0075] The user, through the removal opening, can then remove the selected meal and, through a further opening in the cutlery dispensing unit, can remove the cutlery necessary for consuming it.

[0076] In the machines disclosed above, the unit for the distribution of the meals and unit for dispensing the cutlery are independent of one another and are installed so as to be next to one another.

[0077] In known machines, these units are made with panel structures.

[0078] The machines disclosed above require premises to be available that are sufficiently spacious for housing them because of the considerable spaces necessary for housing the two distinct structural elements that constitute them, i.e. the unit for distributing meals and the cutlery dispensing unit.

[0079] The machines disclosed above furthermore require considerable time and significant cost to be installed, inasmuch as both the unit for distributing the meals and the unit for distributing the cutlery have to be mounted.

[0080] The machines disclosed above are thus easily damageable inasmuch as they are made with panel structures. In particular, these machines can be tampered fairly easily by malicious persons.

[0081] With reference to Figure 17 an apparatus 201 for distributing packaged food products, in particular meals, is shown. As will be disclosed in greater detail below, the food that constitutes the meals is contained in receptacles, for example shaped as trays, that are conserved in a refrigerated environment obtained inside the apparatus and are heated before being distributed to a user.

[0082] The apparatus 201 comprises a casing 234 delimited at the front by a hatch 202 that is movable between an open configuration A1, shown in Figures 19 and 20, in which it is possible to access the inside of the casing 234, and a closed configuration B1, shown in Figures 17 and 18 in which the inside of the casing 234 is isolated from the external environment.

[0083] The hatch 202 comprises a first opening 203 arranged for dispensing a set of cutlery 238, for example contained in a bag, and a second opening 204 that enables the meal that is ready to be consumed to be extracted from the casing 234. The hatch 202 comprises a screen 206 in which information is viewable relating to the types of meals that are selectable and the cost of the latter. The hatch 202 is furthermore provided with a unit 207 comprising a lock 225 arranged for preventing access to the inside of the casing 234 by unauthorised persons, a plurality of pushbuttons 208 that enable the desired meal to be selected, a slit 209 provided with an anti-vandalism device that is not shown that enables a suitable unit to be introduced inside for receiving the money necessary for the purchase of the meal, and a recess 299 arranged for housing a reader of an electronic key device by means of which it is possible to purchase the aforementioned meal.

[0084] A slit 205 is furthermore provided placed near the second opening 204 through which coins are dispensed if the money inserted by the user exceeds the cost of the selected meal. As shown in Figure 18, the casing 234 comprises walls 216 that delimit an internal zone 240, with a substantially parallelpipedon shape, in which a refrigerating unit 211 and a heating unit 212 are provided separated by a wall 217 arranged on a substantially vertical plane. The refrigerating unit 211 is maintained at a temperature noticeably below 0 °C, for example at approximately -18/-20 °C, and comprises a carousel 213 arranged for supporting and distributing the containers containing the meals.

[0085] The heating unit 212 comprises an oven 214, for example a microwave oven, arranged for defrosting and heating the meals conserved in the refrigerating unit 211. The heating unit 212 and the refrigerating unit 211 are made to communicate by a door 215, associated with an opening obtained in the wall 217 that is movable between an open position and a closed position through the action of a driving device that is not shown.

[0086] A dispensing device 218 of sets of cutlery 238 that is associated with the hatch 202 comprises a first dispensing unit 220 and a second dispensing unit 221 that contain and dispense the sets of cutlery 238.

[0087] The hatch 202 is internally provided with a cavity 250 having a depth S1 greater than a transverse dimension d of the first dispensing unit 220 and of the second dispensing unit 221, so that the first dispensing unit 220 and the second dispensing unit 221 are receivable inside the cavity 250 as will be disclosed in greater detail below.

[0088] As shown in Figure 19, the first dispensing unit 220 and the second dispensing unit 221 are associated with the hatch 202 through hinges 223, so as to be movable between a dispensing configuration C1, shown in Figures 18 and 20, in which the sets of cutlery are expelled from the first dispensing unit 220 or from the second dispensing unit 221, and a loading configuration D1, shown in Figure 19, in which an operator can load the first dispensing unit 220 and the second dispensing unit 221 with the sets of cutlery 238.

[0089] In the dispensing configuration C1 the first dispensing unit 220 and the second dispensing unit 221 are received inside the cavity 250, whereas in the loading configuration D1 the first dispensing unit 220 and the second dispensing unit 221 project from the hatch 202 for promoting the introduction of the sets of cutlery 238 by a person in charge of supervising the apparatus 201.

[0090] The first dispensing unit 220 and the second dispensing unit 221 are provided with locking devices 224, for example of magnetic type, that keep these units in the dispensing configuration C1.

[0091] The first dispensing unit 220 and the second dispensing unit 221, are each provided with a box frame 230 delimited by a first side wall 235 and by a second side wall 236 facing one another and interconnected by a third side wall 237.

[0092] The hinges 223 are positioned on a corner defined at the intersection between the first side wall 235 and the third side wall 237.

[0093] The box frame 230 is delimited above by a base wall that is not shown.

[0094] The box frame 230 comprises an opening 231 opposite the aforementioned base wall through which, in use, the sets of cutlery 238 are dispensed, as will be disclosed in greater detail below.

[0095] The box frame 230 furthermore comprises a further opening 239, opposite the third side wall 237, through which an operator can load a plurality of sets of cutlery 238 into the first dispensing unit 220 and into the second dispensing unit 221.

[0096] With each box frame 230 a motor shaft 226 is provided that is arranged near the opening 231, which motor shaft 226 is rotated by an electric motor, and a driven shaft 227, arranged near the aforementioned base wall.

[0097] The aforementioned electric motor rotates the motor shaft 226 by steps.

[0098] The motor shaft 226 and the driven shaft 227 are connected together by a chain 228 with which a plurality of conveying elements 229 are associated, the chain 228 comprising a first part 241 and a second part 242 arranged substantially parallel to the first side wall 235, to the second side wall 236 and the third side wall 237. In other words, the first part 241 and the second part 242 extend substantially vertically.

[0099] The chain 228 furthermore comprises a third part 243 that winds partially around a wheel 246 that is connected to the driven shaft 227 and a fourth part 244 that partially winds around a further wheel 245 connected to the motor shaft 226. The conveying elements 229 are substantially "L"-shaped and comprise a first portion 247 fixed to the chain 228 and a second portion 248 that projects from the chain 228.

[0100] The conveying elements 229 cooperate together and with the first side wall 235, the second side wall 236, the third side wall 237 and the base wall to define a plurality of receptacles 249 that contain the sets of cutlery 238 that are supported and moved by the second portions 248.

[0101] The second portions 248 of the conveying elements 229 that at a given instant of a work cycle of the apparatus 201 are associated with the first part 241 and with the second part 242 define supporting planes arranged substantially horizontally.

[0102] In operation, when the chain 228 associated with one of the dispensing units, for example with the first dispensing unit 220, is driven by the motor shaft 226 for a stroke of preset extent, a conveying element 229, for example the conveying element 229 nearest the opening 231, unloads the set of cutlery 238 associated therewith and directs it to a conveying chute 232 that transfers the set of cutlery 238 to the first opening 203, from which it can be removed by a user.

[0103] In other words, when the chain 228 winds around the further wheel 245, the second portions 248 define supporting planes tilted in relation to a horizontal plane, causing the expulsion of a set of cutlery 238 from the respective conveying element 229.

[0104] Between the opening 231 and the chute 232 there is positioned a detecting device 233 arranged for defining the presence of the set of cutlery 238.

[0105] In particular, the set of cutlery 238, by falling through the force of gravity from the conveying element 229 on which it was resting, interacts with the detecting device 233.

[0106] If although a chain 228 shift has occurred, the detecting device 233 does not detect any set of cutlery 238, a signal is emitted that drives the chain 228 associated with the second dispensing unit 221.

[0107] In the following, with reference to Figures 22 and 23, methods for the control of a thermal conditioning apparatus are disclosed.

[0108] Machines are known for the distribution of heated food products, for example packaged foods, comprising a unit refrigerated for the low-temperature conservation of the food products and a heating unit in which a portion of the food products is heated before being dispensed to a user. The heating units may comprise ovens supplied with electric power, in particular microwave ovens.

[0109] The ovens are provided with command and control units in which, for each type of food product that can be dispensed, a corresponding heating time is memorised.

[0110] In the case of microwave ovens, the aforementioned heating time may comprise periods during which the microwave generating devices are supplied with intervals of one or more rest periods, during which these microwave generators are kept inactive. This enables the heating conditions to be improved. Some food products, in fact, can be burnt if they are subjected to continuous radiation for prolonged periods. A drawback of the aforementioned machines is the incorrect heating of the food product preselected by the user.

[0111] In particular, the food product may have been overheated and therefore be burnt, or vice versa the food product may have been heated too little, thus being still partially frozen. As the aforementioned heating time depends on the supply voltage of the heating unit if the supply voltage is subjected to variations from a nominal value, the total amount of heat supplied by the heating unit to the food product during the heating time mentioned above may undergo corresponding variations that may be very significant.

[0112] In particular, if during operation of these machines a diminution of the value of the supply voltage with respect to the aforementioned nominal value occurs, which happens fairly frequently, for example due to oscillations linked to the load on an electric power distribution main, the heating unit provides the food product with an amount of heat that is less than what is theoretically envisaged.

[0113] This means that the food product may be undercooked, be insufficiently hot or even be still partially frozen.

[0114] On the other hand, if during operation of the machines an increase in the value of the supply voltage with respect to the aforementioned nominal value occurs, the heating unit provides the food product with an amount of heat that is greater than what is theoretically provided.

[0115] This means that the food product may be overcooked or even burnt.

[0116] In known machines, furthermore, the heating time associated with any type of food product that can be dispensed, is established on the basis of a theoretical value of current absorbed by part the heating components of the heating unit. As the heating components of the heating unit may have an actual current absorption value that is different from the theoretical current absorption value, the food product may not be correctly heated.

[0117] In particular, when the apparatus comprises a microwave oven, if the actual value of the current absorbed by microwave-generating devices (for example magnetrons and electromechanical transforming devices associated therewith) is less than the theoretical current absorption value, the effective amount of electric power that is transformed into electromagnetic wave - and consequently the heat supplied to the food product - is less than a nominal amount necessary for obtaining the desired degree of heating.

[0118] On the other hand, if the actual current absorption value is greater than the theoretical current absorption value, the food product is subjected to excessive heating.

[0119] A list of the references is shown below that are used in the attached flow diagrams:

V_E: actual power voltage value (variable);
V_N: nominal power voltage value (constant);
T_N: nominal heating time (constant);
T_E: actual heating time (variable);
T_T: theoretical heating time (constant);
A_E: actual absorbed current value (variable);
A_{MIN}: minimum acceptable absorbed current value (constant);
A_{MAX}: maximum acceptable absorbed current value (constant);
A_{RIF}: reference absorbed current value (constant).

[0120] With reference to Figure 22, there is shown a flow diagram relating to a method for controlling a heating apparatus. The method can be applied for providing a food product with a preset amount of heat before the food product is consumed by a user.

[0121] The heating apparatus can dispense a plurality of food products with each of which a calculated nominal heating time T_N is associated, the aforementioned amount of heat being known, on the basis of a nominal power voltage value V_N, for example equal to 220 V, with which heating elements of the apparatus are supplied.

[0122] In order to keep the aforementioned amount of heat constant, also in the presence of undesired variations in the voltage actually dispensed, setting an actual heating time T_E using the methods indicated below is provided for.

[0123] The method according to the invention provides for detecting an actual voltage value V_E with which the apparatus is supplied and subsequently comparing this value with the nominal voltage value V_N.

[0124] As shown in the right-hand portion of the flow diagram, if from the above comparison it emerges that the actual voltage value V_E is substantially the same as the nominal voltage value V_N, setting the actual heating time T_E the same as the nominal heating time T_N is provided for.

[0125] In this case, in fact, it is not necessary to deviate from the nominal heating time T_N, no variations in supply voltage having occurred.

[0126] If the actual voltage value V_E is different from the nominal voltage value of V_N, calculating the actual heating time T_E on the basis of the nominal heating time T_N and of the difference between the actual voltage value V_E and the nominal voltage value V_N is provided for.

[0127] The actual heating time T_E moves further from the nominal heating time T_N the greater the difference between the actual voltage value V_E and the nominal voltage value V_N.

[0128] In particular, the actual heating time T_E can be calculated as a percentage of the nominal heating time T_N.

[0129] In particular, if the actual voltage value V_E is less than the nominal voltage value V_N, the actual heating time T_E is greater than the nominal heating time T_N.

[0130] On the other hand, if the actual voltage value V_E is greater than the nominal voltage value V_N, the actual heating time T_E is less than the nominal heating time T_N.

[0131] The phases of the method disclosed above, i.e. the recording of the actual voltage value V_E, the comparison between the actual voltage value V_E and the nominal voltage value V_N and the determination of the actual heating time T_E are repeated cyclically over the course of a work cycle of the apparatus. In this way, the actual heating time T_E is updated periodically during the aforementioned work cycle.

[0132] It is therefore possible to obtain a food product that has optimal consumption conditions inasmuch as the actual heating time T_E to which the food product is subjected is selected on the basis of the actual electric power supply conditions of the heating elements.

[0133] With reference to Figure 22, a flow diagram relating to a method for setting a cycle time of a heating apparatus of food products is shown.

[0134] The method can be applied to obtain the nominal heating time T_N to which reference has been made above, this nominal heating time T_N depending on the amount of heat that has to be transmitted to a food product.

[0135] As disclosed above, the heating apparatus can dispense a plurality of food products with each of which a theoretical heating time T_T is associated that is calculated on the basis of a reference absorbed current value A_{RIF} determined on the basis of the nominal values of current absorbed by the heating elements of the apparatus, as supplied by the manufacturers of the heating elements.

[0136] In order to keep the aforementioned amount of heat constant even in the presence of actual current absorption values that are different from the reference absorbed current value A_{RIF}, owing to tolerable differences in the performance of the heating elements, determining the nominal heating time T_N according to the methods indicated below is provided for. The method provides for detecting an actual absorbed current value A_E and subsequently checking whether this actual absorbed current value A_E belongs to an interval defined by a minimum acceptable absorbed current value A_{MIN} and a maximum acceptable absorbed current value A_{MAX}.

[0137] If the actual absorbed current value A_E does not belong to the aforementioned interval a signal is generated that indicates that the apparatus does not meet suitability requirements and that it is necessary to replace the heating elements.

[0138] If on the other hand the actual absorbed current value A_E belongs to the aforementioned interval, this actual absorbed current value A_E is compared with the reference absorbed current value A_{RIF}.

[0139] If the actual absorbed current value A_E is substantially the same as the reference absorbed current value A_{RIF}, setting the nominal heating time T_N the same as the theoretical heating time T_T is provided for.

[0140] On the other hand, if actual absorbed current value A_E is different from the reference absorbed current value A_{RIF}, calculating the nominal heating time T_N on the basis of the theoretical heating time T_T and of the difference between the actual absorbed current value A_E and the reference absorbed current value A_{RIF} is provided for.

[0141] The more the nominal heating time T_N differs from the value of the theoretical heating time T_T the greater is the difference between the actual absorbed current value A_E and the reference absorbed current value A_{RIF}.

[0142] The nominal heating time T_N can be calculated as a percentage of the theoretical heating time T_T.

[0143] In particular, if the apparatus is equipped with a microwave oven provided with magnetrons and respective electromechanical transforming devices it is observed that if the actual absorbed current value A_E is greater than the reference absorbed current value A_{RIF}, the nominal heating time T_N is less than the theoretical heating time T_T.

[0144] This is because the actual quantity of electric power transformed into electromagnetic power is greater than an amount of electric power calculated on the basis of the theoretical heating time T_T.

[0145] On the other hand, if the actual absorbed current value A_E is less than the reference absorbed current value A_{RIF}, the nominal heating time T_N is greater than the theoretical heating time T_T.

[0146] The method thus enables nominal heating times to be identified for each apparatus, each of which is associated with a respective food product, that depends on the actual absorbed current value of the heating elements with which the apparatus is equipped.

[0147] A microwave oven for defrosting and heating precooked foodstuffs according to the invention is disclosed in the following.

[0148] In the modern human diet, for reasons of convenience, rapidity and hygienic safety the use of precooked and frozen foods that are ready to be heated and served at table within a very short time is becoming increasingly common.

[0149] These foods are prepared by specialised companies of the industry in controlled sanitary hygienic conditions, and from the qualitative point of view, they often reach excellent values.

[0150] Freezing enables these foods to be conserved, without resorting to preservatives, for a long period without harming the organoleptic properties and qualitative shelf life.

[0151] The foodstuffs are packaged in containers in cardboard for foodstuffs the inside of which is coated with a film of plastic materials that prevents the leakage of the liquids that accompany the food (juices, sauces, etc.). The containers are packaged, often in a controlled atmosphere, and are sealed with a special cover that ensures the hygienic and sanitary conditions and the preservability of the contents.

[0152] Very many foods are commercially available (first courses of pasta or rice, second courses of meat and fish), side dishes of vegetables, potatoes, etc.

[0153] The problem arises when the food contained in the tray has to be taken to serving temperature within a short time inasmuch as it takes a long time for food extracted from the freezer to reach ambient temperature naturally and then become heated in the traditional manner.

[0154] In this way the rapidity is lost that is one of the factors that have enabled this type of foodstuff to become established.

[0155] Heating the tray with the contents thereof in a traditional oven is not possible because the cardboard of which it consists does not withstand high temperatures and furthermore acts as a thermal insulator.

[0156] Microwave heating is in theory the ideal system but in practice has limitations.

[0157] It is known that microwaves transfer energy to the materials without contact taking place inasmuch as the electromagnetic waves constituting the microwaves agitate the polar molecules present in the materials, causing localised heating that transfers to the rest of the substance.

[0158] The efficacy of the energy transfer by microwaves is defined in function of the distance between the surface of the means to be heated and the depth (penetration) at which the energy associated with the microwave is halved. This value is conventionally defined by the formula: D (cm) = ½ EMO

[0159] The shorter this distance is the greater is the transfer of energy from the microwaves to the means to be heated.

[0160] Table 1 shows the D= ½ E_{MO} values of some substances.

Microwave penetration values in some substances		
Material	**Temperature °C**	**Penetration (D= ½ E_{MO} in cm)**
Water	25	1.4
Water	95	5.7
Ice	-12	1100
Bread	25	2 ... 5
Unpeeled potato	25	0.9
Peeled potato	25	0.8
Carrot	25	1
Meat	25	0.9 ... 1.2
Paper cardboard	25	20 ... 60
Wood	25	8 ... 350
rubber	25	15 ... 350
Glass	25	35
Porcelain	25	56
PVC	20	210
Epoxy resin (Araldite CN-501)	25	4100
Teflon	25	9200
Quartz	25	16000

[0161] Regardless of the polarity features of the substances, the microwaves, owing to the mechanism with which they transfer energy, are very effective when they have to heat liquid substances where the molecules are near and mobile so that they reciprocally transfer movement and heat. Microwaves are not very effective, except for some cases, in transferring energy to solid substances, even if they are polar, because the molecules are immobilised and transfer very little energy to neighbouring molecules. They are even less effective in transferring energy to the gaseous substance because the molecules are very distant from one another. Ice, for example, absorbs the microwaves to a very limited extent as D= ½ EMO = cm 1.100 whereas liquid water is an excellent absorber, as D= ½ EMO = cm 1.4 at 20°C.

[0162] As a result, thawing of foods in which initially only ice is present in practice requires a long time and leads to poor results from the point of view of the quality of the final product.

[0163] In practice, there is a marked temperature gradient that brings the external part of the food to high temperatures whereas the internal part of the food remains frozen or cold. This phenomenon is due to the fact that the peripheral parts of the block of food, regardless of the presence of the microwaves, are the first to defrost through heat exchange with the environment and are therefore the parts that capture most of the energy of the microwaves.

[0164] The object of the present patent is an oven for rapid defrosting and uniform heating to serving temperature of prepackaged frozen foods.

[0165] The particular feature of this oven consists of the fact that combined microwave-traditional thermal heating is implemented.

[0166] Traditional thermal heating is achieved by means of solid bodies of various shape that are placed in direct contact with the bottom of the container of the frozen food. These solid bodies consist of materials that are excellent captors of microwaves that are capable of effectively converting the energy associated with the microwaves into heat and in this way the food placed at the bottom of the tray starts to defrost and change into a liquid state. The susceptors are in turn housed in a solid support consisting of a material that is transparent to the microwaves that also acts as a support plane of the tray containing the frozen food. At this point the microwaves act effectively on this layer of liquid, heating it and causing a chain mechanism that leads to the rapid defrosting of the food and to the subsequent heating thereof to serving temperature.

[0167] The reciprocal position of container-number of heaters-shape of heaters is the object of this patent as the position, the shape and the surface of the heaters influence the path of the microwaves and concentrate them homogenously in the part of the oven occupied by the food to be heated.

[0168] The concentration of the microwaves in this aforementioned zone enables the following phases to take place that are schematised below:

Disclosure of the initial situation (see Fig. 24):

[0169] The microwaves emitted by the antenna 325 follow different paths. A part acts directly or through reflection on the heaters 329 (dotted arrows 327) that capture them and heat them, starting to transfer the heat to the bottom of the container 302A.

[0170] Other microwaves (arrows 328 with a dashed line) traverse undisturbed both the container 302A and the frozen food 302 inasmuch as the D= ½ E_{MO} of these materials is very high. Others, finally, after traversing the container 302A and the food 302, act on the heaters 329 from above, heating them greatly. The heaters 329 transmit the heat to the frozen food 302 in the tray 320A, which starts to defrost, forming a thin layer of microwave-receiving liquid 310.

Disclosure of the evolving heating.

[0171] The microwaves travel the same paths with respect to the initial situation, with the difference that they now also encounter a layer of liquid 310 in a phase of continuous growth to which they effectively transfer energy, heating it. The result is rapid heating of the food 302 that becomes uniform if the EM field associated with the microwaves is uniform in the zone of space occupied by the tray 302A containing the food 302.

[0172] In this patent solid materials that effectively absorb the microwaves, strongly heating them, are used as heaters 329 or, as defined in the technical literature, as susceptors. These solid state materials, in addition to being good conductors of heat, have D= ½ E_{MO} values that are particularly low. Many natural or synthetic materials exist that have these features but not all can be used in microwave ovens intended for heating foods inasmuch as the chemical composition thereof includes toxic harmful heavy metals such as nickel, chrome and copper. The materials in this type of oven that are usable as susceptors are on the other hand graphite, coal, magnetite, silicon carbide, many types of glass and ceramics and the Ceram, a vitroceramic material that is used to make cooking hotplates with electric and gas heating. The function of these susceptors in the microwave oven that is the object of this invention is to capture part of the energy of the microwaves and to become greatly heated. In order to obtain the greatest effectiveness in the transfer of heat from the susceptors to the tray of frozen food, good contact is achieved so as to obtain controlled defrosting of a layer of food and the formation of a thin layer of liquid water on which the microwaves act effectively. Heat transfer by conduction and by convection to the neighbouring layers also occurs, which defrost, causing a chain mechanism that leads to rapid and uniform defrosting.

[0173] These susceptors rest on slabs 306 consisting of materials that are transparent to microwaves and also in this case not all materials, due to their chemical composition, are suitable for this purpose. The suitable ones are, on the other hand, polyethylene, polypropylene, polytetrafluorethylene (Teflon), the epoxy resins and inorganic materials such as calcite-based marble, chalk, quartz and the ceramic fibre used as a thermal insulator in laboratory microwave ovens.

[0174] The materials making up the susceptors, the shape and arrangement thereof within the oven 301 are the object of this patent as it has been surprisingly found that it is possible to defrost and heat food uniformly in a very short time. This phenomenon is due to the homogenisation of the field of the microwaves in the zone in which the container is present with the food produced by the arrangement, shape and surface of the susceptors. This homogenous arrangement of the EM field generated by the microwaves was surprisingly ascertained by heating numerous containers of frozen food, noting that it is sufficient to insert a quantity of susceptors the surface of which covers 8% to 15% of the surface of the horizontal plane of the oven 301 to obtain, although at differing times, defrosting and heating of the foods in a uniform manner.

[0175] The indication of the points at which the temperatures were measured that were reached by the food after heating in the microwave oven that is the object of this patent have been set out in Table A and summarised in each example shown using Table B.

Table A

[0176] Indication of the points at which the temperatures were measured that were reached by the food after heating in the microwave oven that is the object of this patent.

Tray containing the food seen from above.

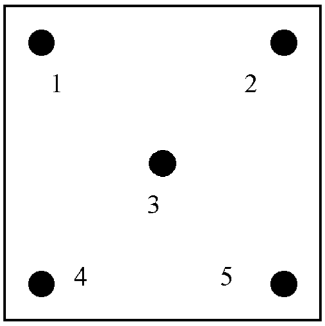

Table A Distribution of the temperature reached by the food after heating in the oven that is the object of this patent.			
Food to be defrosted:	Temperature reached by the food after ... seconds		
Distribution of susceptors:	Point 1		Point 2
Type of susceptor:		Point 3	
Supporting material:	Point 4		Point 5

[0177] Some embodiments of the invention are illustrated here below.

Example 1 (Figure 26A, 26B, 26C)

[0178] In an oven for defrosting and heating precooked foods having the following dimensions: width 250 mm, height 125 mm, depth 310 mm, surface of the horizontal plane 77500 mm^2, 8 susceptors in Ceram were inserted that were 4 mm thick, the other dimensions thereof being 20 mm and 60 mm. The surface of the single susceptor was therefore 1200 mm^2 and the surface covered by the susceptors was 12.38% of the total of the horizontal plane. The representation of the position of the Ceram inside the oven is shown in Figure 26.

[0179] The Ceram plates were placed in cavities obtained in a vitroceramic slab, a material that is permeable to microwaves, and were fixed with refractory cement so that they are at the same level as the plane of the slab, thus ensuring intimate contact with the bottom of the container of the food. The vitroceramic slab had the same horizontal dimensions as the oven. The position of the plates was selected so that it corresponded to the position of the bottom of the container of the food in the heating phase.

[0180] With this configuration of the susceptors inside the oven, it was possible, starting from three types of food frozen at -20°C, to obtain defrosting and heating with a distribution of the temperatures as shown in Figures 26A-26C that refer respectively to a heating time of 105, 150, and 90 seconds.

Example 2

[0181] In an oven for defrosting and heating precooked foods having the following dimensions: width 250 mm, height 125 mm, depth 310 mm, surface of the horizontal plane 77500 mm^2, 10 susceptors in Ceram were inserted that were 4 mm thick, the other two dimensions thereof being 20 mm and 60 mm. The surface of the individual susceptor was therefore 1200 mm^2 and the surface covered by the susceptors was 15.48% of the total surface on the horizontal plane.

[0182] The representation of the position of the Ceram inside the oven is shown in Figure 27.

[0183] The Ceram plates were placed on suitable recesses obtained in a vitroceramic slab, material permeable to microwaves, and fixed with refractory cement, so that they were at the same level as the plane of the slab, thus ensuring intimate contact with the bottom of the food container. The vitroceramic slab had the same horizontal dimensions as the oven. The position of the plates was chosen so that it corresponded to the position of the bottom of the container of the food being heated. With this configuration of the susceptors inside the oven, it was possible, starting with foods frozen to -20°C, to obtain the defrosting and heating thereof with distribution of the final temperatures, as shown in Figures 27A-27C, that refers respectively to temperatures measured after 105, 150 and 90 seconds of heating.

Example 3

[0184] As example 1, with the difference that susceptors made of silicon carbon were used so as to achieve a "star" formation. The surface covered by the susceptors represents 8.8 % of the horizontal plane of the oven. The supporting plane was made of epoxy resin, susceptors were isolated from the resin by interposing a layer of ceramic fibre and fixed with refractory cement.

[0185] The representation of the position of Ceram inside the oven is shown in Figure 28.

[0186] With this configuration of the susceptors inside the oven, it was possible, starting with foods frozen to -20°C, to obtain the defrosting and heating thereof with a distribution of the final temperatures, as shown in Figures 28A-28C which refer respectively to 105, 150 and 90 seconds of heating.

Example 4

[0187] As example 1, with the difference that susceptors made of silicon carbon have been used so as to form an "irregular chequered pattern" arrangement. The surface covered by the susceptors represents a 10.8% cover of the horizontal plane of the oven. The supporting plane was made of white Carrara marble and the susceptors were fixed with refractory cement. The representation of the position of the Ceram inside the oven is shown in Figure 29.

[0188] With this configuration of the susceptors inside the oven, it was possible, starting with foods frozen to -20°C, to obtain the defrosting and heating thereof with distribution of the final temperatures, as shown in Figures 29A-29C, which refer respectively to 105, 105 and 90 seconds of heating.

Example 5

[0189] As example 1, with the difference that susceptors made of magnetite were used so as to achieve a "close chequered" arrangement. The surface covered by the susceptors represents 12.9 % of the horizontal plane of the oven. The supporting plane was made of white Carrara marble and the susceptors were fixed with refractory cement.

[0190] The representation of the position of the susceptors in magnetite inside the oven is shown in Figure 30.

[0191] With this configuration of susceptors inside the oven, it was possible, starting with foods frozen to -20°C, to obtain the defrosting and heating thereof with distribution of the final temperatures, as shown in Figure 30A-30C which refer respectively to 105, 105 and 90 seconds of heating.

Example 6

[0192] As example 1, with the difference that susceptors made of Ceram were used so as to make a "wide chequered arrangement". The surface covered by the susceptors represents 8.25 % of the horizontal plane of the oven. The supporting plane was made of polypropylene and the susceptors were insulated from the plane in plastic material with a layer of ceramic fibre and were fixed with refractory cement.

[0193] The representation of the position of the Ceram inside the oven is shown in Figure 31.

[0194] With this configuration of the susceptors inside the oven, it was possible, starting with foods frozen to -20°C, to obtain the thawing and heating thereof with distribution of the final temperatures, as shown in Figures 31A-31C which refer respectively to 105, 150 and 90 seconds of heating.

Claims

1. Apparatus for processing food products (302), comprising a chamber (304) for receiving internally said food products (302), provided internally with susceptor means (329) suitable for interacting with microwaves (327, 328) for producing thermal energy to be transferred to said food products (302), said susceptor means being formed by distinct elements (329), mounted on a support (306) for the food products (302).

2. Apparatus according to claim 1, wherein said distinct elements (329) have a thickness that is not less than about 1 mm, and occupy an area comprised between approximately 5% and approximately 20% of a plan section of said chamber.

3. Apparatus according to claim 2, wherein said distinct elements (329) have a dimension (AA) and a further dimension

(BB), parallel to a rest surface of said support (306), of the same order of magnitude as said thickness.

4. Apparatus according to claim 2 or 3, wherein said area is comprised between approximately 8% and approximately 15% of said plan section.

5. Apparatus according to claim 3 or according to claim 4 as appended to claim 3, wherein said dimension (AA) is approximately 20 mm and said further dimension (BB) is approximately 60 mm.

6. Apparatus according to any one of claims 2 to 5, wherein said thickness is approximately 4 mm.

7. Apparatus according to any one of claims 1 to 6, wherein said elements (329) comprise a first element and a second element aligned in a first direction, and a third element and a fourth element aligned in a second direction transverse to said first direction, said second direction intersecting said first direction in a zone interposed between said first element and said second element.

8. Apparatus according to claim 7, wherein said second direction is perpendicular to said first direction and equidistant from said first element and from said second element.

9. Apparatus according to claim 7 or 8, wherein said third element and said fourth element are arranged on opposite sides with respect to said first direction.

10. Apparatus according to any one of claims 7 to 9, wherein said elements (329) comprise a fifth element and a sixth element aligned in a third direction that is transverse to said first direction and to said second direction, said fifth element and said sixth element being arranged on opposite sides from one another with respect to said first direction and to said second direction and being equidistant from said first direction and from said second direction.

11. Apparatus according to claim 10, wherein said elements (329) comprise a seventh element and an eighth element aligned in a fourth direction that is transverse to said third direction, said seventh element and said eighth element being arranged on opposite sides with respect to said third direction and being equidistant from said first direction and from said second direction.

12. Apparatus according to any one of claims 1 to 6, wherein said elements (329) are arranged so as to define a first row of elements and a second row of elements, said first row of elements and said second row of elements being substantially parallel to one another, said first row of elements comprising a plurality of elements that are parallel to one another, wherein adjacent elements of said plurality of elements are separated by the same distance.

13. Apparatus according to claim 12, wherein said second row of elements comprises a further plurality of elements that are parallel to one another, and wherein adjacent elements of said further plurality of elements are separated by the same distance.

14. Apparatus according to claim 12 or 13, wherein elements of said plurality of elements are separated by a first distance from corresponding elements of said further plurality of elements near ends of said first row of elements and of said second row of elements, and wherein further elements of said plurality of elements are separated by a second distance from corresponding further elements of said further plurality of elements, near a central portion of said first row of elements and of said second row of elements.

15. Apparatus according to claim 14, wherein said second distance is greater than said first distance.

16. Apparatus according to claim 13 or according to claim 14 or 15 as claim 14 is appended to claim 13, wherein said plurality of elements and said further plurality of elements each comprises five elements.

17. Apparatus according to any one of claims 1 to 16, wherein said elements (329) are obtained from a material selected from a group comprising: Ceram, ferrites, graphite, coal, silicon carbide, ceramic materials and glass materials, and wherein said support comprises a slab (6) which is obtained from a material selected from a group comprising: ceramic-fibre materials, ceramic materials, glass materials.

18. Apparatus according to claim 17, wherein said slab is provided with a plurality of seats, each of which is arranged to house a respective element (329), each element (329) being fixed to a respective seat by means of refractory cement.

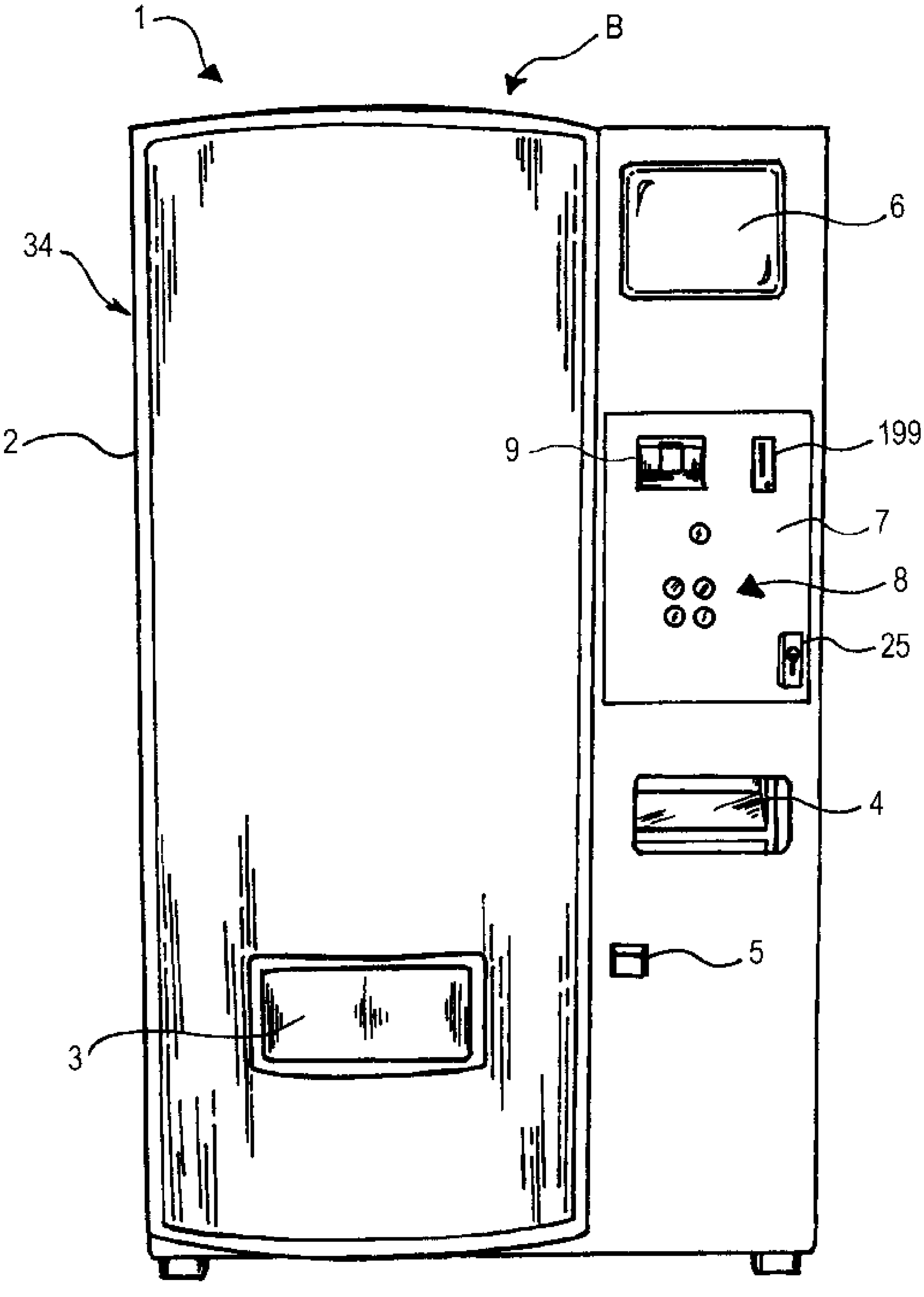

Fig. 1

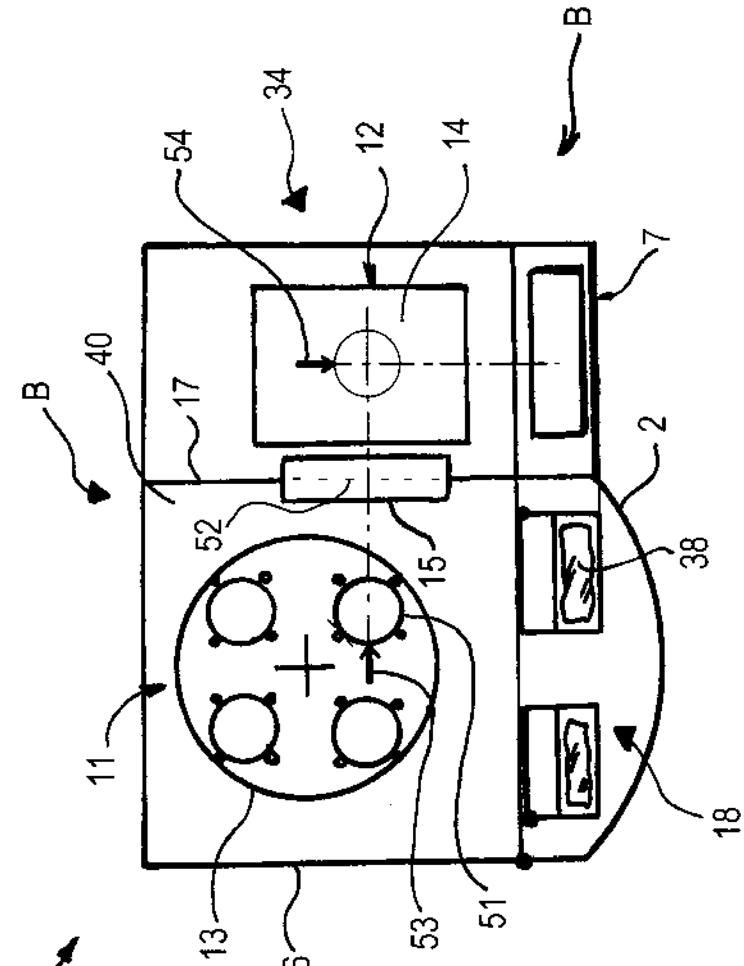

Fig. 2

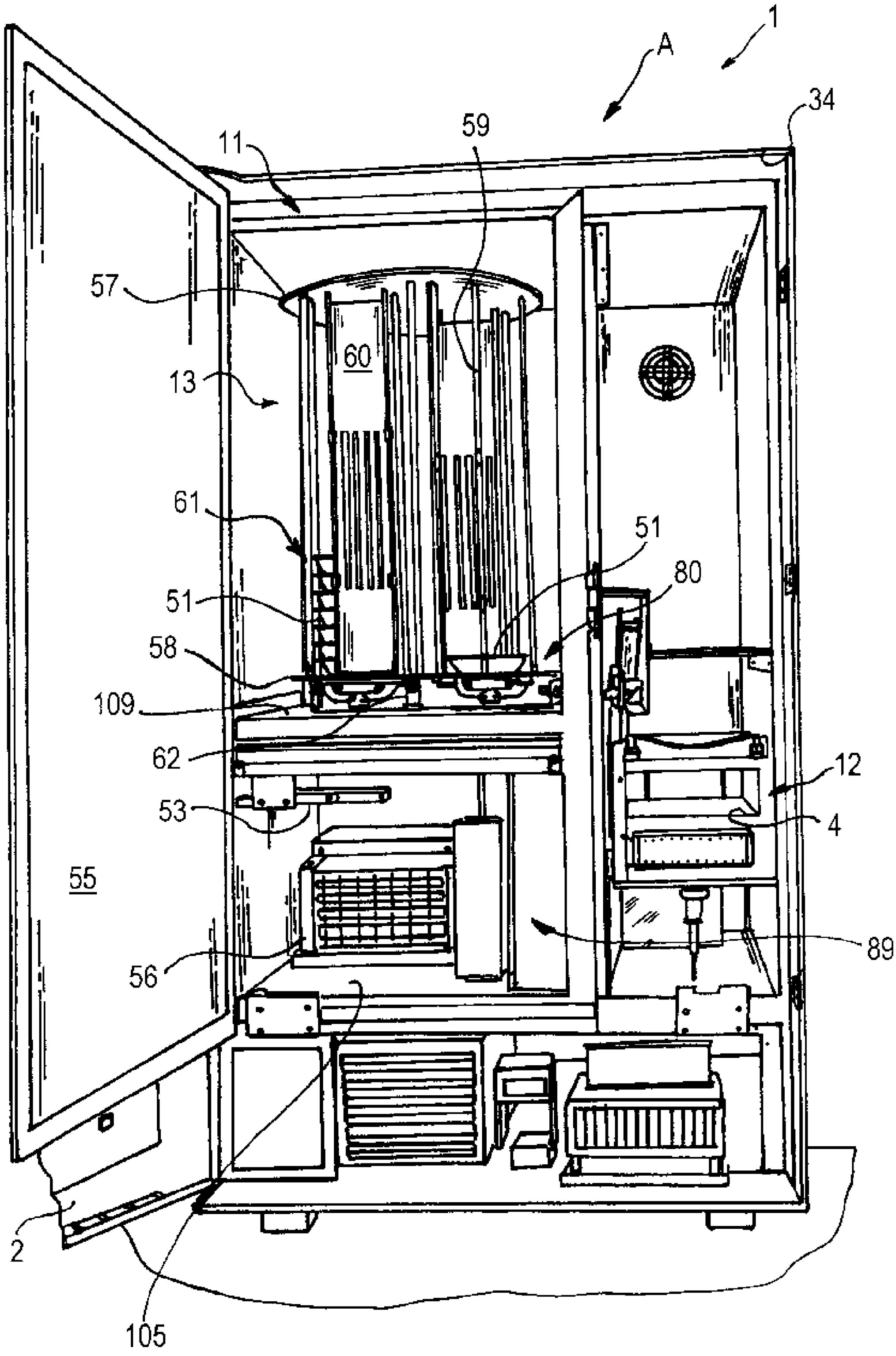

Fig. 3

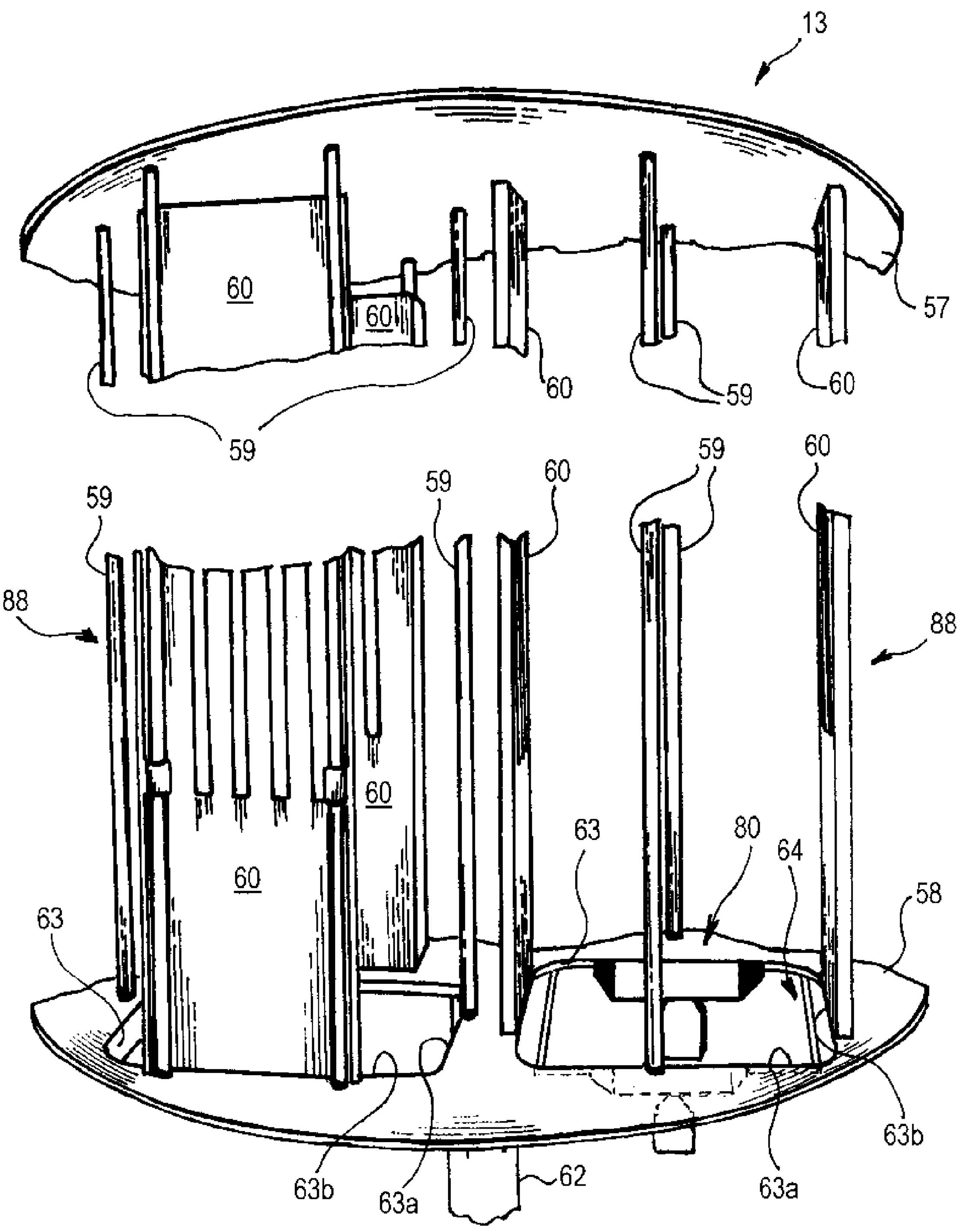
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Fig. 4

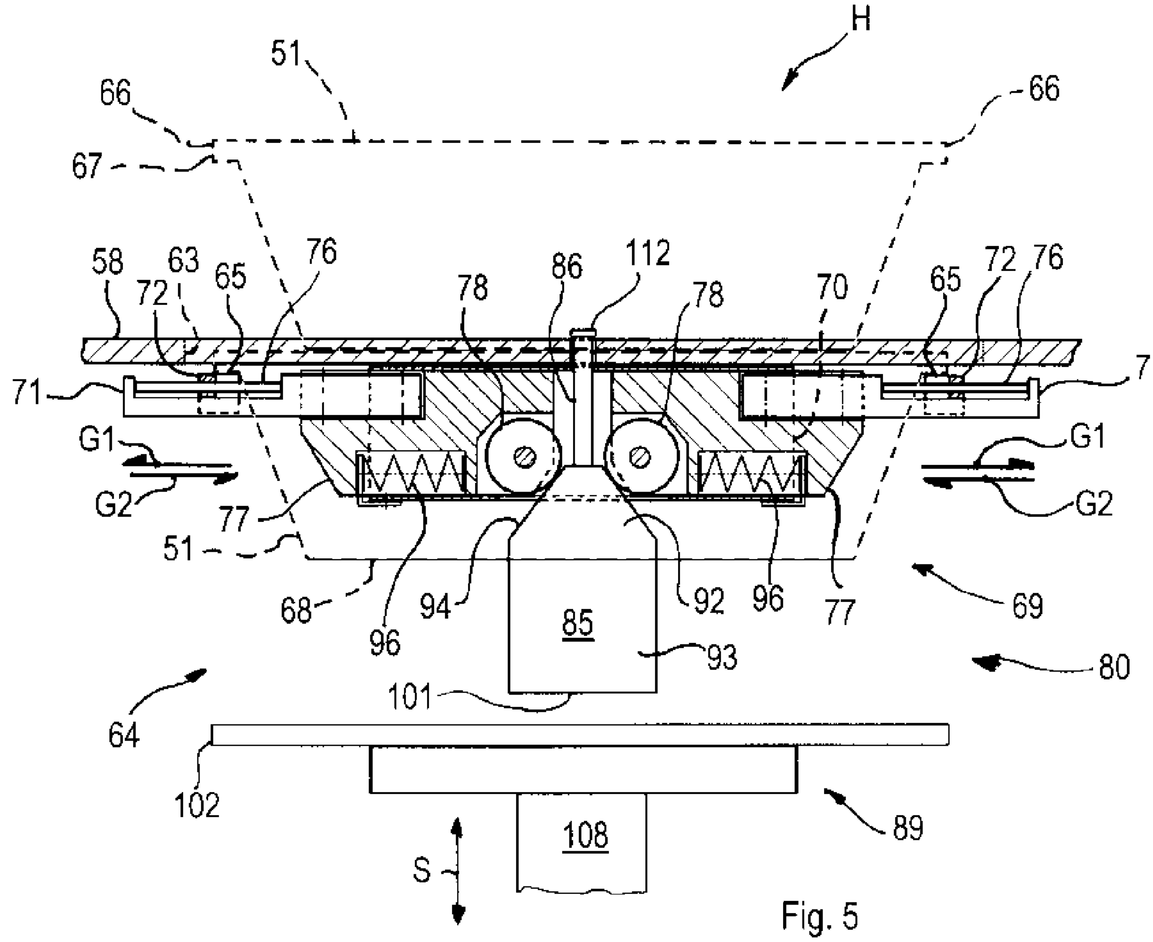
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Fig. 5

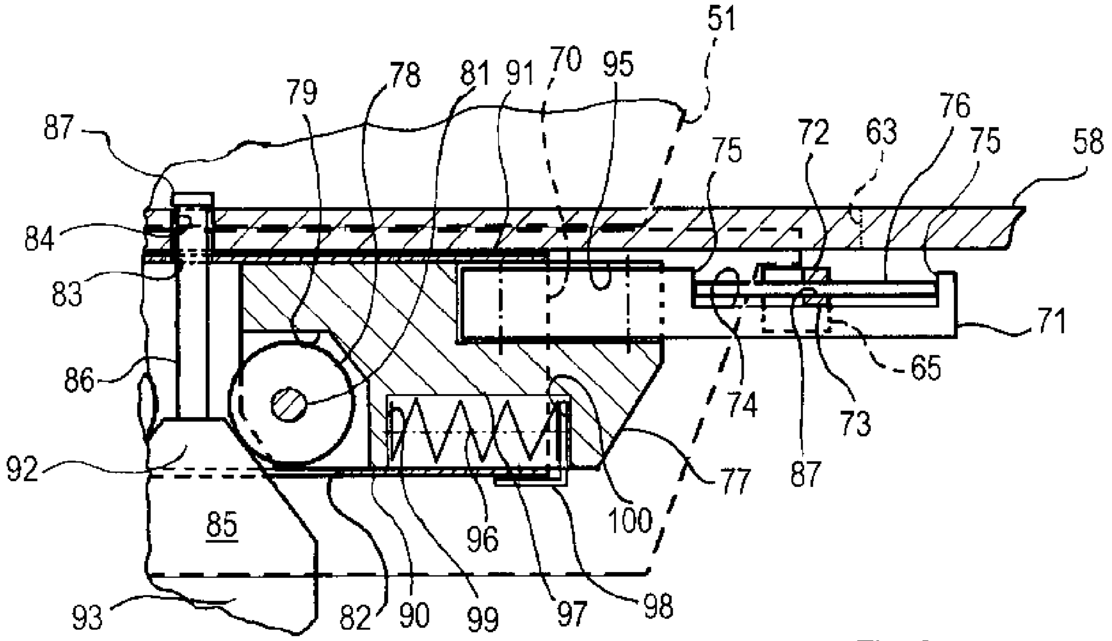
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Fig. 6

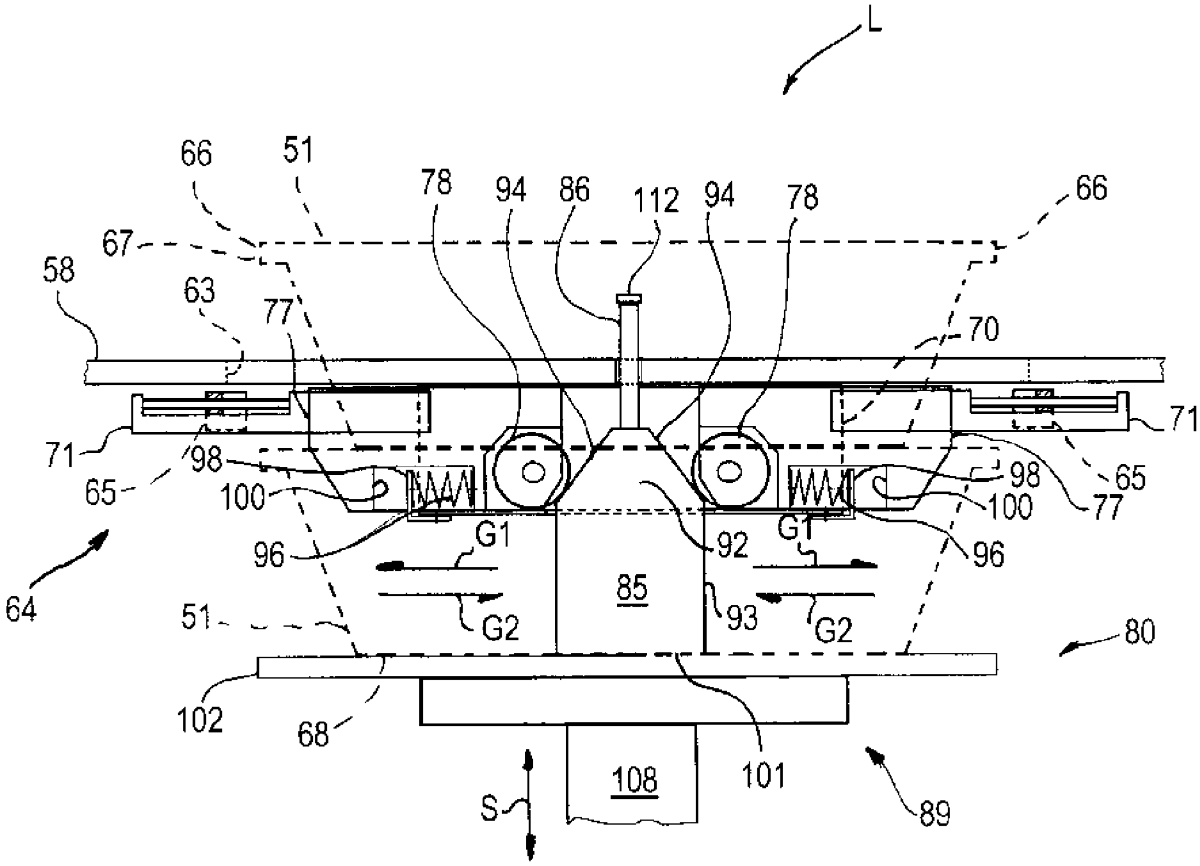
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Fig. 7

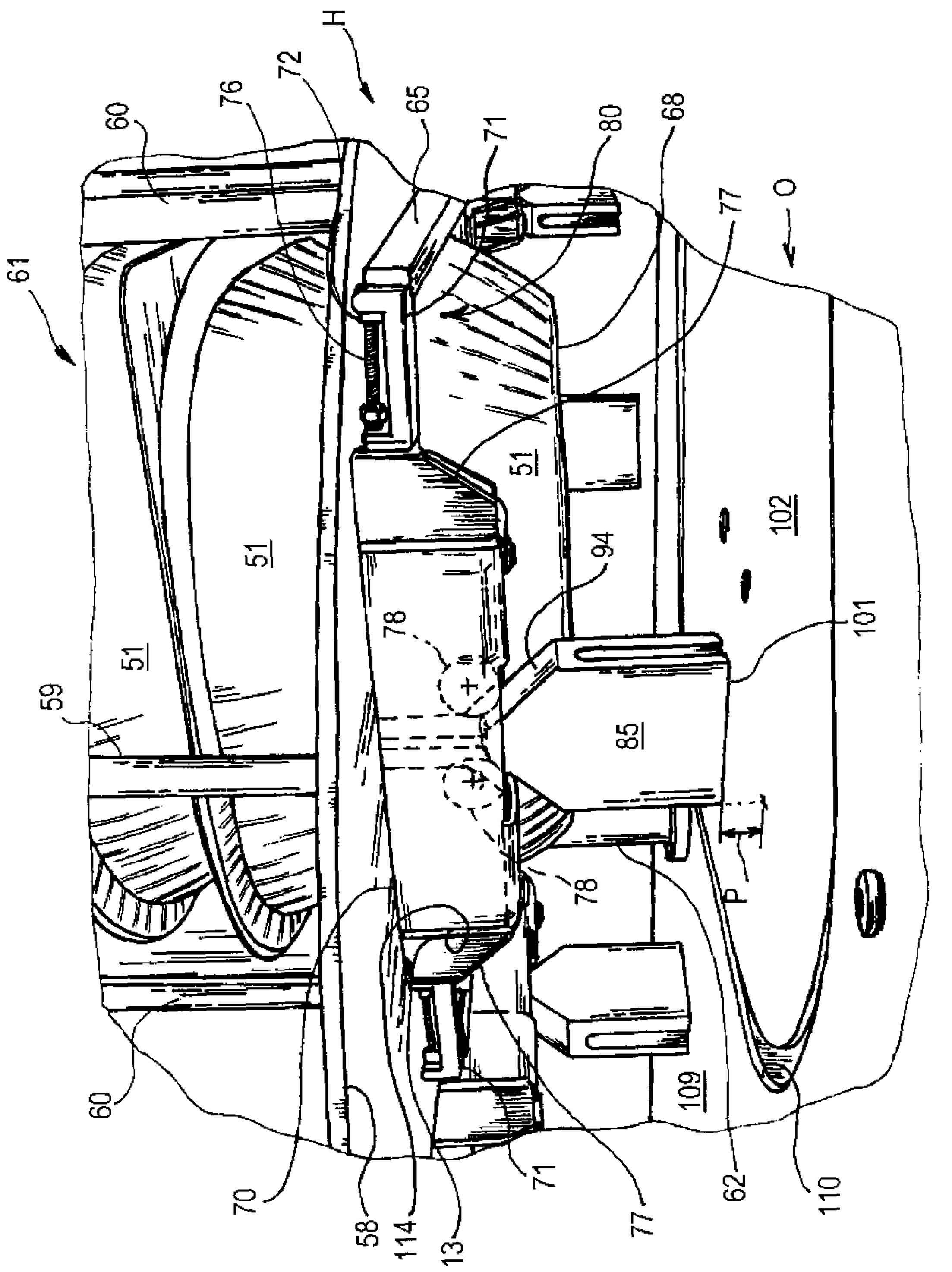
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Fig. 8

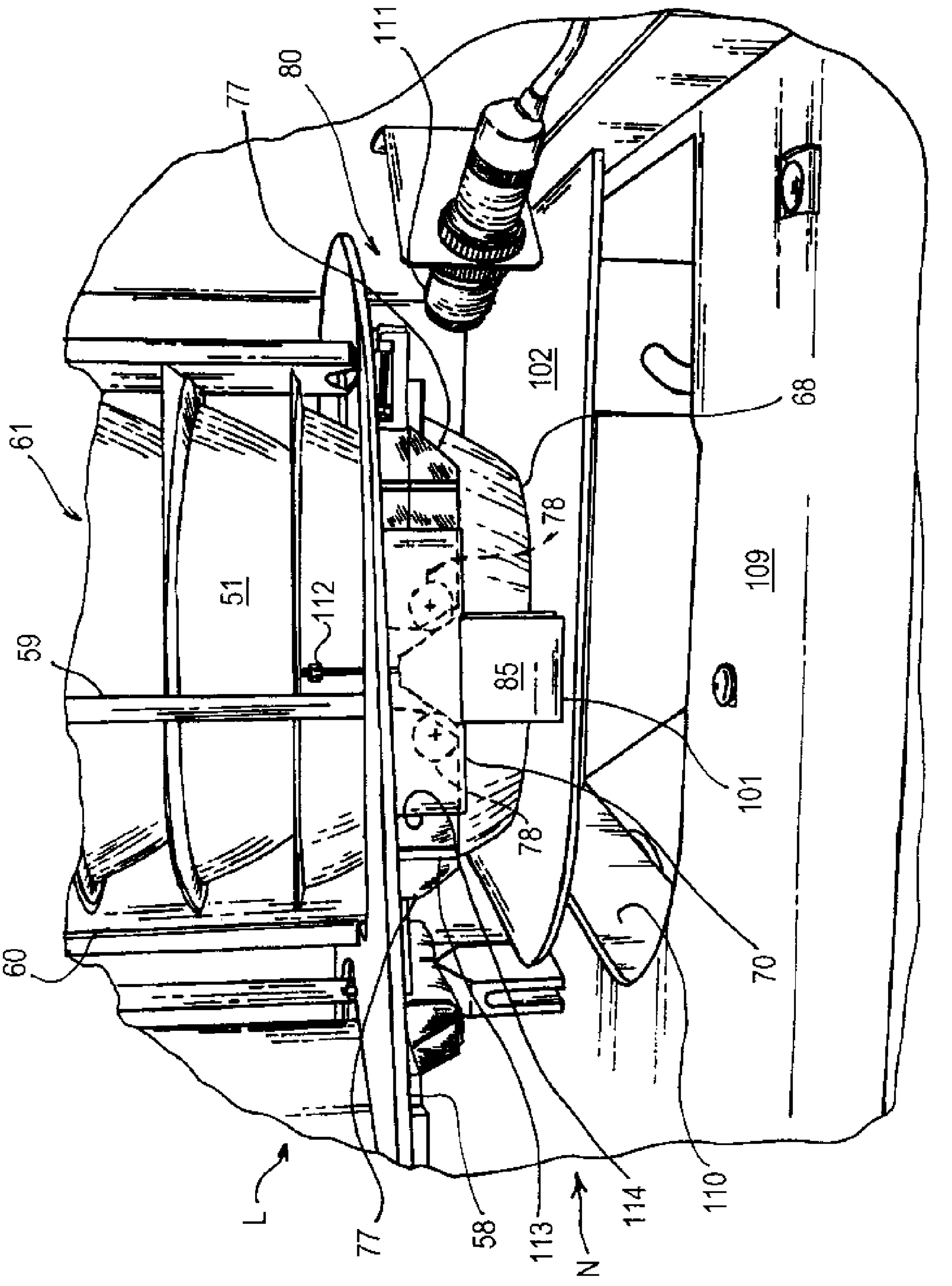
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Fig. 9

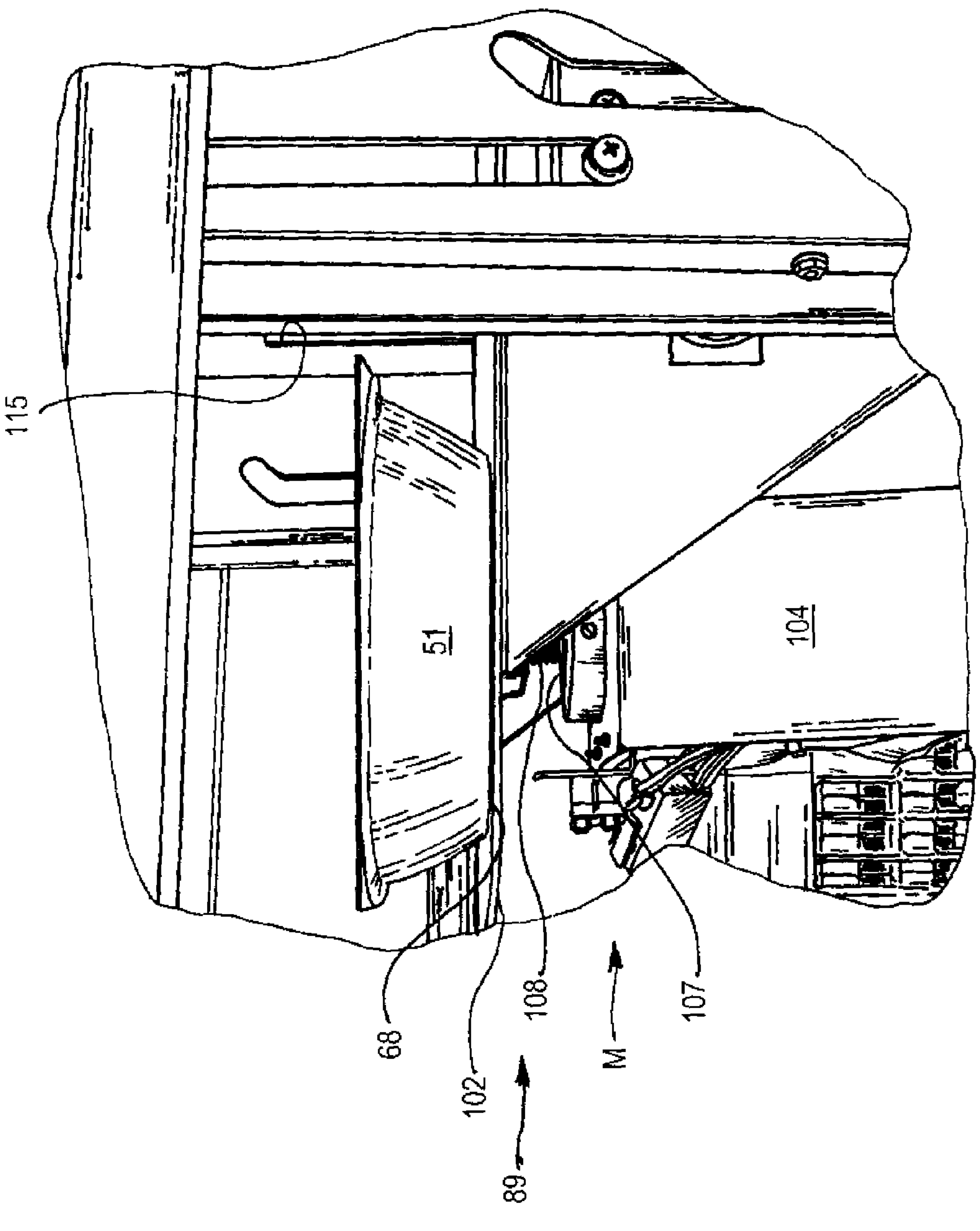

Fig. 10

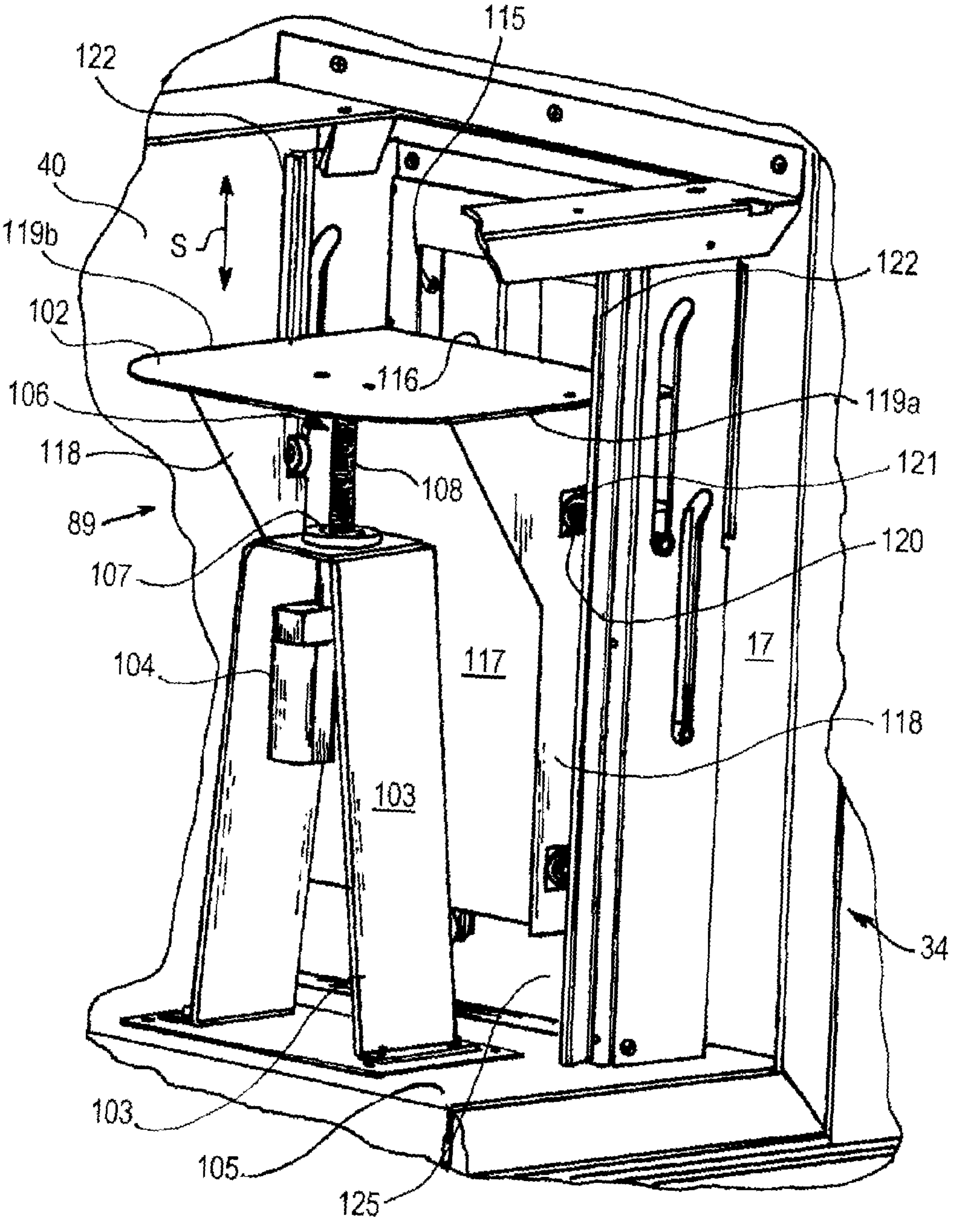
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Fig. 11

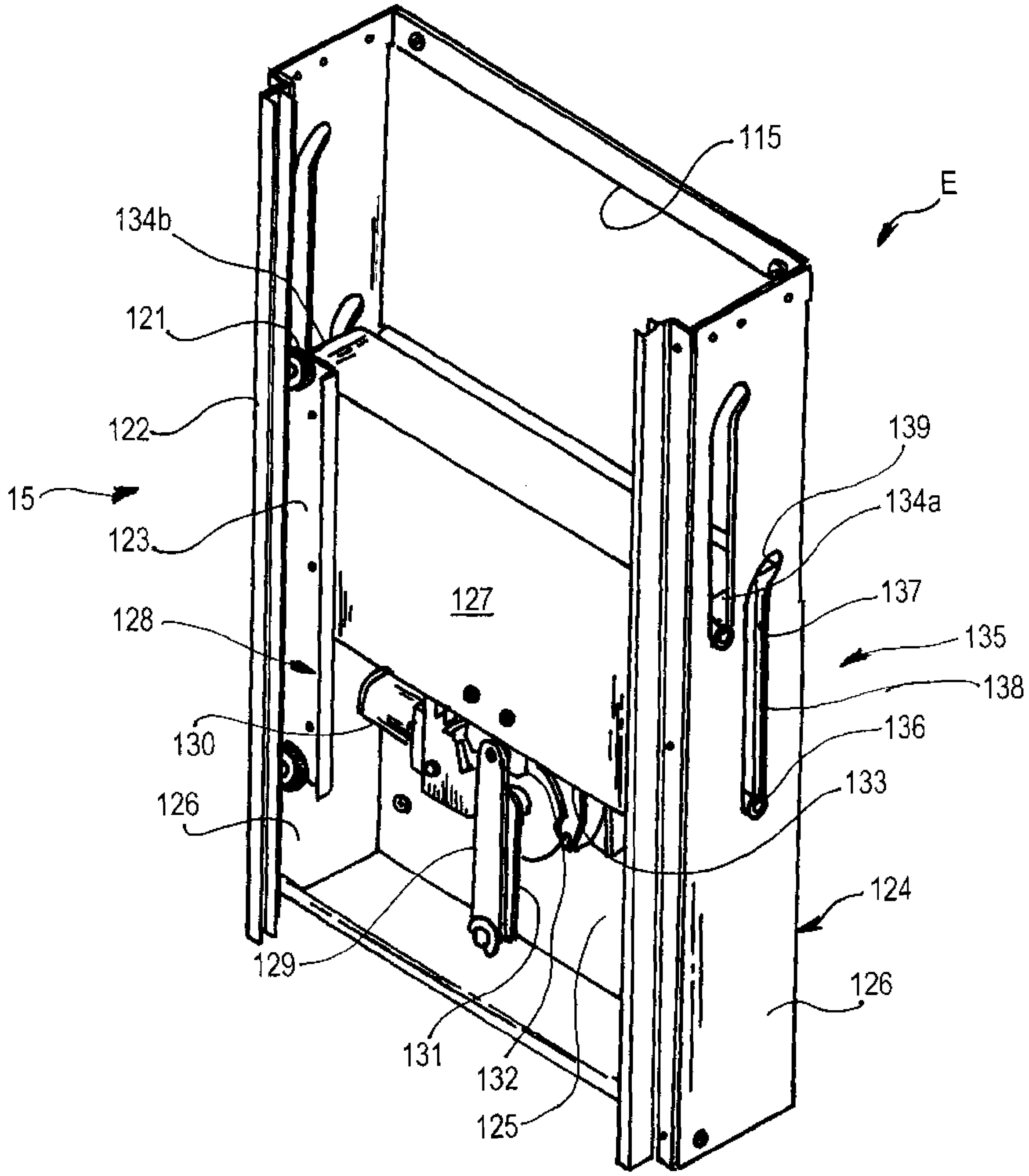
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Fig. 12

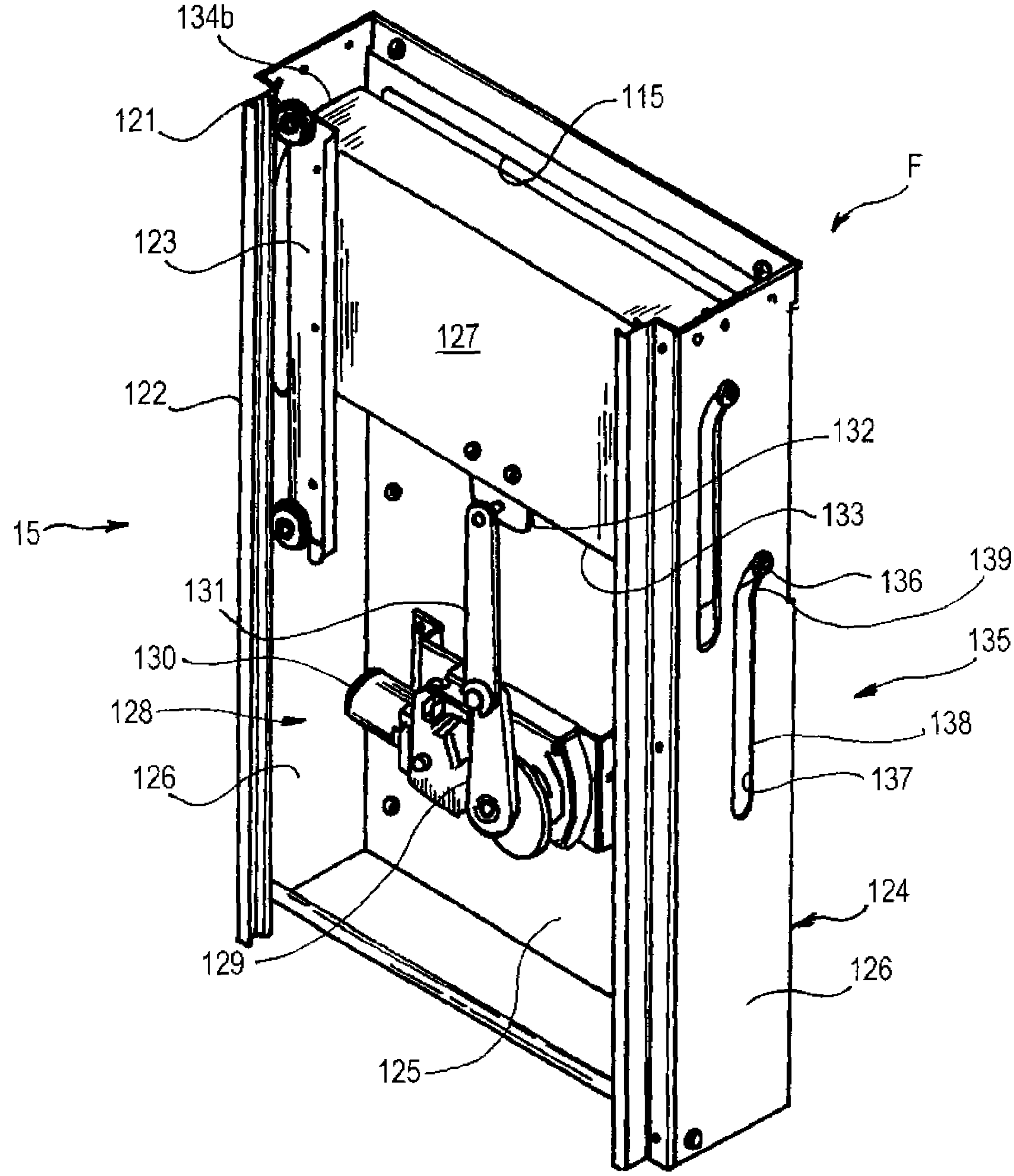
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Fig. 13

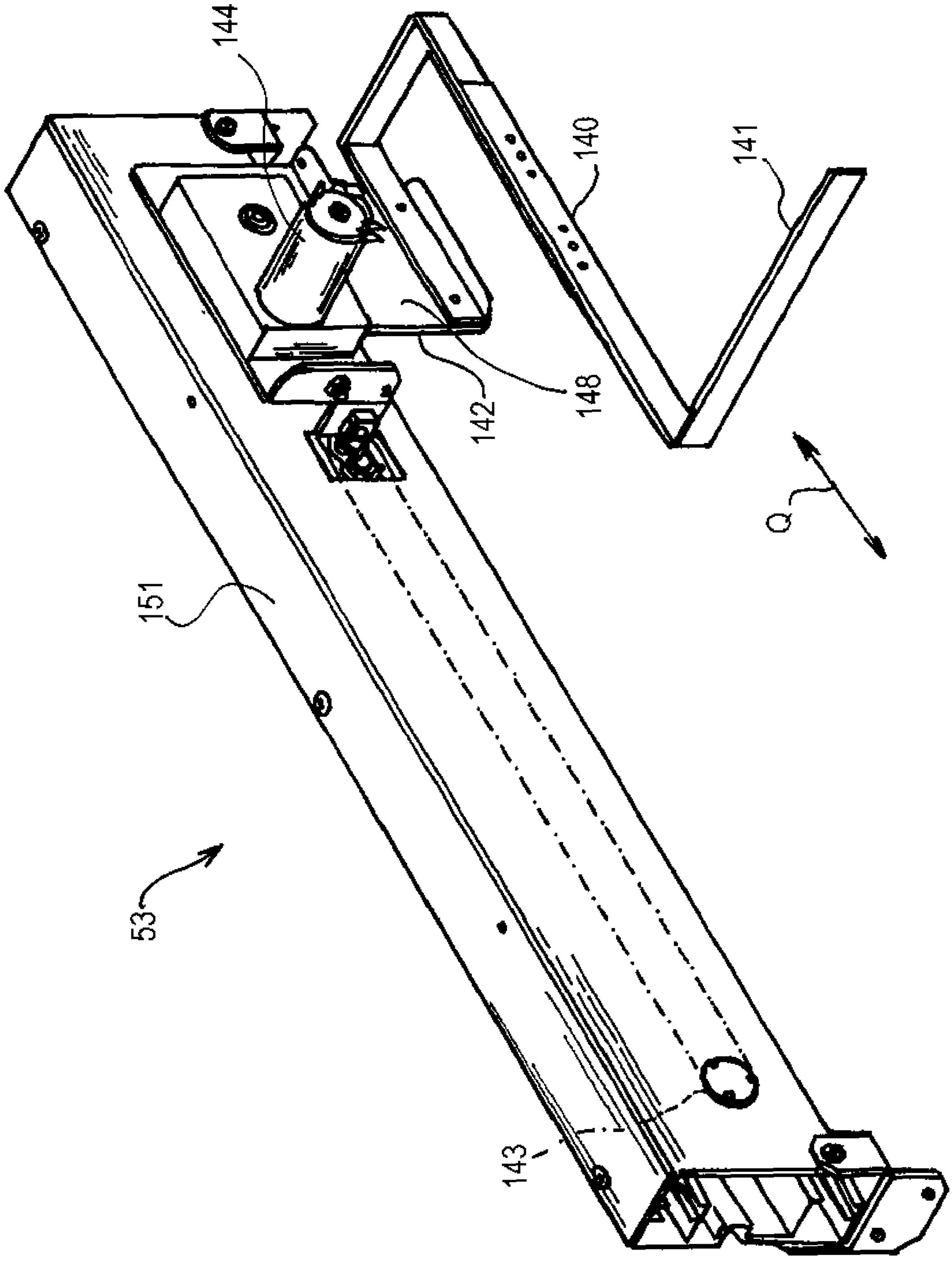

Fig. 14

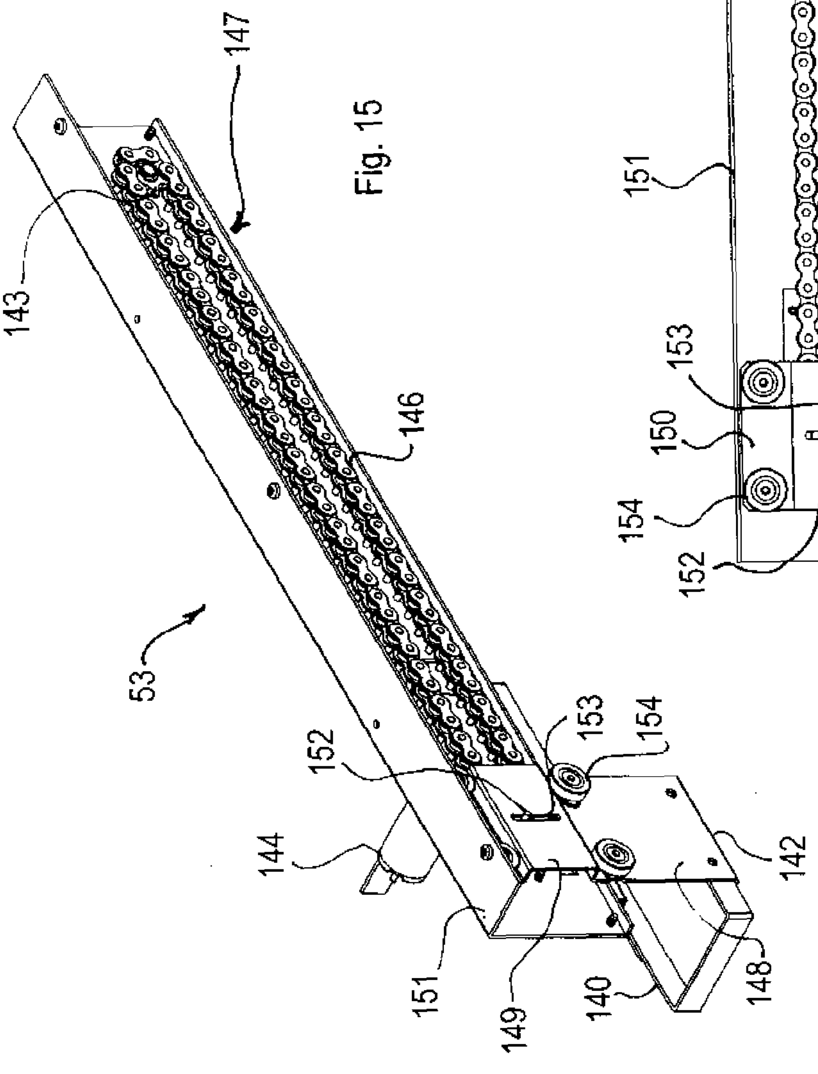
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Fig. 15

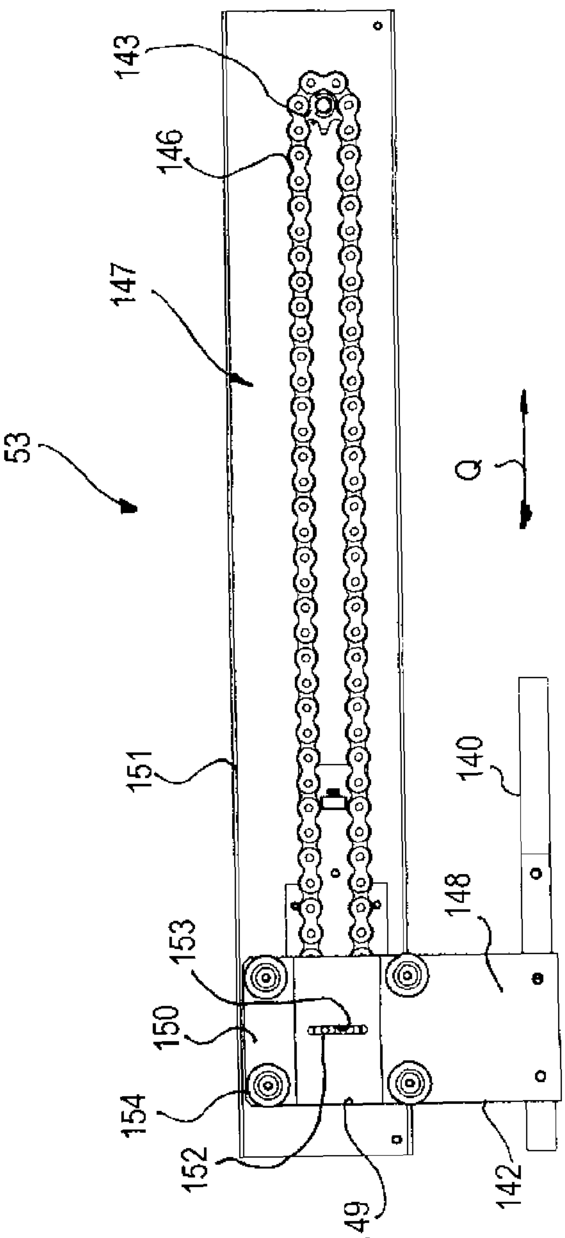
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Fig. 16

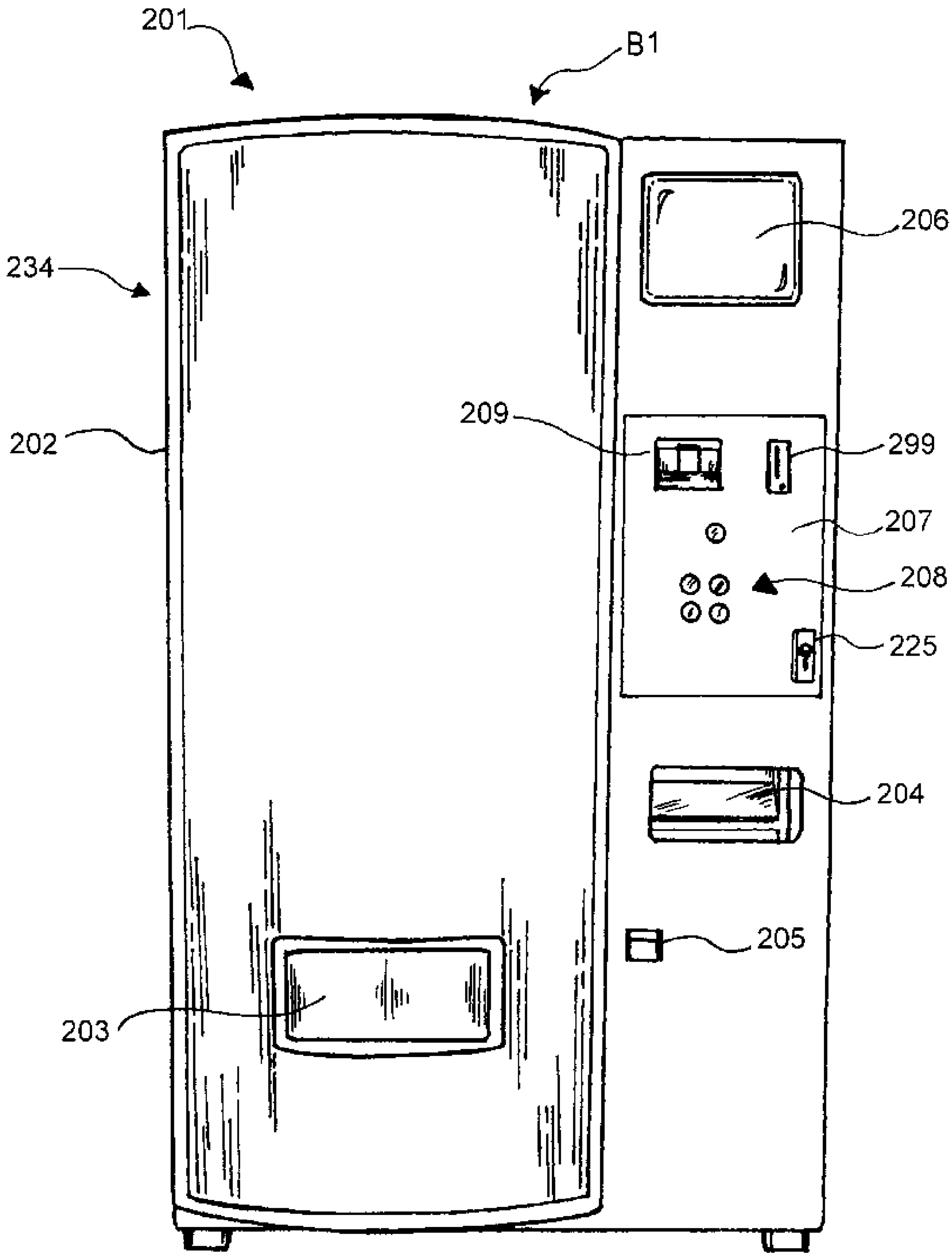

Fig. 17

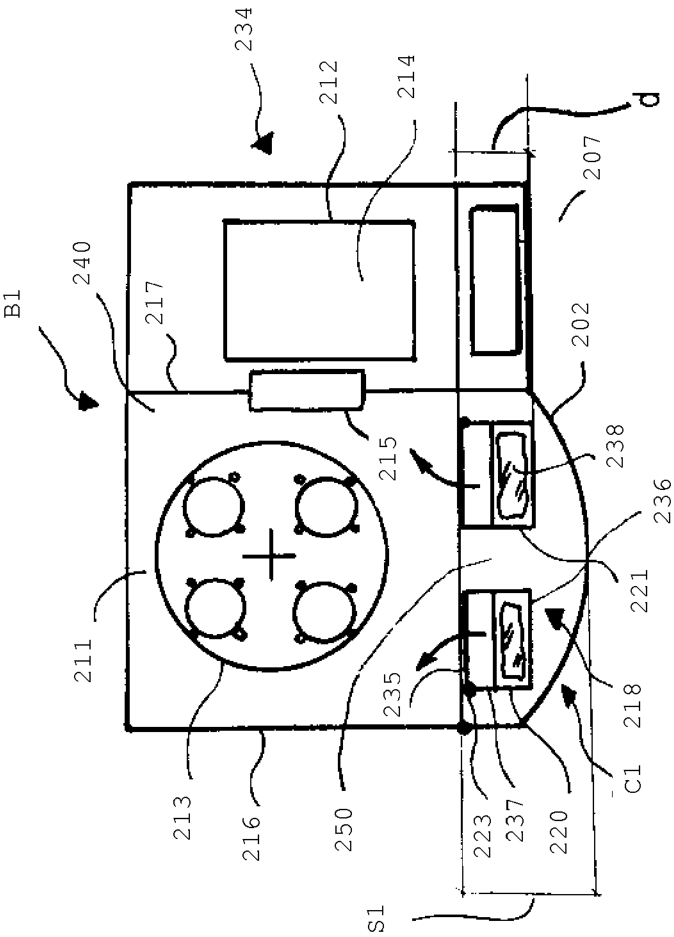
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Fig. 18

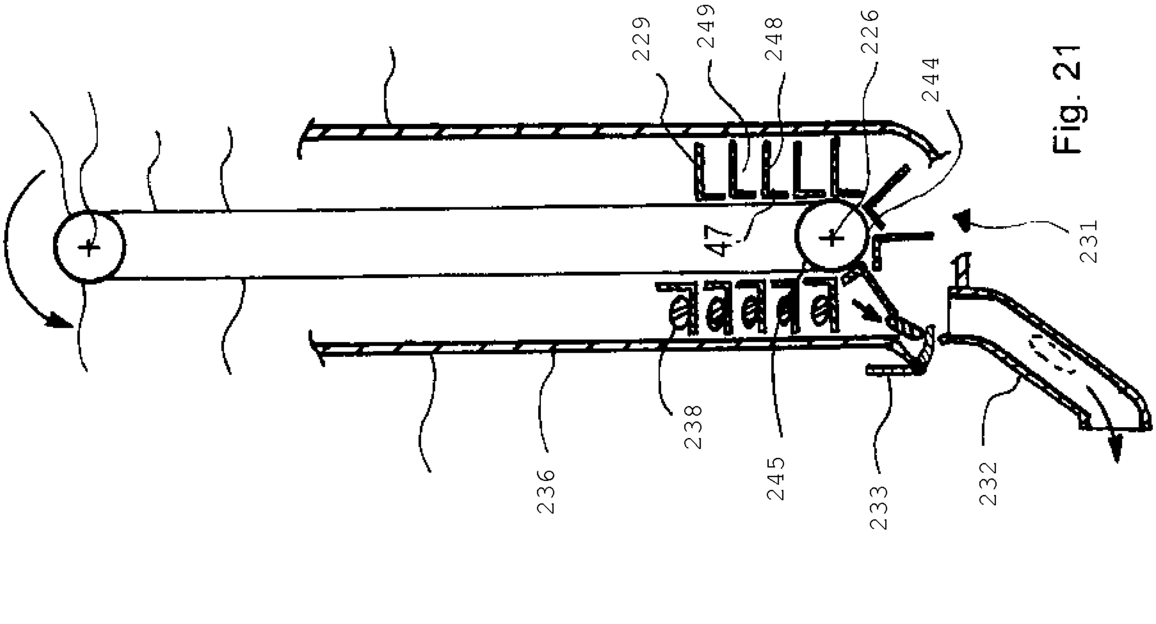
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Fig. 21

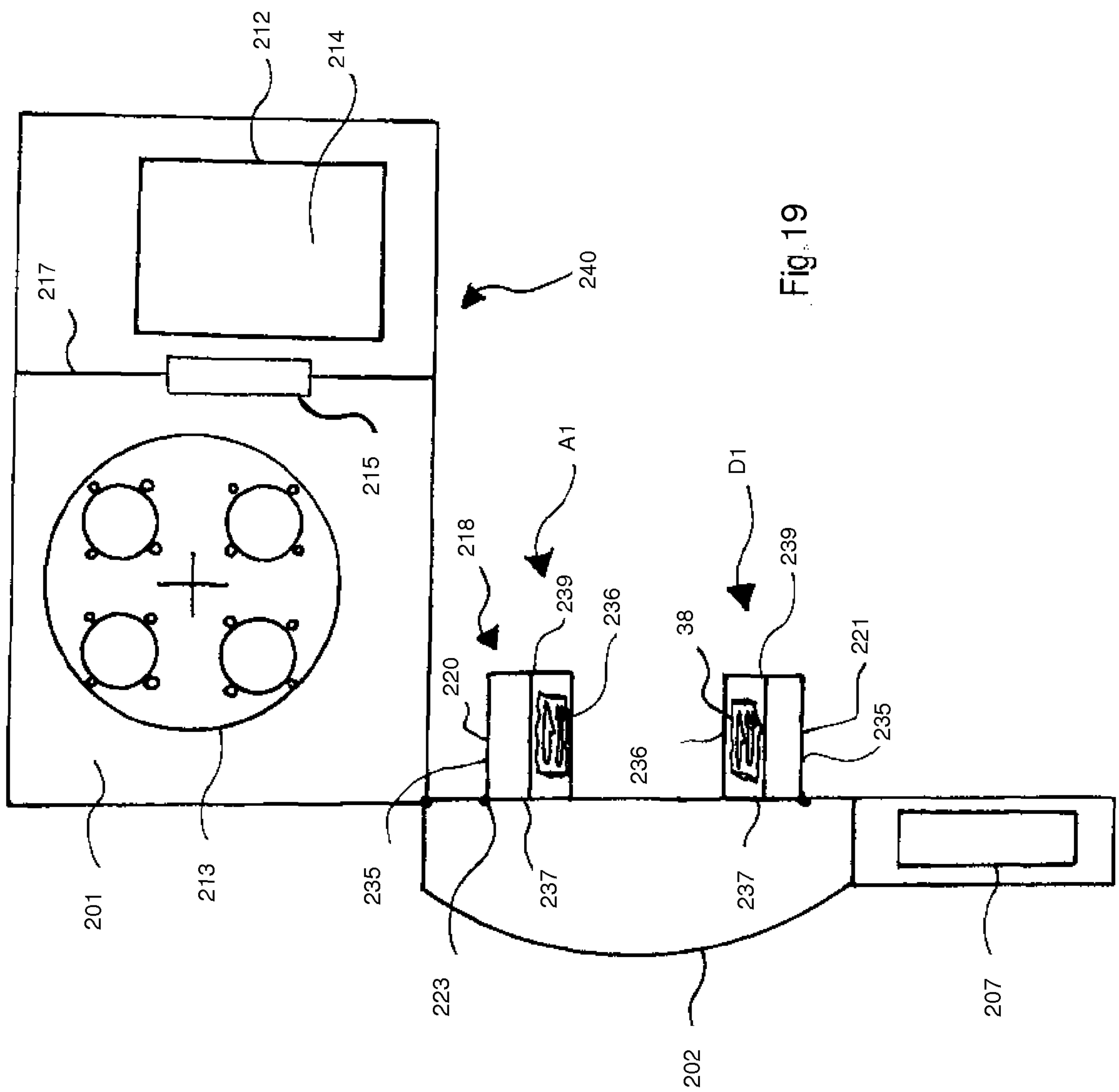
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Fig.19

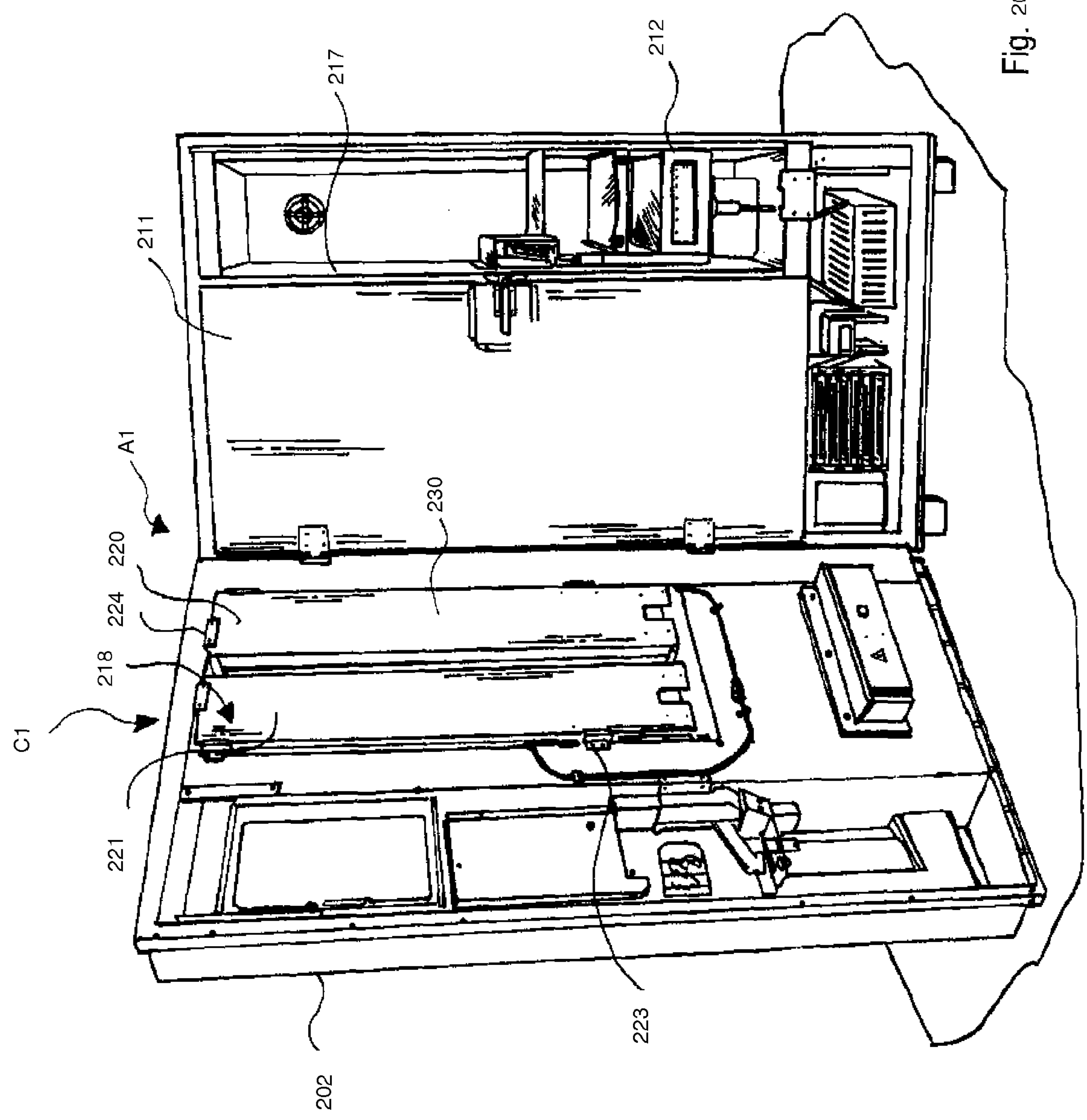

Fig. 20

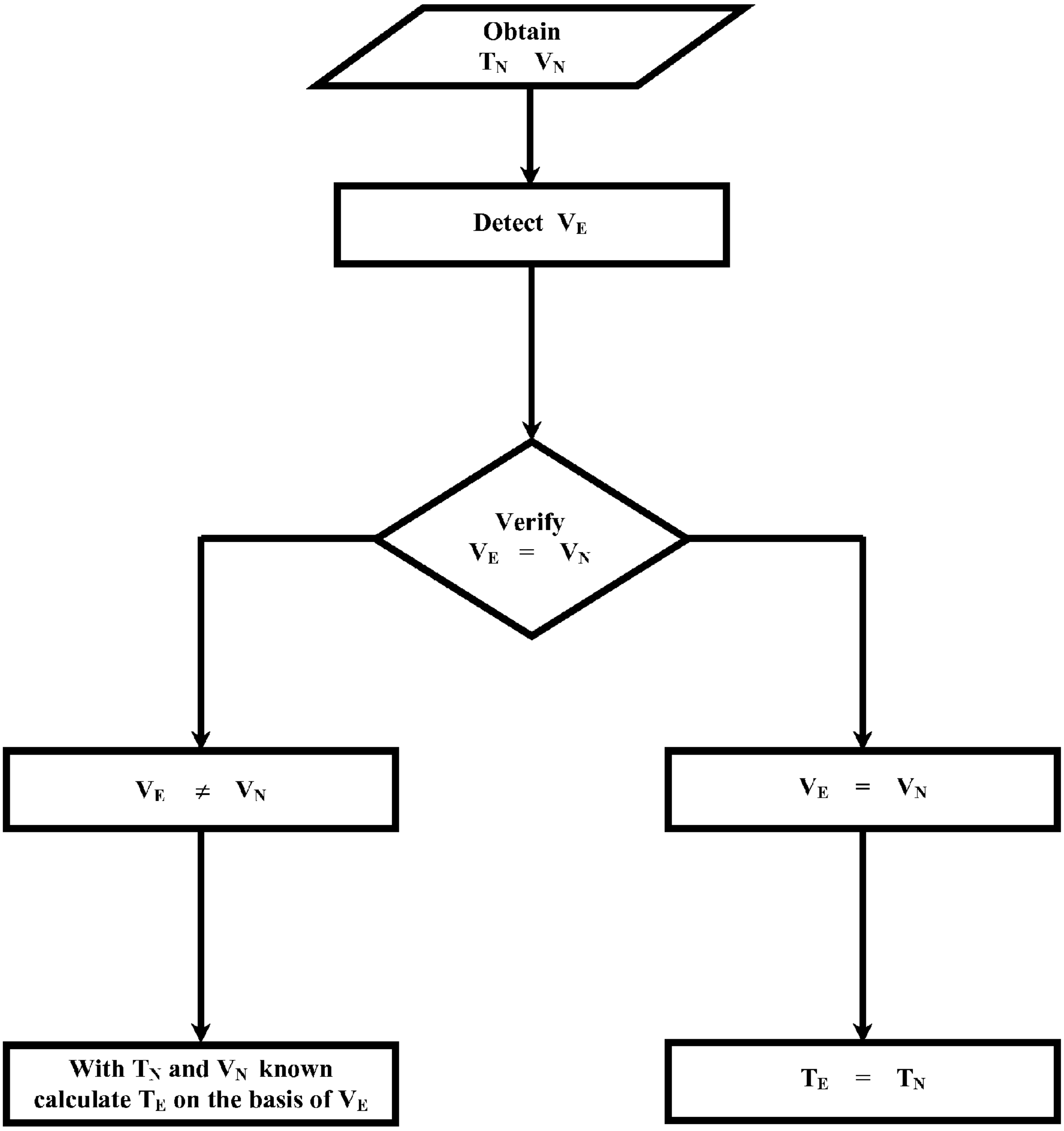
Obtain
T_N V_N
Detect V_E
Verify
$V_E = V_N$
$V_E \neq V_N$
$V_E = V_N$
With T_N and V_N known
calculate T_E on the basis of V_E
$T_E = T_N$

Fig. 22

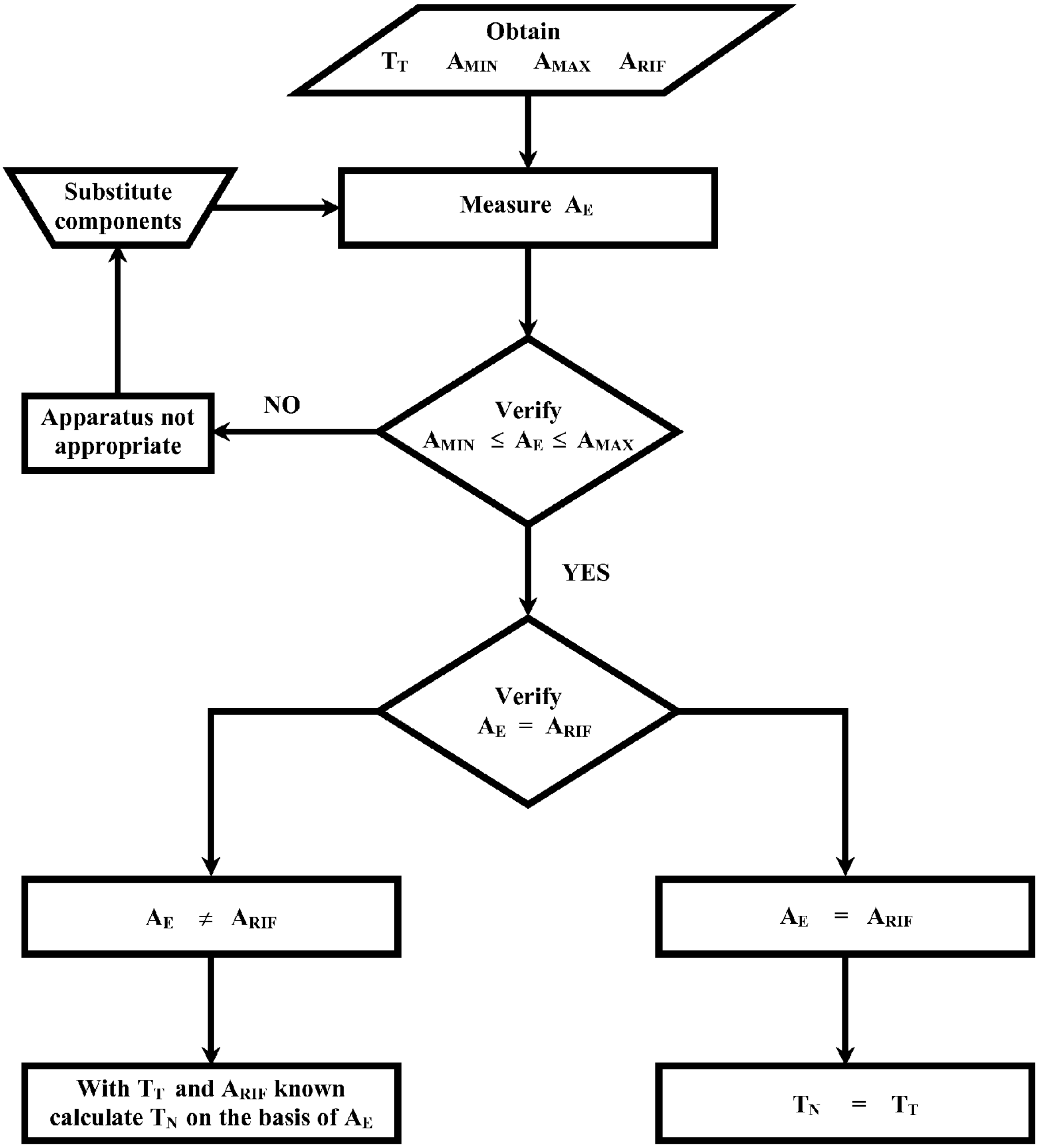
Obtain
T_T A_{MIN} A_{MAX} A_{RIF}
Substitute components
Measure A_E
Apparatus not appropriate
NO
Verify
$A_{MIN} \leq A_E \leq A_{MAX}$
YES
Verify
$A_E = A_{RIF}$
$A_E \neq A_{RIF}$
$A_E = A_{RIF}$
With T_T and A_{RIF} known calculate T_N on the basis of A_E
$T_N = T_T$

Fig. 23

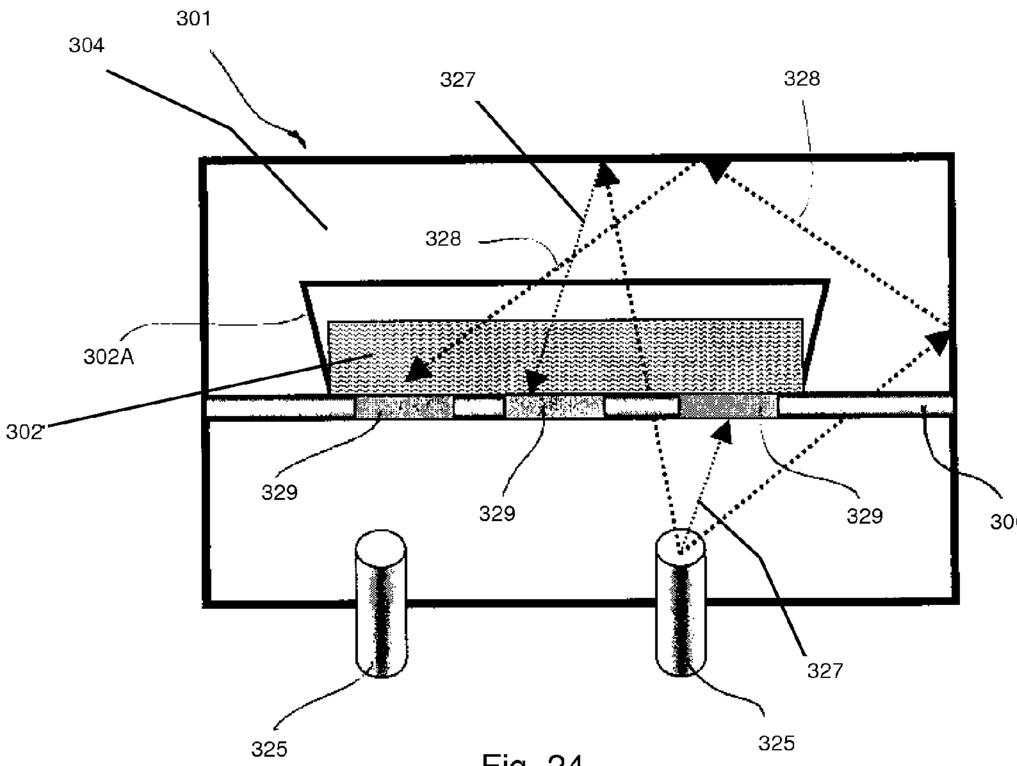
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Fig. 24

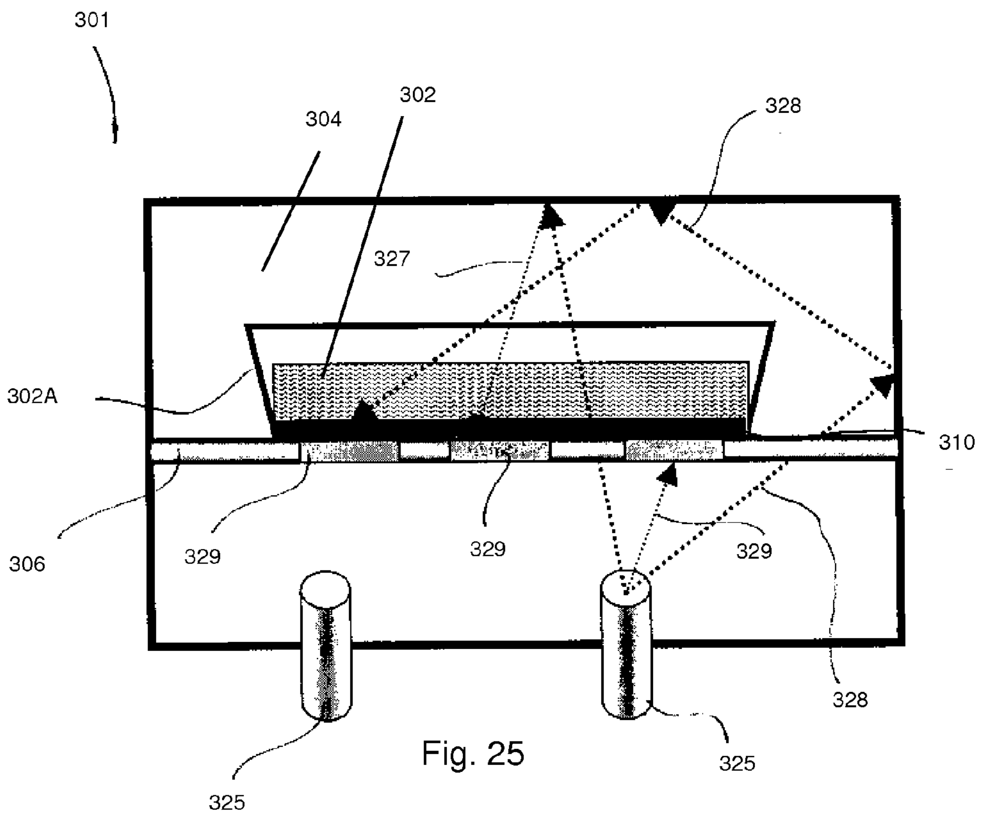
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Fig. 25

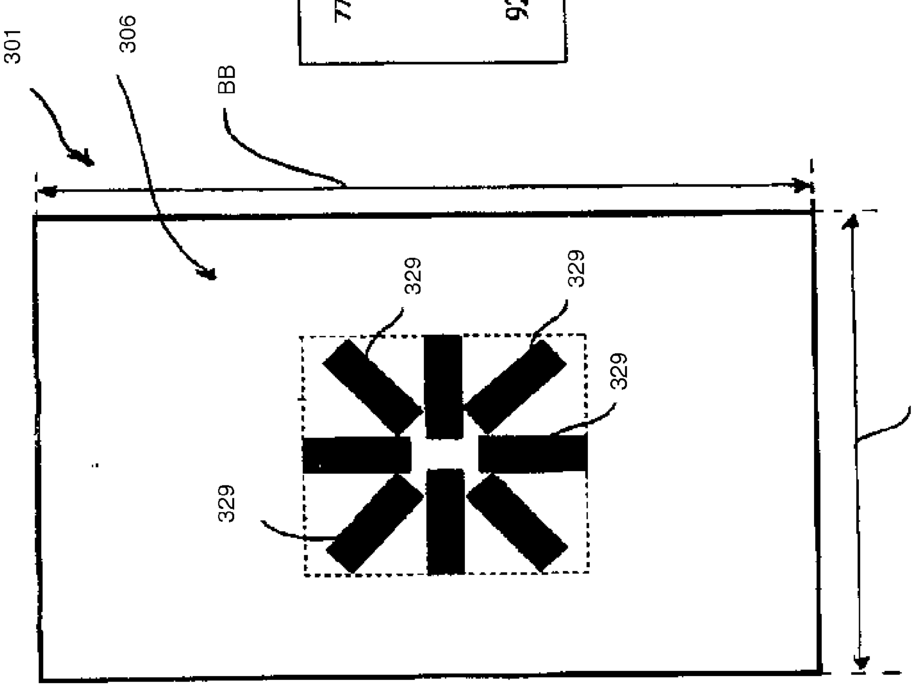

Fig. 26

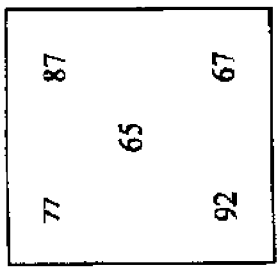

Fig. 26A

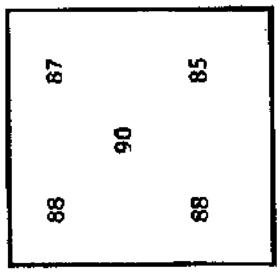

Fig. 26B

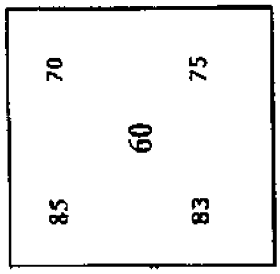

Fig. 26C

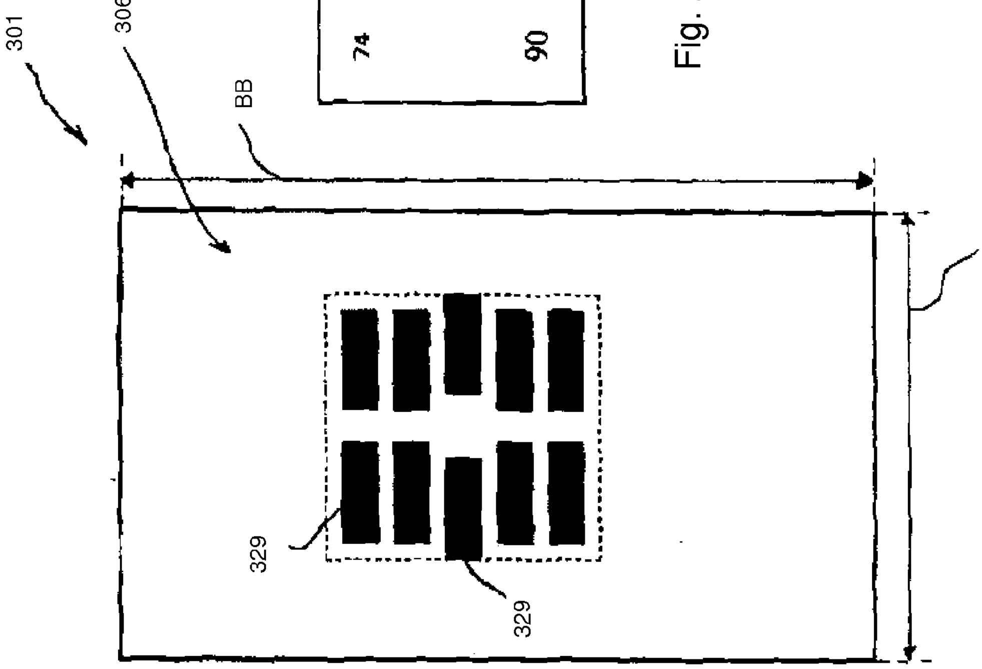

Fig. 27

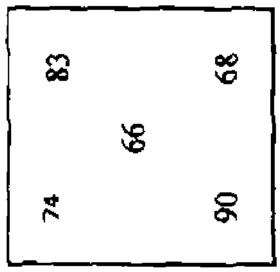

Fig. 27A

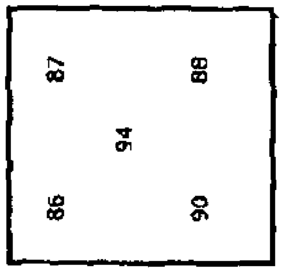

Fig. 27B

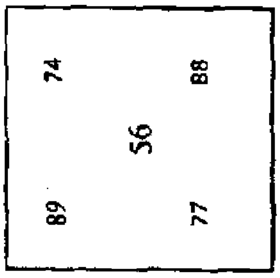

Fig. 27C

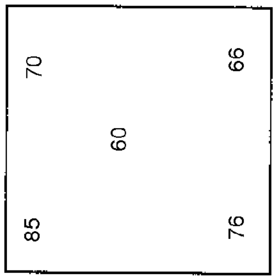

Fig. 28C

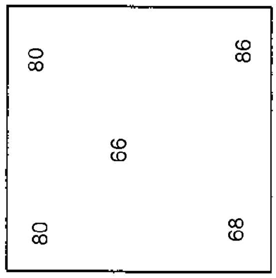

Fig. 28B

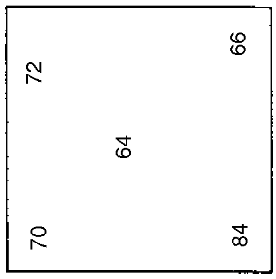

Fig. 28A

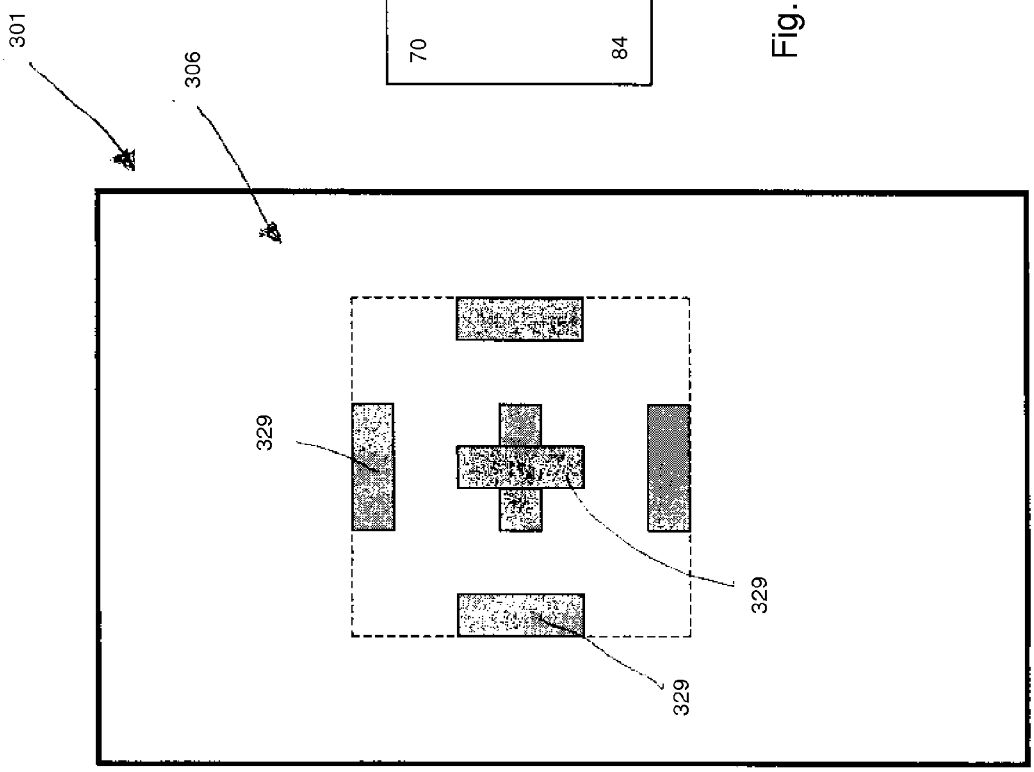

Fig. 28

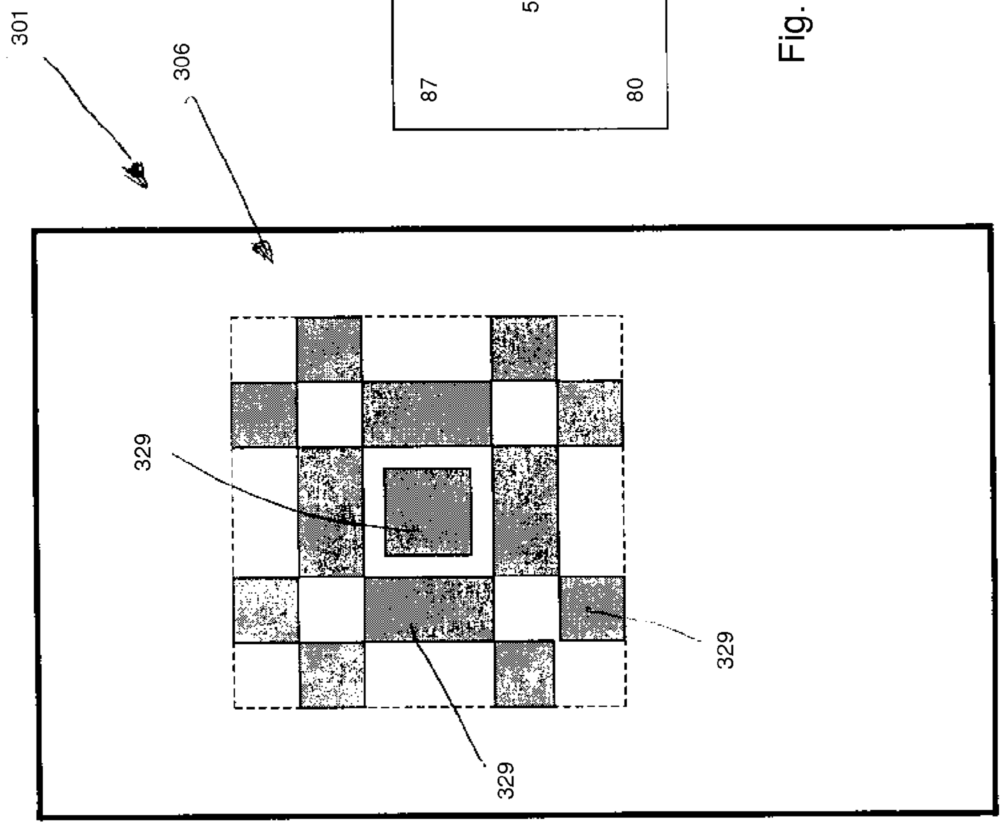

Fig. 29

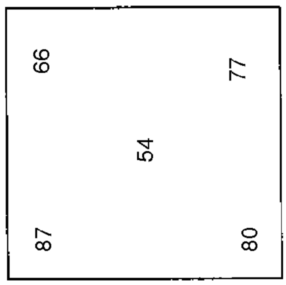

Fig. 29A

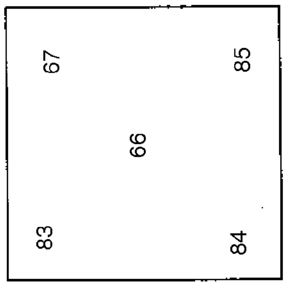

Fig. 29B

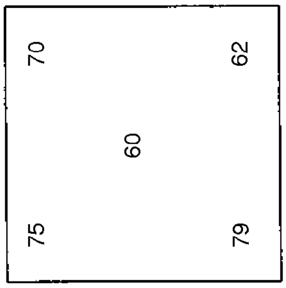

Fig. 29C

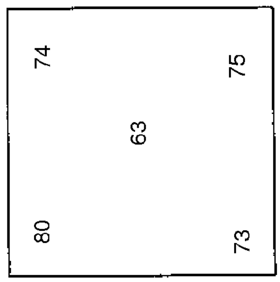

Fig. 30C

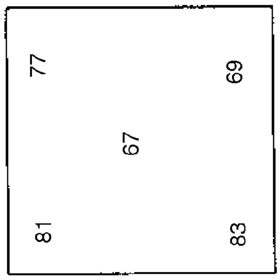

Fig. 30B

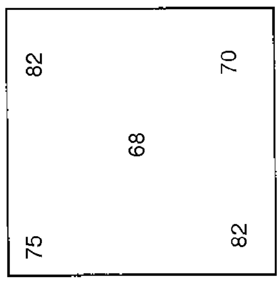

Fig. 30A

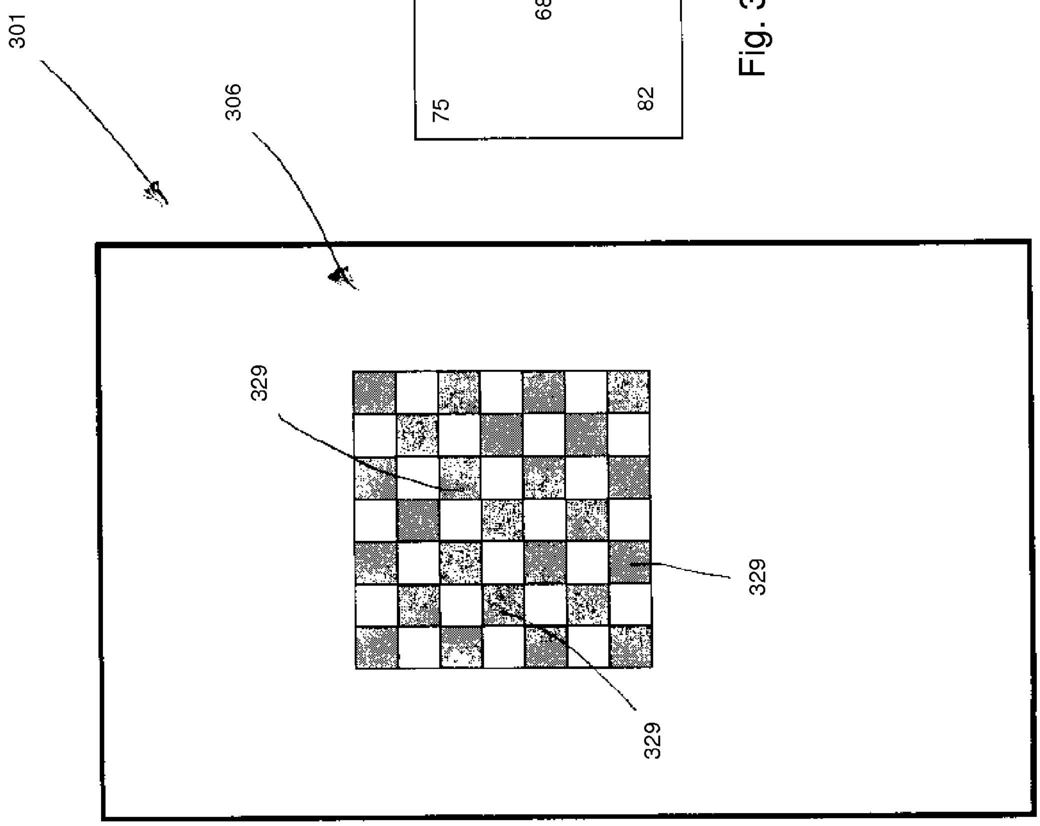

Fig. 30

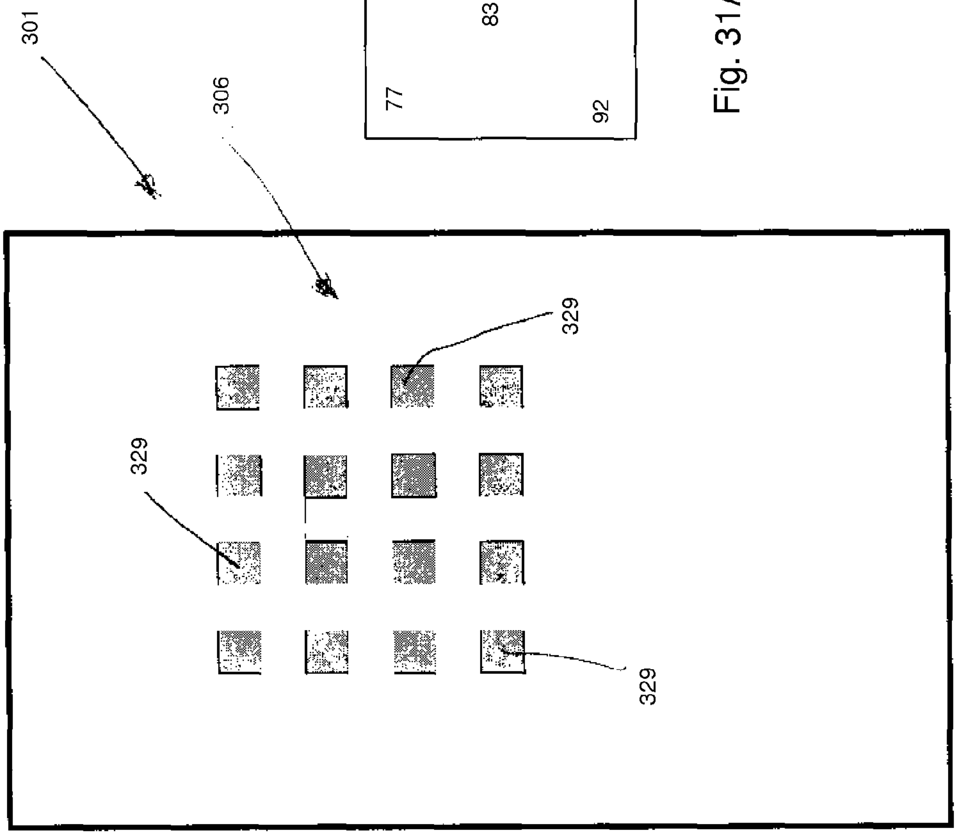

Fig. 31

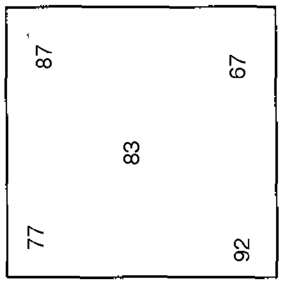

Fig. 31A

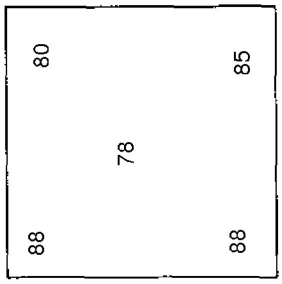

Fig. 31B

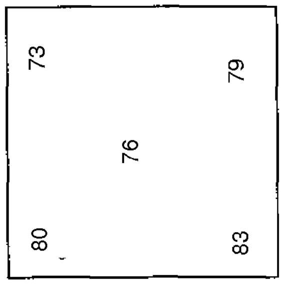

Fig. 31C

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 18 1292

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 4 822 966 A (MATSUBARA YUZURU [JP]) 18 April 1989 (1989-04-18) * abstract * * column 4, line 14 - line 46; figures 1-6 *	1-6,17 7-16,18	INV. H05B6/64
X A	US 2001/030188 A1 (WONG NANCY J [US] ET AL) 18 October 2001 (2001-10-18) * abstract * * paragraphs [0035], [0036] *	1 2-18	
A	US 5 585 027 A (YOUNG ROBERT C [US]) 17 December 1996 (1996-12-17) * the whole document *	1-18	
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