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(54) **[AUTOMATIC FRYING APPARATUS FOR BOTH DEEP AND SHALLOW FRYING]**

(76) Inventors: **Zhaoxia Xu**, Ypsilanti, MI (US); **Zheng Peng**, Ypsilanti, MI (US)

Correspondence Address:
ZHAOXIA XU
4694 SYCAMORE DR.
YPSILANTI, MI 48197 (US)

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(57) **ABSTRACT**

An automatic frying apparatus (**100**) for both deep and shallow frying. Frying apparatus (**100**) comprises a container (**102**) having an inner cylindrical wall (**102***b*) installed on the central bottom thereof, so as to emanate from the bottom to substantially the upper portion of container (**102**) for holding foods and oil, a lid (**104**) covering on top of container (**102**), a plurality of stirring blades (**108**) rotatably and removably installed inside container (**102**) for stirring foods, a power-drive assembly (**110**) operationally coupled with blades (**108**) for driving blades (**108**) through repeating stirring cycles, a coupling device (**106**) for coupling in between assembly (**110**) and blades (**108**), a venting device (**200**) for filtering and deodorizing cooking fumes, and a blowing device (**202**) for forcing fresh air into frying apparatus (**100**) for moisture removal from thereinside. Blades (**108**) sweep across food pieces intermittently, such that blades (**108**) dwell for a predetermined dwell period starting near the end of each stirring cycle. This intermittent operation favors better agitation of food pieces and affords relief from constant stirring of food pieces at a higher speed. Food pieces are partially immersed in the boiling oil, and therefore, less oil is required for frying foods, thereby, causing less energy consumption, less fat absorption by the food, less time for cooking, and less used oil for disposal. The frying process is fully automatic and requires minimal human involvement and chore.

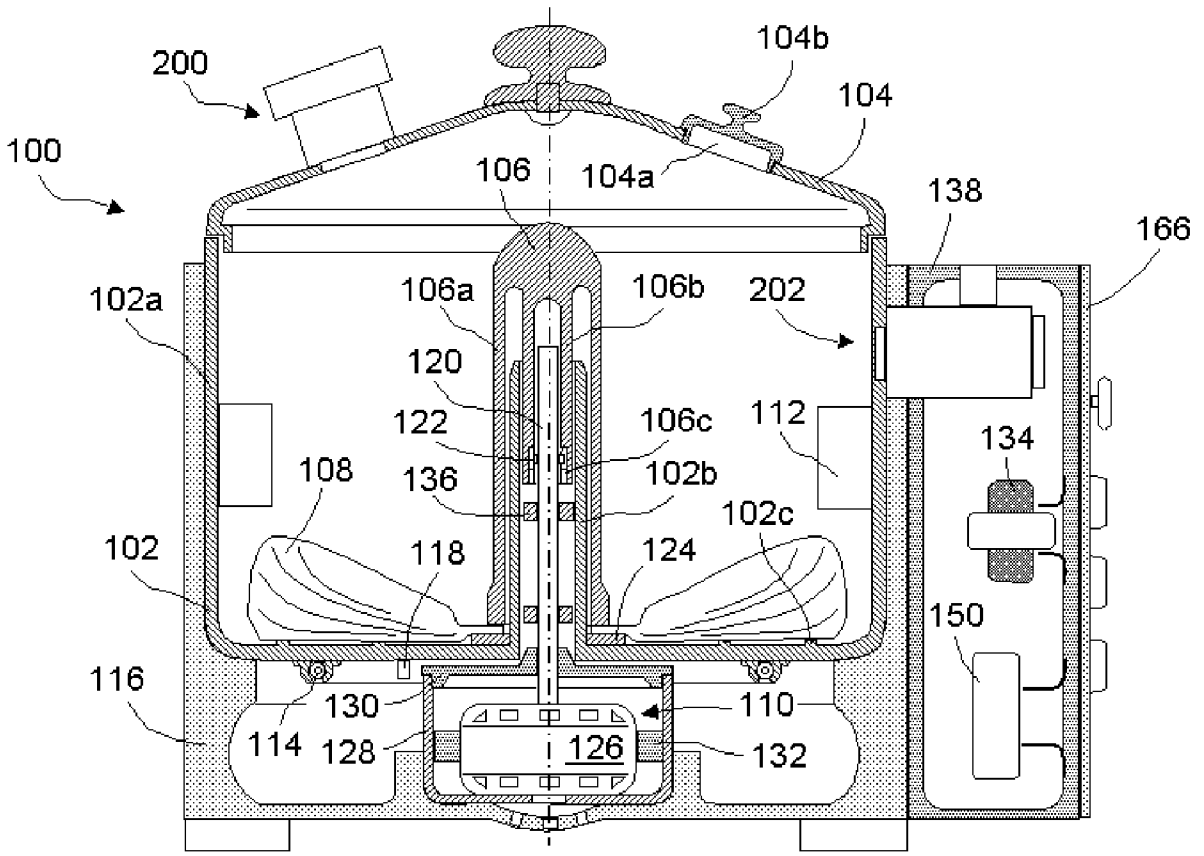
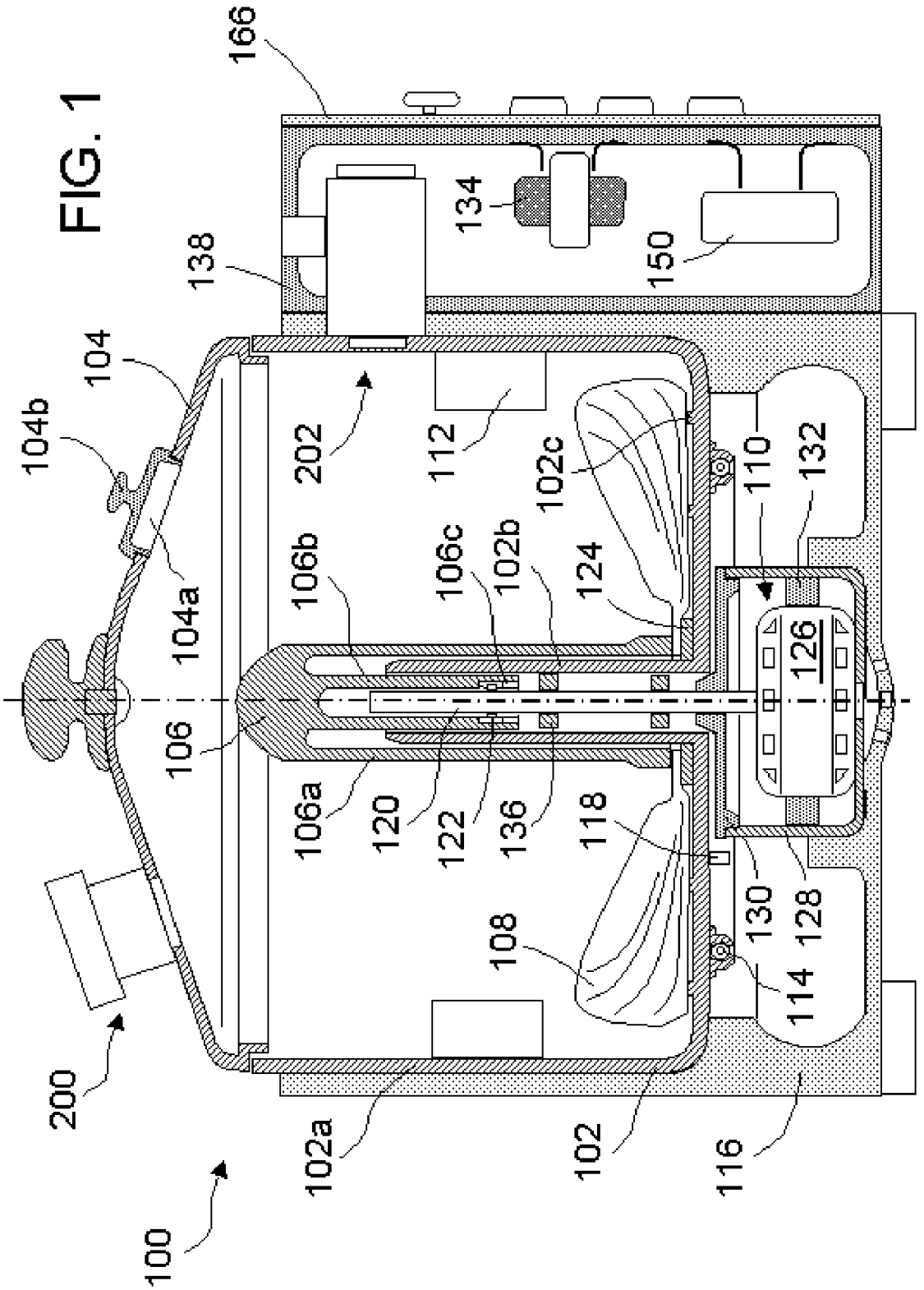


FIG. 1


166
134
150
138
104
104b
202
112
102c
110
132
106b
106c
102b
124
104a
126
106
106a
120
122
136
118
130
128
108
114
200
102a
102
116
100

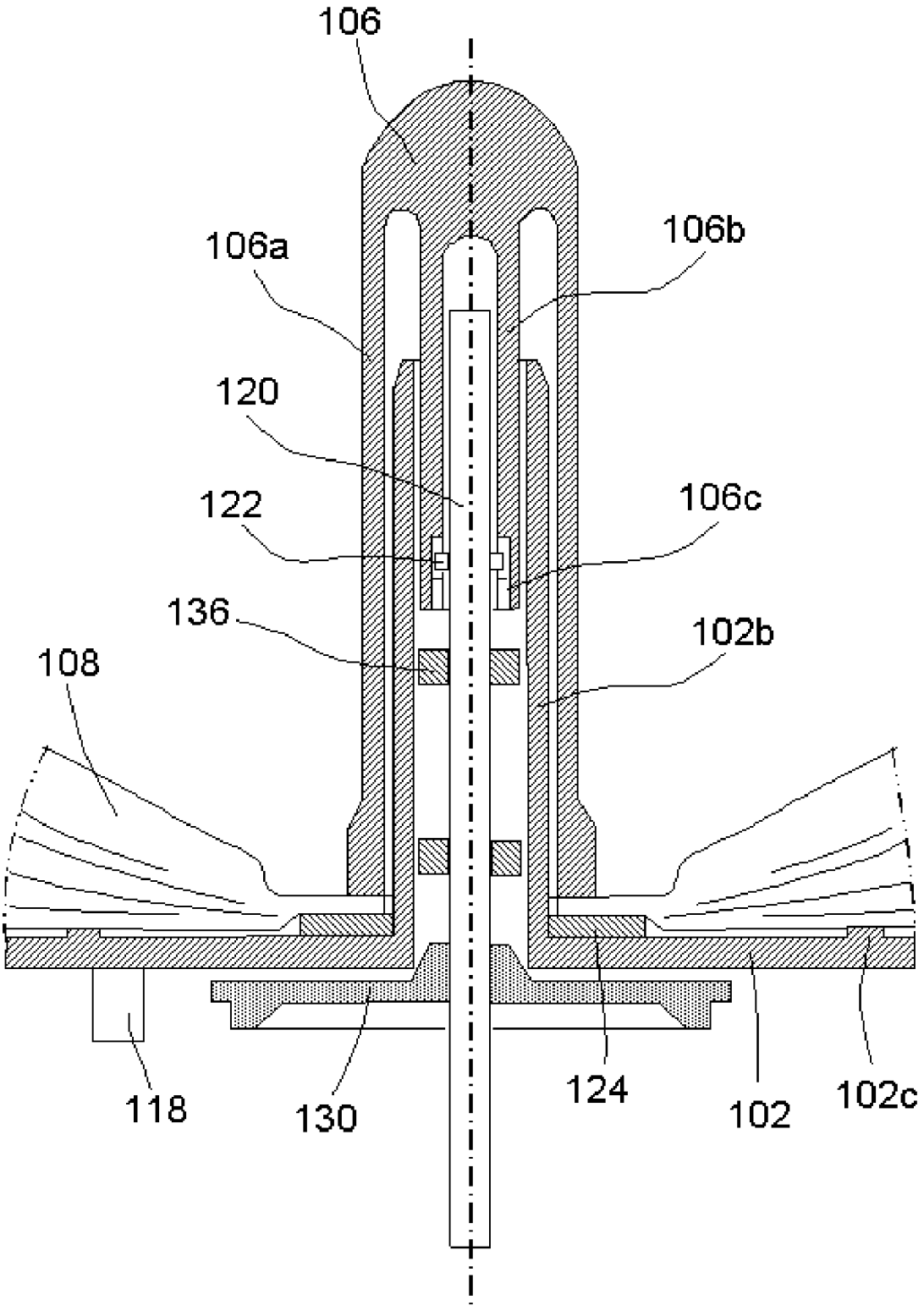


FIG. 2

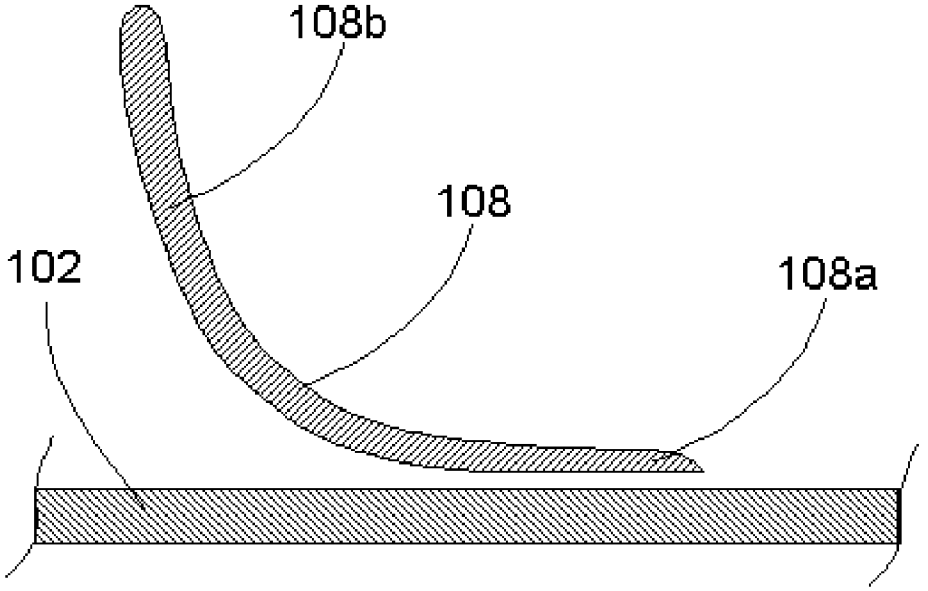


FIG. 3

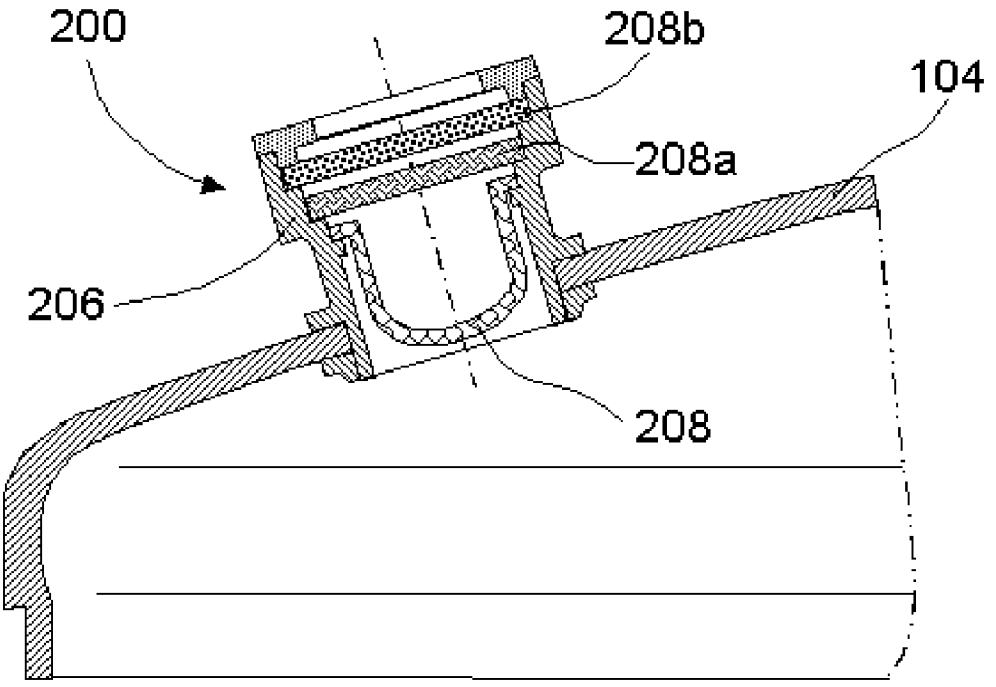


FIG. 4

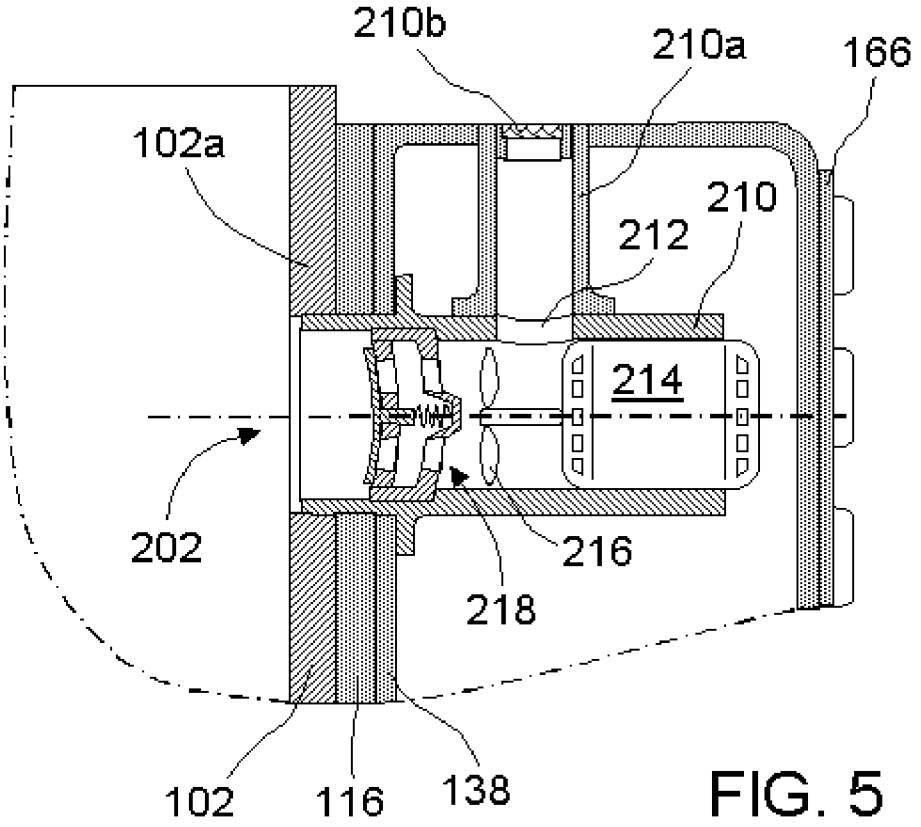

210b
210a
166
102a
210
212
214
202
216
218
102
116
138

FIG. 5

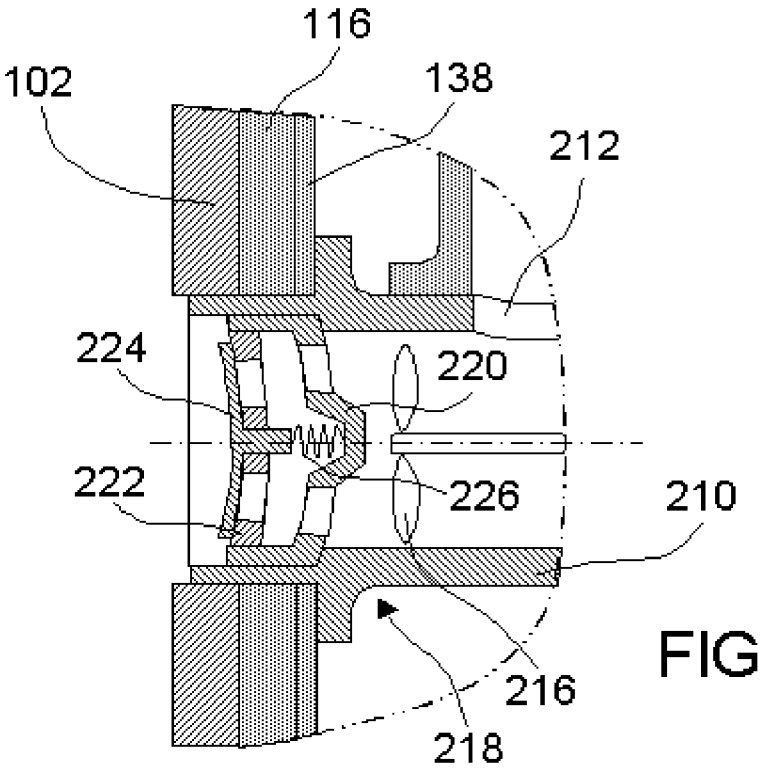

116
102
138
212
224
220
222
226
210
216
218

FIG. 6

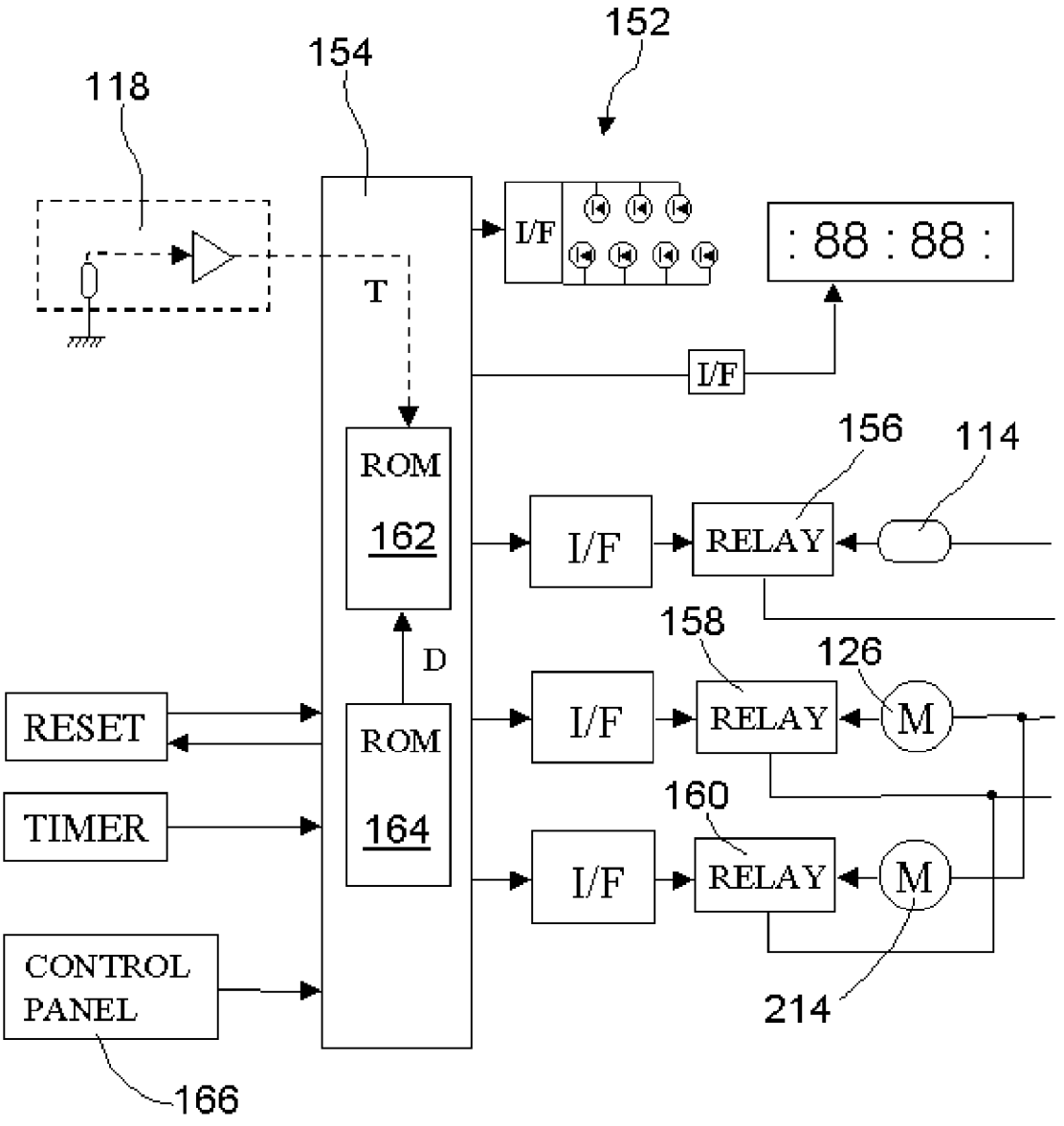

152
154
118
I/F
: 88 : 88 :
T
I/F
ROM
162
156
114
I/F
RELAY
158
126
D
RESET
ROM
I/F
RELAY
M
TIMER
164
160
I/F
RELAY
M
CONTROL
PANEL
214
166

FIG. 7

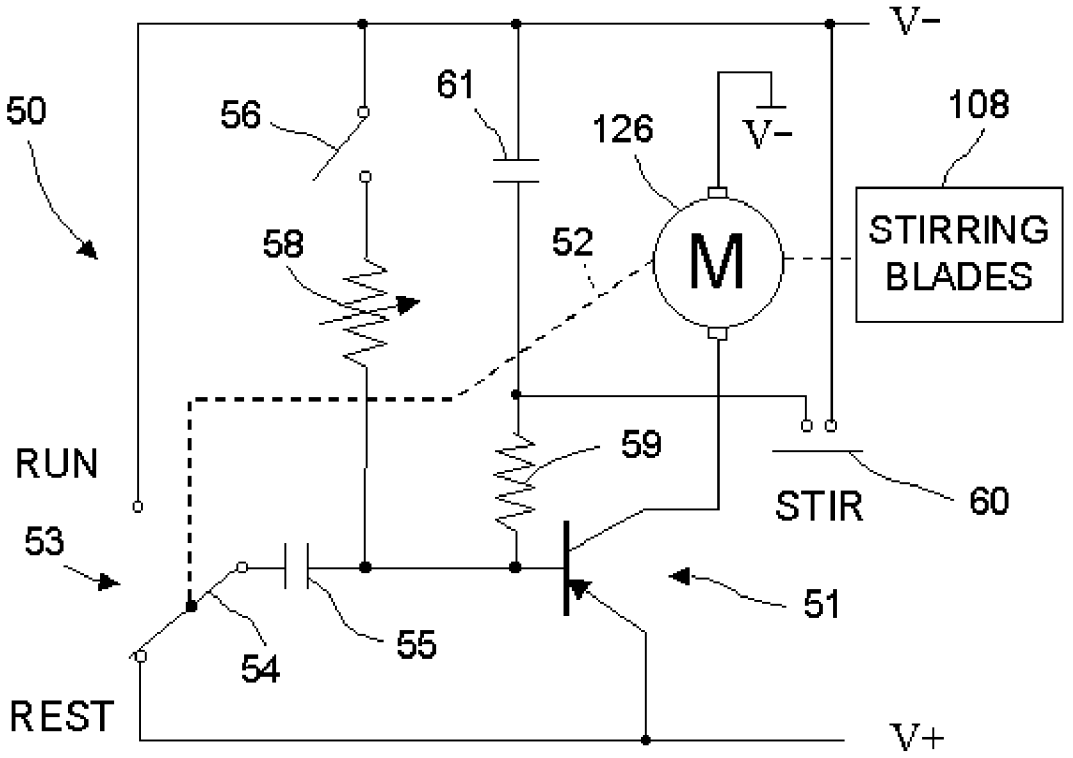

V-
50
56
61
126
V-
108
58
52
M
STIRRING BLADES
RUN
59
STIR
60
53
51
54
55
REST
V+

FIG. 8

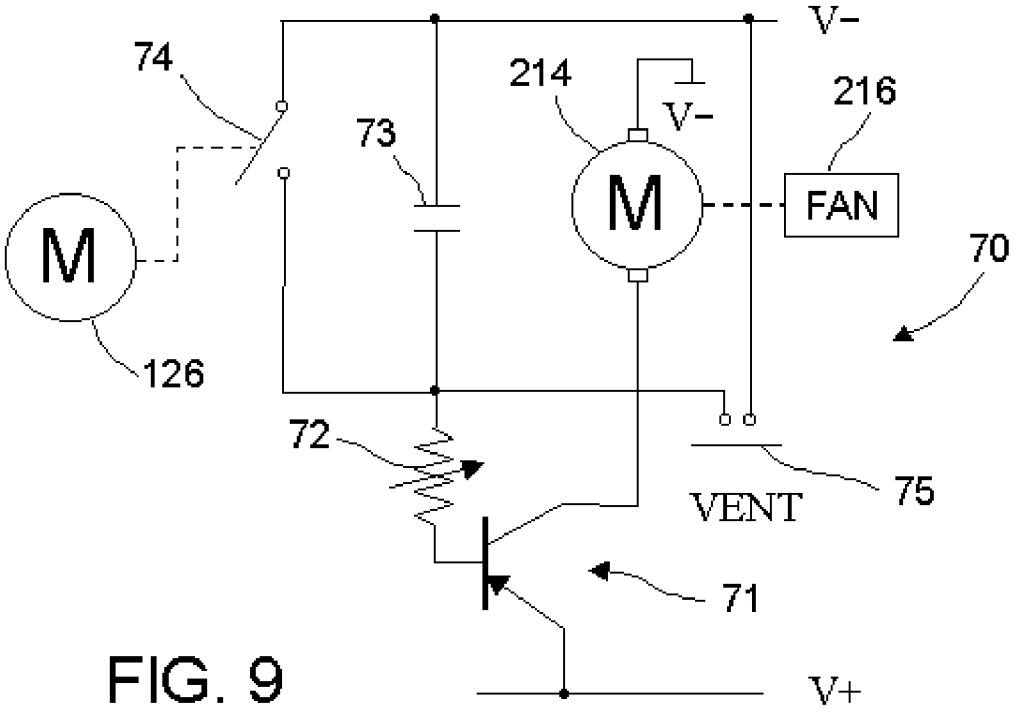

V-
74
214
V-
216
73
M
FAN
M
70
126
72
75
VENT
71
V+

FIG. 9

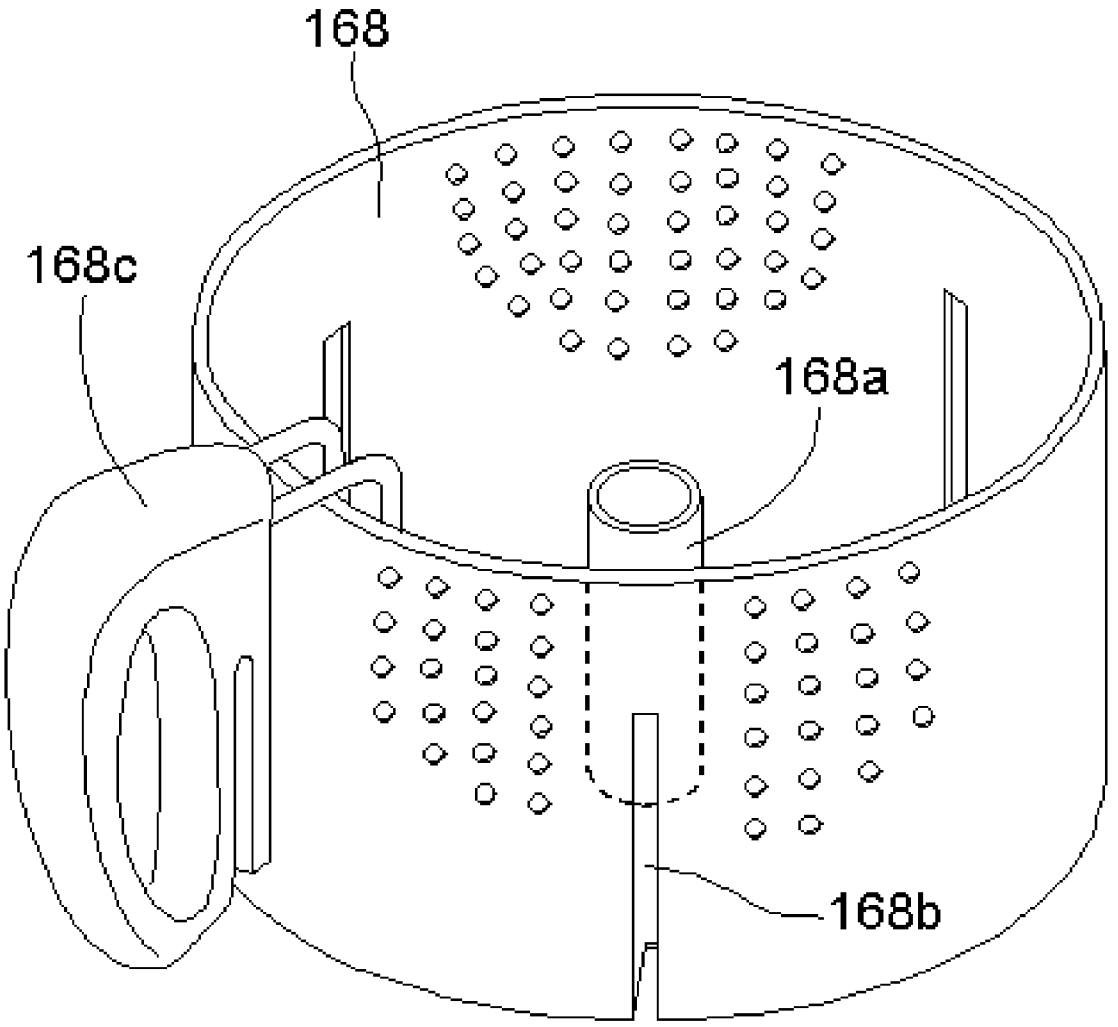


FIG. 10

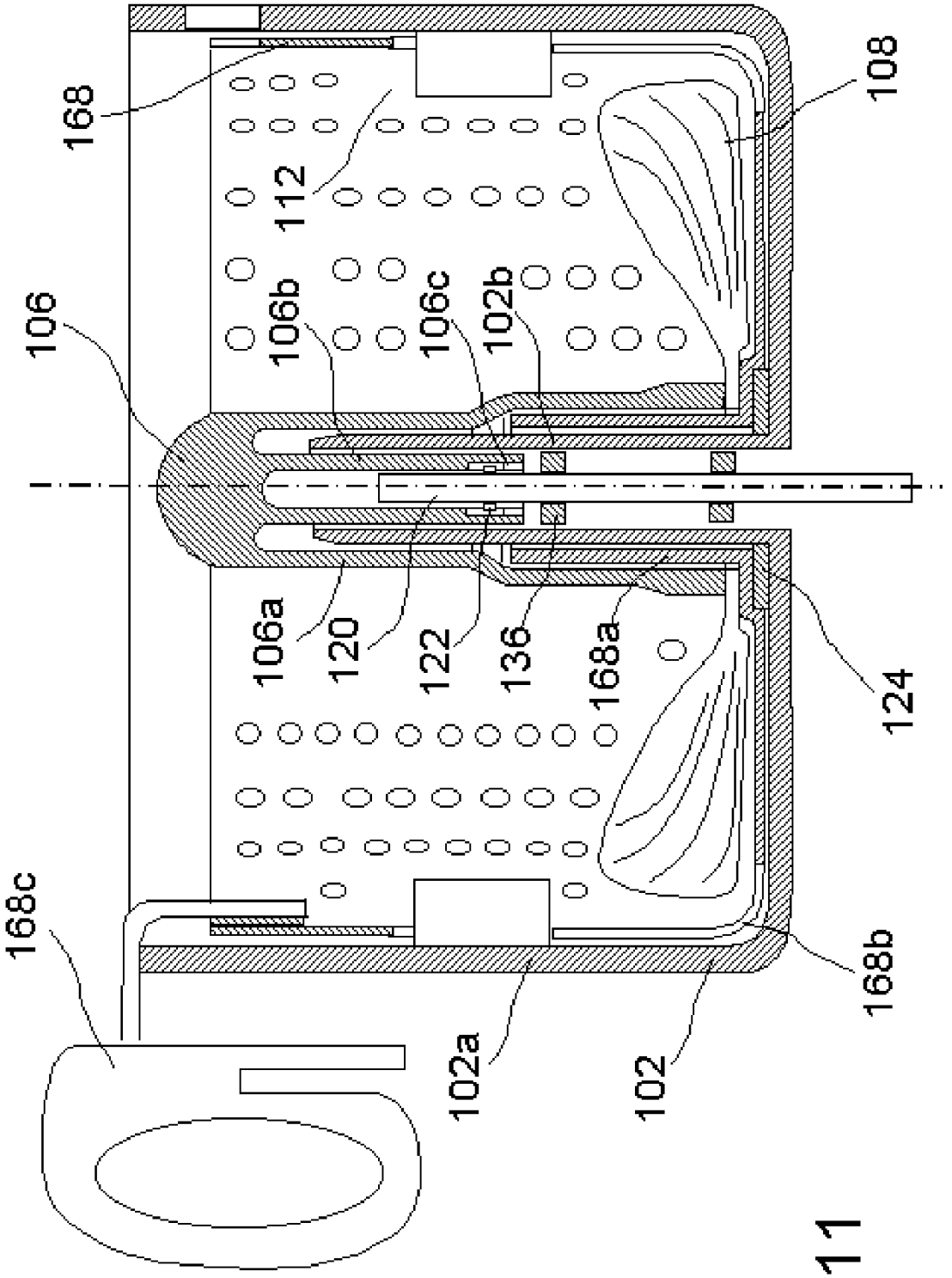

168
112
108
106
106b
106c
102b
106a
120
122
136
168a
124
168c
168b
102a
102

FIG. 11

FIG. 12

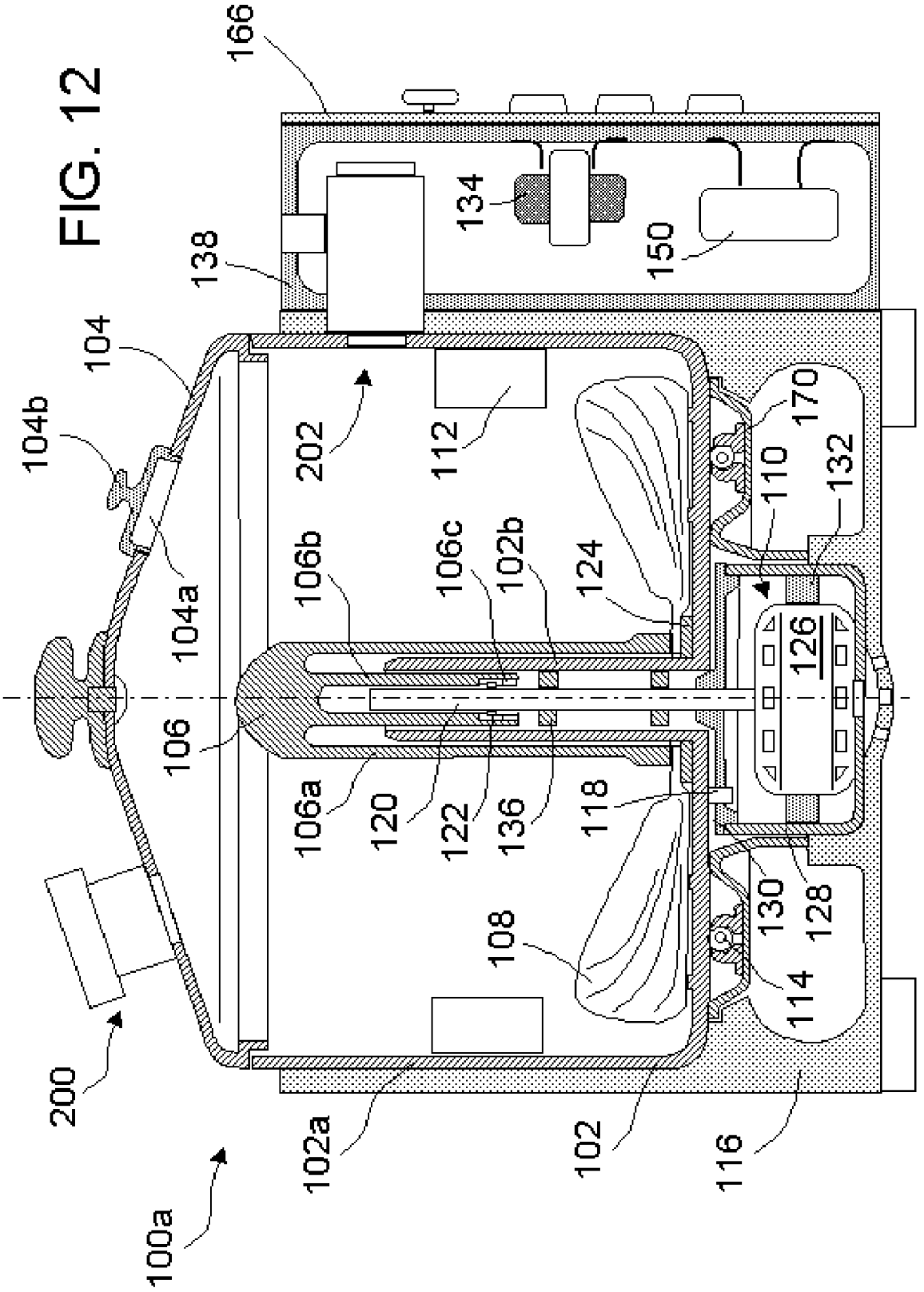

166
134
150
138
104
104b
202
112
170
110
132
104a
106b
106c
102b
124
126
106
106a
120
122
136
118
130
128
108
114
200
102a
102
116
100a

FIG. 13

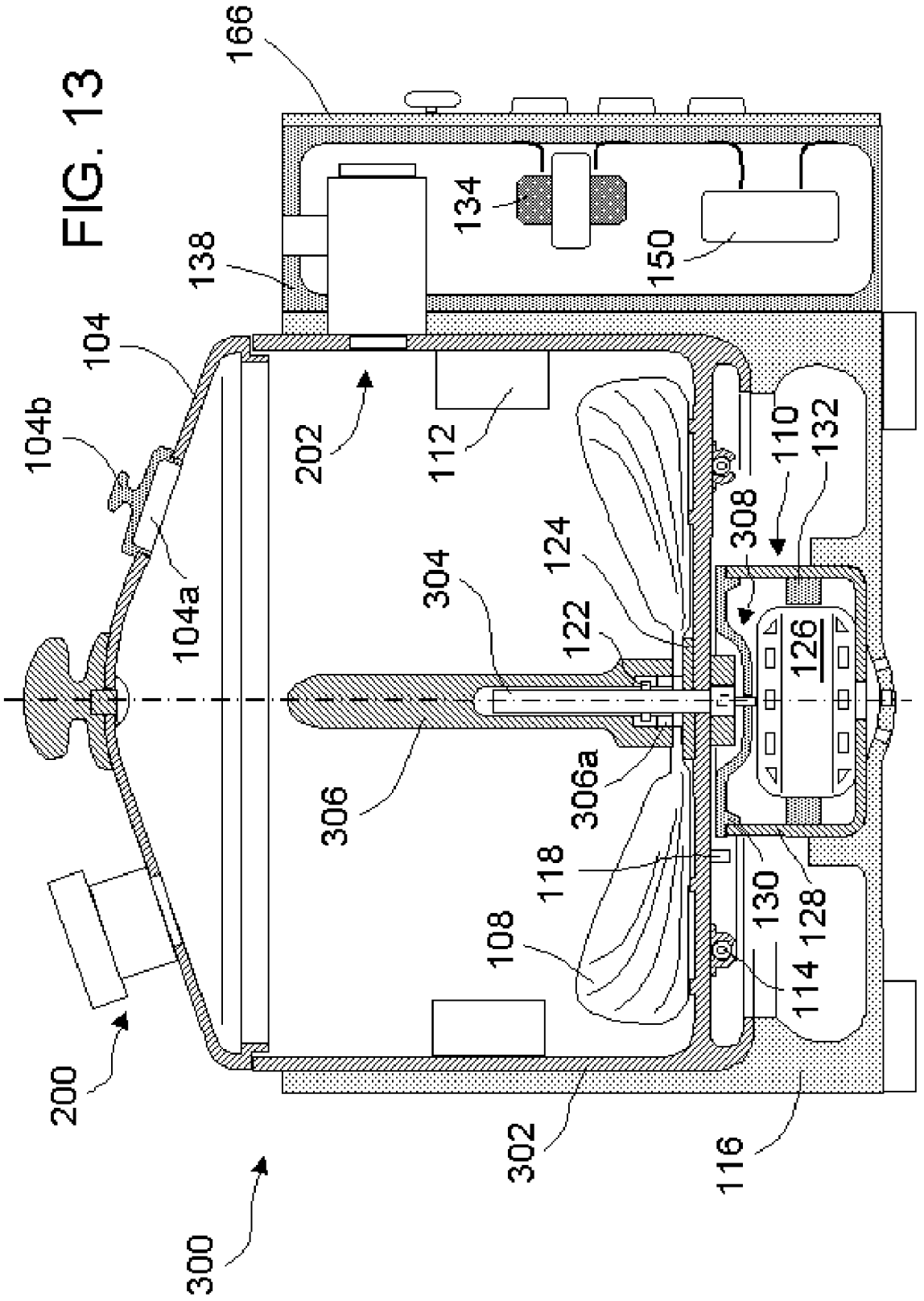

166
134
150
138
104
104b
202
112
110
132
308
124
304
104a
122
126
306
306a
118
108
130
128
114
200
302
116
300

FIG. 14

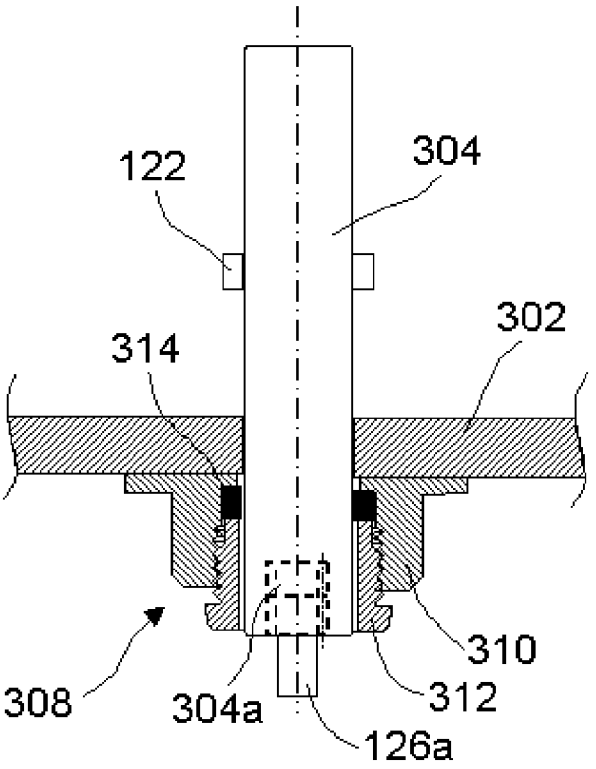

122
304
302
314
310
308
304a
312
126a

FIG. 15

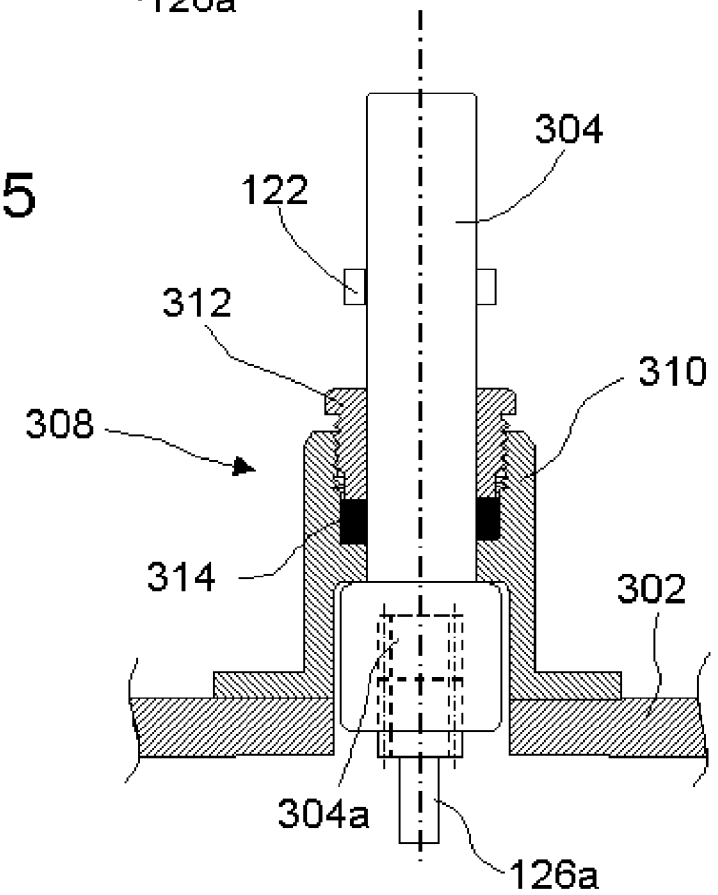
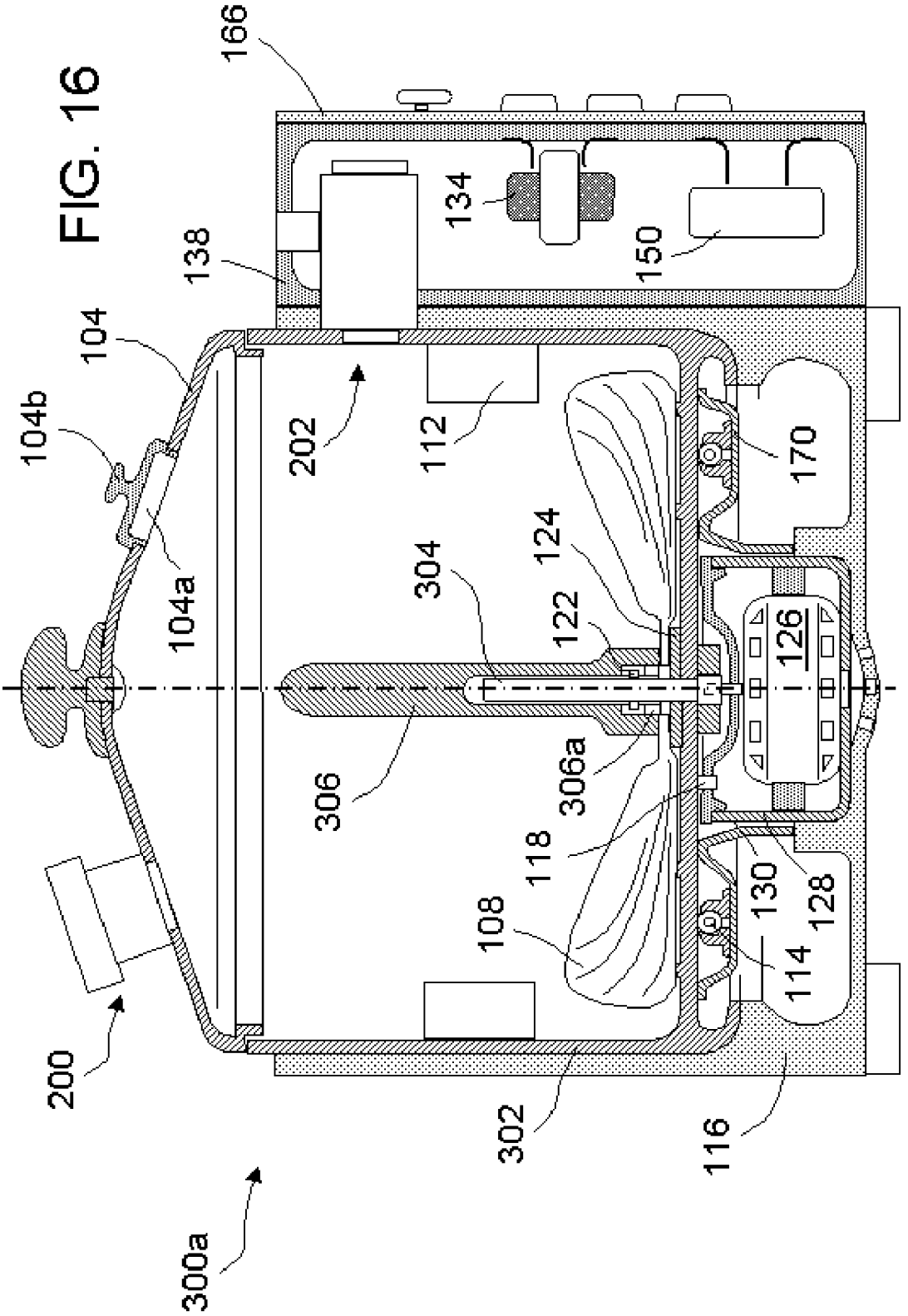

304
122
312
310
308
314
302
304a
126a

FIG. 16


166
134
150
138
104
104b
104a
202
112
170
304
124
122
126
306
306a
118
108
130
128
114
200
302
116
300a

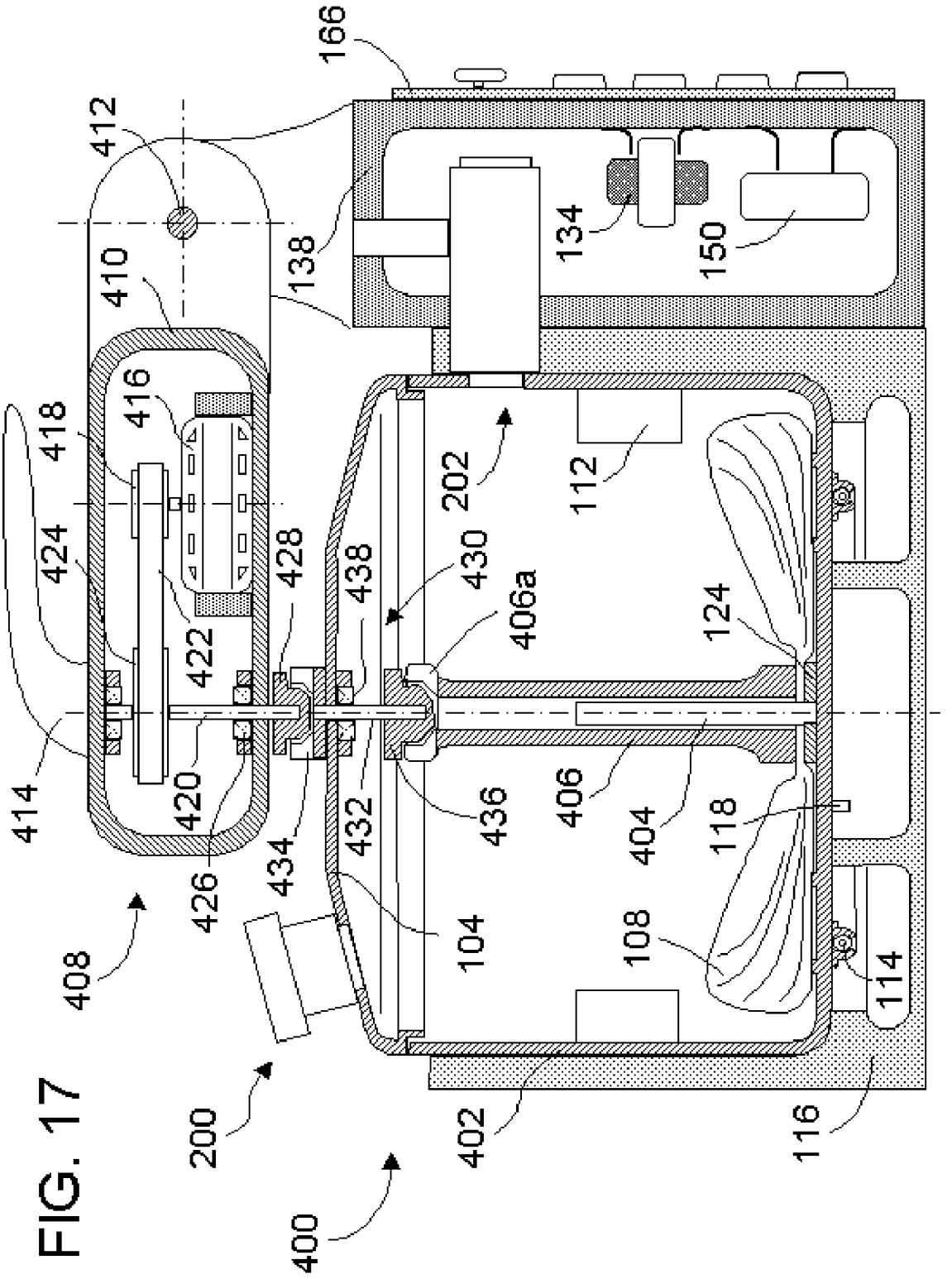

166
412
138
134
150
410
416
418
202
112
424
428
438
430
406a
124
422
420
426
434
432
436
406
404
118
414
408
104
108
114
200
402
116
400

FIG. 17

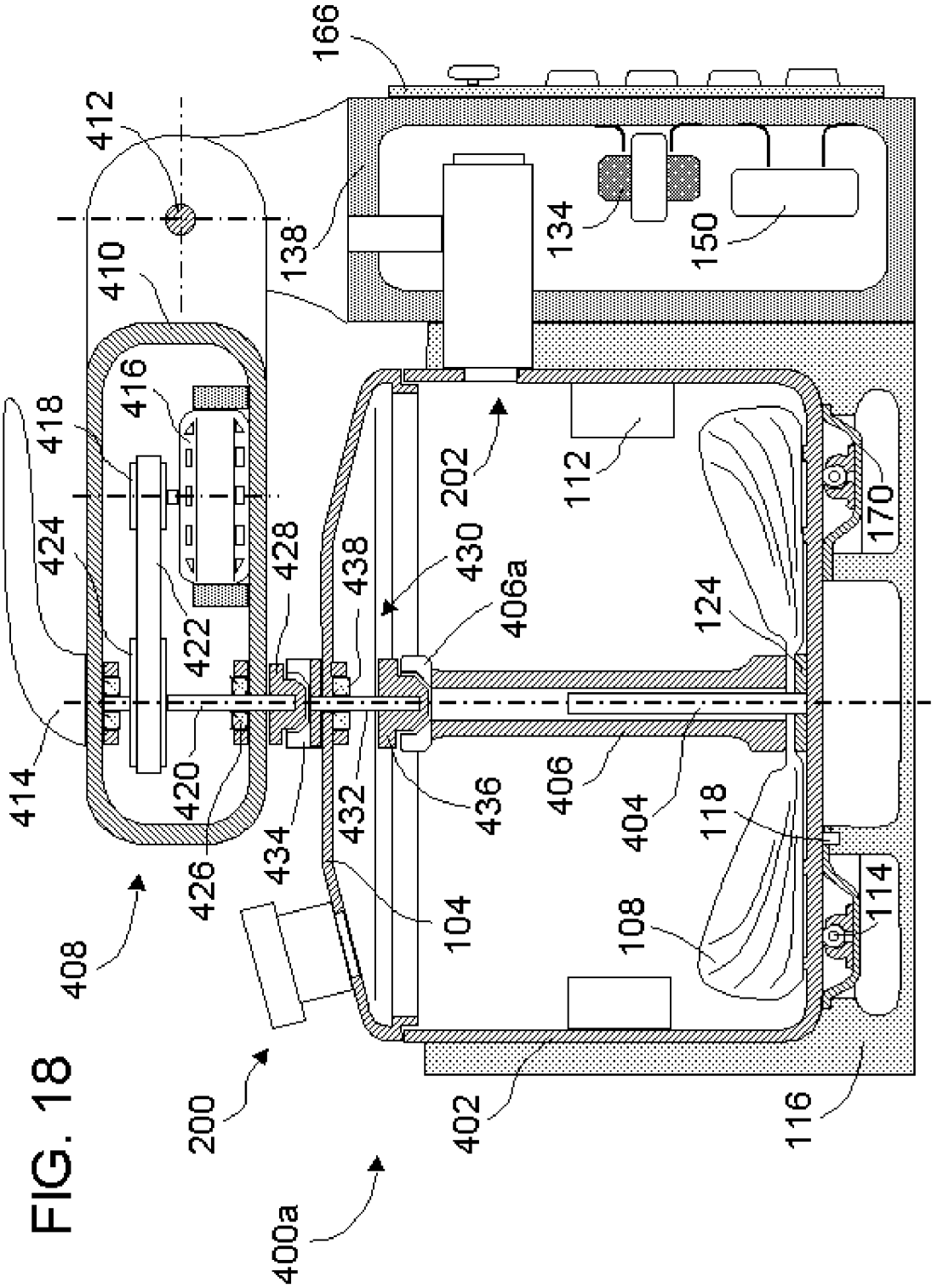

166
412
410
138
134
150
416
418
424
422
428
438
430
406a
202
112
124
170
414
420
426
434
432
436
406
404
118
104
108
114
408
200
402
116
400a

FIG. 18

[AUTOMATIC FRYING APPARATUS FOR BOTH DEEP AND SHALLOW FRYING]

BACKGROUND OF INVENTION

[0001] This invention generally relates to cooking/food processing apparatuses. More specifically, this invention relates to automatic frying apparatuses for both deep and shallow frying.

[0002] Fried foods, such as fried shrimp, fried fish, fried chicken, etc., are tasteful. Two of the most important characteristics of fried foods are: outside, golden and crispy; and inside, juicy and tender. There are some issues associated with preparing fried foods at home.

[0003] First, the contact of moisture-containing raw foods with hot oil produces grease splattering. Most times, the splattering liquids and food particles reach out of frying apparatuses to considerable distances. These will not only mess up stovetops and surrounding surfaces but also create undue oil burn injuries to the people who are preparing fried foods. The problem of grease fires in the kitchen as well as severe oil burns to people has been well documented.

[0004] Second, oil vapor is produced when oil is heated. The people who are preparing fried foods involuntarily inhale considerable amount of cooking fumes during the cooking process. Oil vapor is harmful to human health and might pose long-term health threats to the people who expose themselves to oil vapor on a very regular base.

[0005] Third, the oil vapor generated in the cooking process might easily reach much farther in the kitchen or even other rooms and deposit on the furniture, paintings, electrical appliances, etc., causing long-term hazards to home environment.

[0006] Fourth, on the other hand, there is an ever-increasing concern over the amount of oil or fat in one's diet for general public. In particular, a low fat diet is desirable in light of related health concerns. Generally, fried foods prepared using conventional methods and cooking wares contain more fat than other foods.

[0007] Many products of deep-frying apparatuses or food processing apparatuses are on the market, including the electric frying apparatus taught by U.S. Pat. No. 6,365,878, issued to Lau, on Apr. 2, 2002. These products are equipped with vertically moving baskets and generally require the food to be immersed deep in the frying oil; which means that large quantity of oil is required. The high quantity of oil needed for proper cooking also means high operating cost due to high energy consumption and longer time for cooking. The quantity of oil absorption by the food is prohibitively high, as well.

[0008] The disposal of used oil is going to be an environmental issue. Food processing businesses and restaurants might be able to afford expensive equipment for the disposal or treatment of used oil. But general public will find it difficult in dealing with large quantity of used oil.

[0009] Another issue is that the user has to repeatedly stir or turn the food around to separate the food pieces during frying, such that the food can be cooked more uniformly.

[0010] Over years, various devices have been developed to address these problems associated with frying at home.

[0011] U.S. patent application Ser. No. 10/249,240, filed by myself, on Mar. 25, 2003, teaches a forced venting fry utensil. The fry utensil comprises a container for holding foods and oil, a lid covering on top of the container, a blowing device for forcing fresh air into the fry utensil for facilitating the evaporation of food moisture, and a venting device for filtering and deodorizing cooking fumes.

[0012] The aforementioned prior art is concentrating on the issue of splattering of hot grease and food particles and cooking fume treatment. However, It fails to address the necessity of automating frying processes. Without frying process automation, especially at home, consumers have to stir the food or turn the food over in the middle of frying processes. In this case, the generation of hot oil splattering and the escape of oil vapor into the room are still inevitable.

[0013] Some patents have been granted in the area of automatic frying apparatuses.

[0014] U.S. Pat. No. 5,027,697, issued to De Longhi, on Jul. 2, 1991, teaches a rotating oblique basket fryer for cyclic immersion cooking; which facilitates the elimination of moisture in the food, accelerates the heat exchange process, and favors uniform operating temperatures.

[0015] U.S. Pat. No. 5,543,166, issued to Masel, et al., on Aug. 6, 1996, describes a cooking appliance including a drum for receiving the food articles to be cooked. The appliance is characterized in that the finished food is spun about a central axis to spin out unwanted excess of oil.

[0016] U.S. Pat. No. 5,611,265, issued to Ronci et al., on Mar. 18, 1997, describes a combination of fryer and char-broiler food cooking apparatus. The excessive oil is separated from the fried foods using centrifugal means.

[0017] U.S. Pat. No. 6,453,801, issued to Masel, et al., on Sep. 24, 2002, teaches a cooking appliance and method for cooking food articles by means of a rotary drum. The appliance is characterized in that a liquid container is selectively movable to a raised or lowered position to adjust the oil level with respect to the food articles.

[0018] The aforementioned prior arts are concentrating on automatic frying apparatuses with special emphasis on low fat frying. The low fat characteristic is mostly achieved by mechanical means, e.g., centrifugal means. This makes the prior art apparatuses less appealing because mechanical separation devices generally require a large size of the frying apparatus. The manufacturing cost is higher and consequently the higher prices the general public pays to buy these apparatuses. Another reason why these prior art apparatuses do not prevail lies on the fact that the mechanisms for achieving targeted objectives are, to some extent, too complicated, which, again, drives up the manufacturing cost. The effort spent on cleaning these apparatuses after use is another important factor. In addition, they fail to address the issue of cooking fume hazards and moisture removal from inside the frying apparatus.

[0019] Low fat frying can be, alternatively, achieved by means of how the food is processed. The key point is that the moisture content residing in the raw food, especially in the surfaces of food pieces, has to be removed as quickly as possible. The removal of the surface moisture content greatly favors less fat absorption, less time for frying, less energy consumption, and foods of great looking, taste, and texture.

[0020] U.S. patent application Ser. No. 10/249,399, filed by myself, on Apr. 5, 2003, teaches an automatic frying apparatus having a perforated rotary drum for holding and frying foods removably installed inside a container, and a forced venting system for forcing fresh air into the frying apparatus for facilitating food moisture evaporation and cooking fume treatment. The frying apparatus overcomes all the shortcomings of prior art products.

[0021] However, all the prior arts, including the one proposed by myself in U.S. patent application Ser. No. 10/249,399, have a very important drawback; they are specifically addressing the issues associated with deep-frying. These prior art products cannot be used for shallow frying, in another word, stir-frying, which is a widely used food preparing/processing method, especially in oriental cuisine. Shallow frying requires constant stirring. Therefore, grease splattering and oil vapor hazards are among the most important issues to deal with. On the other hand, shallow frying requires much more human effort, whereby automation is highly desired.

[0022] Therefore, it remains desirable to provide frying apparatuses that can be used for both deep and shallow frying, that are automatic to minimize the human involvement or chore during the frying process, that favors homogeneous heating of foods, that require minimal quantity of oil for frying foods, that can effectively and efficiently evaporate the surface moisture content of food pieces to achieve the characteristic of low fat absorption and great looking, taste, and texture of foods, that are inexpensive to manufacture and simple and easy to use, and also that are environment, people, and home friendly.

SUMMARY OF INVENTION

[0023] Accordingly, the present invention is an automatic frying apparatus for both deep and shallow frying. This frying apparatus comprises a container having an open top for holding foods and oil, a lid covering on top of the container for closing up the open top, a plurality of stirring blades rotatably and removably installed inside the container, on the central bottom, a power-drive assembly operationally coupled with these stirring blades for driving these stirring blades through repeating stirring cycles for facilitating homogeneous heating, a blowing device for forcing fresh air into the frying apparatus for facilitating evaporation of moisture content residing in the surfaces of food pieces, and a venting device for filtering and de-odorizing cooking fumes.

[0024] These stirring blades sweep across food pieces in an intermittent operation, in which they dwell for a predetermined dwell period near the end of each stirring cycle. This intermittent operation affords relief from constant stirring of food pieces at a higher speed, thereby favoring foods of great texture and looking. Food pieces are partially immersed in the boiling oil, and therefore, less oil is required for frying. Cooking fumes are treated right before leaving the frying apparatus, whereby, this fry apparatus of the present invention is people and home environment friendly.

[0025] Accordingly, the followings are some of the objects, features, and advantages of the present invention:

[0026] It is an object of the present invention to provide a frying apparatus for use to prepare tasteful fried foods for both deep and shallow frying.

[0027] It is another object of the present invention to provide a frying apparatus that is automatic in separating, stirring, and turning over food pieces for facilitating moisture evaporation and uniform heating, so as to minimize the human involvement or chore during the frying process.

[0028] It is a further more object of the present invention to provide a frying apparatus that is environment, people, and home friendly.

[0029] It is a still further more object of the present invention to provide a frying apparatus that requires minimal quantity of oil for frying foods, and consequently causes less energy consumption, less used oil for disposal, and less time for cooking.

[0030] It is a still further more object of the present invention to provide a frying apparatus that is of durable and reliable constructions, easily and efficiently manufactured and marketed, and at the same time economically available to the general public.

[0031] It is a feature of the present invention that this frying apparutus has a plurality of stirring blades rotatably and removably installed on the central bottom of the container for stirring foods. These blades sweep across food pieces in an intermittent operation, in which they dwell for a predetermined interval of time near the end of each sweeping cycle and then automatically begin another cycle of operation. This intermittent operation affords relief from constant stirring of food pieces at a higher speed, thereby favoring foods of great texture and looking.

[0032] It is another feature of the present invention that this frying apparatus has a forced venting system including a blowing device to force fresh air into the frying apparatus for facilitating moisture removal from thereinside and a venting device for removing the oil vapor content in the grease-laden air generated during the frying process before the air is exhausted into the room.

[0033] It is a further more feature of the present invention that the food to be fried is partially immersed in the boiling oil, thereby reducing the requirement on the quantity of oil for proper frying, and consequently this frying apparatus of the present invention consumes less energy and takes less time for cooking.

[0034] It is a still further more feature of the present invention that this frying apparatus fries foods in a programmed automatic manner; therefore, minimal human involvement or chore is rendered.

[0035] It is an advantage of the present invention that this frying apparatus is virtually hand-free for frying foods and can be used for both deep and shallow frying.

[0036] It is another advantage of the present invention that this frying apparatus is environment, people, and home friendly.

[0037] It is a further more advantage of the present invention that this frying apparatus is easy to operate, cheap to manufacture, and providing large value to businesses and general public.

[0038] Further more features and advantages of the present invention will be readily appreciated, as the same

becomes better understood after reading the subsequent description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0039] **FIG. 1** illustrates a cross-sectional view of an embodiment of the present invention, a frying apparatus **100**.

[0040] **FIG. 2** illustrates an exploded cross-sectional view of coupling device **106**.

[0041] **FIG. 3** illustrates an exploded cross-sectional view of blades **108**.

[0042] **FIG. 4** illustrates an exploded cross-sectional view of venting device **200**.

[0043] **FIG. 5** illustrates an exploded cross-sectional view of blowing device **202**.

[0044] **FIG. 6** illustrates an exploded cross-sectional view of one-way valve **218** of **FIG. 5**.

[0045] **FIG. 7** illustrates a blocked diagram of control circuit **152** for frying apparatus **100**.

[0046] **FIG. 8** illustrates a schematic diagram of control circuit **50** for providing the intermittent operation of blade sweeping for frying apparatus **100**.

[0047] **FIG. 9** illustrates a schematic diagram of control circuit **70** for providing the intermittent venting operation for frying apparatus **100**.

[0048] **FIG. 10** illustrates a perspective view of perforated basket **168** for use with frying apparatus **100**.

[0049] **FIG. 11** illustrates a cross-sectional view of basket **168** in an operation position.

[0050] **FIG. 12** illustrates an alternative design of frying apparatus **100** of **FIG. 1**, a frying apparatus **100***a*.

[0051] **FIG. 13** illustrates a cross-sectional view of another embodiment of the present invention, a frying apparatus **300**.

[0052] **FIG. 14** illustrates an exploded cross-sectional view of seal assembly **308** of **FIG. 13**.

[0053] **FIG. 15** illustrates an exploded cross-sectional view of an alternative design of seal assembly **308** of **FIG. 14**.

[0054] **FIG. 16** illustrates an alternative design of frying apparatus **300** of **FIG. 13**, a frying apparatus **300***a*.

[0055] **FIG. 17** illustrates a cross-sectional view of a further more embodiment of the present invention, a frying apparatus **400**.

[0056] **FIG. 18** illustrates an alternative design of frying apparatus **400** of **FIG. 17**, a frying apparatus **400***a*.

DETAILED DESCRIPTION

[0057] Reference is made to **FIG. 1**, which illustrates a cross-sectional view of an embodiment of the present invention, a frying apparatus **100**. Frying apparatus **100** comprises a container **102**, a lid **104**, a coupling device **106**, a plurality of stirring blades, generally designated as **108**, a power-drive assembly **110**, a venting device **200**, and a blowing device **202**.

[0058] Container **102**, having an open top, an outer wall **102***a*, and an upstanding inner cylindrical wall **102***b*, is provided for holding foods and oil. Cylindrical wall **102***b* is installed on the central bottom of container **102**, so as to emanate from the bottom thereof upward to substantially the open top, forming a central aperture therein. Container **102** is, preferably, coated with a non-stick material.

[0059] A plurality of co-rotation preventing blades, generally designated as **112**, is installed inside container **102**, on outer wall **102***a*, for preventing the food from co-rotating with stirring blades **108**, as blades **108** rotate. Blades **112**, disposed on positions slightly higher than blades **108**, generally extend vertically. The size of blades **112** can be substantially different based on specific designs of container **102**.

[0060] A heating element **114**, installed on the outside surface of the bottom of container **102**, is provided for heating foods and oil disposed inside container **102**. Heating element **114** is in a heat-transferable condition, e.g., in physical contact, with the bottom of container **102**, such that when heating element **114** heats up upon connection with an electricity source, foods and oil therein will also heat up. Heating element **114** can be electrical resistance type heaters or many other types, such as high-intensity infrared lamps, as known to those skilled in the art and suggested by this invention disclosure.

[0061] A container support **116**, installed on the bottom and side of container **102**, is provided for furnishing a bottom support for container **102**, such that frying apparatus **100** can stand on a flat surface, e.g., a kitchen counter top. Another function of support **116** is insulating the bottom of container **102**. The sidewall of support **116** can extend upward, covering substantially large area of outer wall **102***a* of container **102** for minimizing heating energy loss. In this case, support **116** serves as an outer housing.

[0062] A temperature sensor **118** is provided for measuring the temperature of the frying oil, as an input variable to be controlled. Sensor **118** is installed at an appropriate position on the bottom of container **102**, or any other suitable positions. When the temperature of the frying oil is above the user's desired one, the electrical power to heating element **114** will be shut down to better meet the user's desired frying requirement and to save energy.

[0063] Lid **104** is provided for covering on top of container **102** for closing up the open top thereof. Lid **104** can be made of a transparent material, or a metal material but has an observation window (not shown), made of a transparent material, for observing the frying process by the user.

[0064] An opening **104***a* is provided on lid **104**, disposed at a suitable location, for adding ingredients to the food inside container **102** by the user in the middle of frying processes. A cap **104***b* is provided for covering up opening **104***a*.

[0065] **FIG. 2** illustrates an exploded cross-sectional view of coupling device **106**. Coupling device **106**, having an outer cylindrical wall **106***a* and an inner cylindrical wall **106***b*, is provided for coupling a main shaft **120** from

power-drive assembly **110** and stirring blades **108** for transferring rotation power. Walls **106***a* and **106***b* are substantially co-axial to cylindrical wall **102***b* of container **102** and are fixedly connected together on the upper portion thereof. The lower portion of wall **106***a* is engaged with blades **108**. The lower portion of wall **106***b* has a cross-channel coupling element **106***c*, or other types of coupling elements, which lockably receives main shaft **120** and a main shaft pin **122**. Pin **122** is mounted on the upper portion of main shaft **120**, running across a diameter thereon for coupling main shaft **120** and coupling element **106***c*. In operation, wall **106***a* is routed over wall **102***b* and wall **102***b* is routed over wall **106***b*. The upper portion of main shaft **120** threads inside wall **106***b*. Minimal clearance is desired among these walls for ideal performance.

[**0066**] Blades **108**, rotatably and removably installed inside container **102** on the central bottom thereof, are provided for stirring foods. There is a central aperture on blades **108** to permit threading over cylindrical wall **102***b*.

[**0067**] A stirring blade spacer **124**, fixedly installed on the central bottom of container **102** around the bottom portion of wall **102***b*, is provided for supporting blades **108**.

[**0068**] **FIG. 3** illustrates a cross-sectional view of blades **108** in relation to the bottom of container **102**. The cross-section generally forms a plow-like configuration. The front portion thereof, generally designated as **108***a*, is close to the bottom of container **102** with a small predetermined clearance for better scooping up food pieces. The rear portion thereof, generally designated as **108***b*, extending gradually upward, serves for lifting up/turning over food pieces. The clearance between front portion **108***a* and the bottom of container **102** is minimized for ideal performance.

[**0069**] However, when the clearance is small, it is inevitable that blades **108** will scrape on the bottom of container **102**, causing worn-out of blades **108** and energy loss due to friction of large area. To deal with this dilemma, a plurality of circular protrusions, generally designated as **102***c*, fixedly installed on the bottom of container **102**, is proposed in this invention disclosure. Reference is made to **FIGS. 1 and 2** for the configuration of protrusions **102***c*. Protrusions **102***c* provide further support to blades **108**, in addition to spacer **124**, which is more clearly shown in **FIG. 2**. A predetermined small width of protrusions **102***c* is desired for providing adequate support and, at the same time, minimizing friction. In the case for a container coated with a non-stick material, the top surface of protrusions **102***c* is, preferably, not coated. Local areas on blades **108**, which are in the vicinity of protrusions **102***c*, can have a different material for durability consideration. The height of protrusions **102***c* is, preferably, small, e.g., less than 1 mm, for ideal performance of blades **108** in scooping up food pieces and avoiding sticking. Protrusions **102***c* can readily have many other configurations, or pattens.

[**0070**] The speed, at which blades **108** sweep across food pieces, is important. For too low speeds, blades **108** cannot scoop up food pieces and therefore food pieces cannot be agitated adequately to achieve the desired effect of homogeneous heating and the evaporation of food moisture. Corotation of food pieces with blades **108**, as blades **108** rotate, is going to be a big issue. Therefore, a higher speed is desirable for good performance. But, on the other hand, for continuous operation of blade sweeping, when the speed is high, food pieces are agitated too much, for too long time, such that the crispy surfaces of food pieces are damaged, which, in turns, causes frying oil to be wasted due to too many tiny food particles in the oil. In addition, the worn-out of blades **108** and energy loss due to friction between blades **108** and the bottom of container **102** are going to be serious problems.

[**0071**] To solve this dilemma, an intermittent operation of blade sweeping is proposed in this invention disclosure. In this intermittent operation, blades **108** dwell for a predetermined interval of time after one or two rounds of sweeping, referred as one stirring cycle, and then automatically begin another cycle of operation. This intermittent operation affords relief from constant stirring of food pieces at a higher speed, prolongs the life of blades **108** and power-drive assembly **110**, and saves some energy required for driving blades **108**, as compared with the continuous operation. This intermittent operation also favors foods of great texture because during the dwell period, the food pieces have adequate time to form crispy surfaces; which, in turns, favors foods of great looking. A computer control method and an electronic control circuit for achieving this intermittent operation are going to be disclosed later on, when the control portion of frying apparatus **100** is discussed.

[**0072**] Reference is, again, made to **FIG. 1**. Power-drive assembly **110** includes a drive motor **126** and main shaft **120**.

[**0073**] A motor housing **128**, having an open top, is provided for housing motor **126**. Motor housing **128** is installed on the central bottom of support **116**. A cap **130** is provided for covering on top of motor housing **128** for closing up the open top thereof. There is a central aperture on cap **130** for permitting main shaft **120** to thread therethrough.

[**0074**] Motor **126** is installed inside motor housing **128** through a bracket **132** and is operationally connected to a DC adapter **134**.

[**0075**] Main shaft **120** is operationally coupled with motor **126**, directly for a low-speed motor or via some gears or belt-pulley devices for a high-speed motor. Main shaft **120** is substantially co-axial to cylindrical wall **102***b* and threads therein, so as to emanate from the bottom of container **102** to substantially the upper portion of wall **102***b*.

[**0076**] Reference is made to **FIG. 2**, again. On the upper portion of main shaft **120**, coupling pin **122** is provided for the engagement with coupling element **106***c* of coupling device **106**. Pin **122** has a predetermined length so as to conveniently slide in the opening on the lower portion of cylindrical wall **106***b* for removably locking on coupling element **106***c*.

[**0077**] A plurality of main shaft supporting elements, generally designated as **136**, installed on the upper portion of main shaft **120**, is provided for further supporting main shaft **120**, against cylindrical wall **102***b*. Elements **136** have a ring-like configuration and are slidably threaded inside cylindrical wall **102***b*, together with main shaft **120**. The clearance between elements **136** and cylindrical wall **102***b* is minimized for ideal performance. Bearings are ideal options for elements **136** for minimizing power loss due to friction.

[0078] Reference is, now, made to **FIG. 4** and **FIG. 5**, which illustrate an embodiment of a forced venting system including a venting device **200** and a blowing device **202** of **FIG. 1**.

[0079] Venting device **200** includes a venting conduit **206** and a venting filter **208**. The first end of venting conduit **206** is mounted on lid **104**. There is an opening on lid **104** inline with venting conduit **206** for allowing cooking fumes to be forced out therethrough. Venting conduit **206** also serves as a bracket for holding venting filter **208**. Venting filter **208** is removably engaged with the second end of venting conduit **206**. Venting filter **208** further includes a disposable paper filter **208***a* and/or a disposable activated charcoal filter **208***b*, together, as an integrated filter.

[0080] Venting filter **208** is provided to trap the grease impurities in the grease-laden air forced out from inside frying apparatus **100**. Venting filter **208** is, preferably, made of one or multiple layers of metal meshes, such as aluminum ones. Metal meshes have different sizes of meshes and overlap each other. When cooking fumes pass therethrough, the oil particles will be trapped thereon. Filters **208***a* and **208***b* are provided to further remove the remaining oil vapor and chemical contents in the cooking fumes and for removing the cooking fume odors before the air is exhausted into the room.

[0081] Blowing device **202** includes an in-take conduit **210**, a blowing motor **214**, a fan **216**, and a one-way valve **218**.

[0082] The first end of in-take conduit **210** is mounted on the upper portion of container **102**. There is an opening on the sidewall of container **102** inline with in-take conduit **210** for allowing fresh air to be forced into frying apparatus **100**. There is an aperture **212** on in-take conduit **210**. Aperture **212** functions as an air inlet. An inlet conduit **210***a* extends from aperture **212** to the outside space, such that fresh air from outside atmosphere can be readily drawn into frying apparatus **100**. A filter **210***b*, made from metal meshes, is provided for preventing some large particles from being drawn therein. In-take conduit **210** also serves as a bracket for holding motor **214** in position. Motor **214** is removably coupled with the second end of in-take conduit **210**. Fan **216** is connected to motor **214** on the shaft and inserted inside in-take conduit **210**. Motor **214** is operationally connected to adapter **134**, which is shown in **FIG. 1**.

[0083] As shown in **FIG. 6**, which illustrates an exploded cross-sectional view of one-way valve **218** of **FIG. 5**. Valve **218** includes a valve housing **220**, a valve body **222**, a covering piece **224**, and a biasing spring **226**. Valve housing **220** is engaged with the first end of in-take conduit **210**. There are apertures on valve housing **220** for allowing air to pass therethrough. Valve body **222** is engaged with the open end of valve housing **220**. There are apertures on valve body **222** for allowing air to pass therethrough. Covering piece **224** covers on valve body **222** for closing and opening valve **218**. There is a central protrusion on covering piece **224**. The central protrusion is slidably inserted into a central aperture on valve body **222**, such that the protrusion can slide along the central aperture for a predetermined distance. Spring **226** is attached between the protruding end of the protrusion and valve housing **220**, such that spring **226** is biased in slight tension, thereby, pulling covering piece **224** toward/against valve body **222** for closing up valve **218**.

[0084] When blowing device **202** is in working condition, the air pressure generated by fan **216** forces covering piece **224** to slide away from valve body **222**, such that valve **218** is in opening state for allowing air to pass therethrough. Valve **218** is provided for preventing cooking fumes inside frying apparatus **100** from escaping through blowing device **202** while blowing device **202** is temporarily not in working condition.

[0085] Those skilled in the art will appreciate in view of this invention disclosure that many other suitable valve designs are readily applicable for this application of the present invention.

[0086] Venting device **200** and blowing device **202** can be alternatively installed on frying apparatus **100** at many other positions. For example, venting device **200** can be alternatively installed on the upper portion of container **102** and blowing device **202** can be alternatively mounted on lid **104**. These variations are, therefore, covered by this invention disclosure.

[0087] Venting device **200** is provided for cooking fume treatment. Compared with prior art products, which allow cooking fumes to escape freely, this centralized venting system design vents cooking fumes in a controlled manner, such that heating energy is better preserved for a more efficient frying apparatus.

[0088] Blowing device **202** is provided for forcing moisture content out of frying apparatus **100**, especially at the early stage of a frying process, such that frying apparatus **100** can fry foods of great taste, great texture, and great looking. This also favors less cooking time and, as a result, less energy consumption. However, there is some heating energy loss associated with using blowing device **202**. Therefore, the use of blowing device **202** should be in a controlled manner.

[0089] Stronger blowing favors better inside airflow for better facilitating moisture removal. However, Continuously strong blowing will cause excessive heating energy loss. To solve this dilemma, an intermittent venting operation is proposed in this invention disclosure. In this intermittent venting operation, fan **216** dwells for a predetermined interval of time near the end of a blowing cycle, e.g., of 10 seconds, and then automatically begins another cycle of operation. An electronic control circuit for achieving this intermittent operation is going to be disclosed later on, when the control portion of frying apparatus **100** is discussed.

[0090] Immediately after the frying is satisfactorily accomplished, the food is still sizzling hot and there is still residual cooking fume residing inside frying apparatus **100**. Blowing device **202** can be used to bring in fresh air to cool the food down to a predetermined temperature and, at the same time, to purge the residual cooking fumes out through venting device **200**. This process greatly favors safety of food handling, home environment protection, and foods of great texture and looking.

[0091] The above-discussed forced venting system is good for both deep and shallow frying. For deep-frying it facilitates the evaporation for food surface moisture. For shallow frying, especially for frying vegetables, it favors foods of great looking. It is a well-known fact that when fried using a conventional frying pan with the lid covering on top thereof, green vegetables tend to become yellowish.

[0092] Reference is made to **FIG. 1**, again. A control housing **138** is provided for housing a control module **150**. Control housing **138** is installed on the sidewall of container **102**.

[0093] Control module **150**, installed inside housing **138**, is provided for controlling various functions of frying apparatus **100**, such as the oil temperature for frying foods, motor speeds for rotating blades **108**, and the speed at which blowing motor **214** is rotating.

[0094] Control module **150** includes a control circuit **152**, as the blocked construction diagram shown in **FIG. 7**. Circuit **152** comprises a microcomputer **154**, which controls various functions of frying apparatus **100**, a relay **156**, which activates heating element **114**, a relay **158**, which activates motor **126**, and a relay **160**, which activates motor **214**.

[0095] Microcomputer **154** is provided with ROM and RAM for data memory, and further provided with I/O ports A/D converters as interfaces. The aforementioned ROM's comprises a ROM **162** containing control programs related to the performance of all frying processes and a ROM **164**, which memorizes referenced data.

[0096] Temperature sensor **118** is provided for measuring the oil temperature, which is taken by microcomputer **154**, as an input variable to be controlled. When the temperature of the frying oil is above the user's desired one, the electrical power to heating element **114** will be shut down by relay **156** to better meet the user's desired frying requirement and to save energy.

[0097] Computer **154** can be such programmed that relay **158** activates motor **126** intermittently with a bias toward a longer dwell after each stirring cycle of one or two rounds of rotation. In the same manner, an intermittent venting operation can be programmed with relay **160** activating motor **214** intermittently.

[0098] DC adapter **134** is installed inside control housing **138**, as shown in **FIG. 1**. Adapter **134** provides electricity power to control circuit **152** and elements, like indicators, beepers, LCD, etc., and to motors **126** and **214**, as well.

[0099] A control panel **166**, attached to control housing **138**, as shown in **FIG. 1**, is provided for supporting elements, like switches, indicators, adjusting knobs, beepers, LCD, and so on.

[0100] Reference is made to **FIG. 8**, which illustrates a schematic diagram of a control circuit **50** for providing the intermittent operation of blade sweeping for frying apparatus **100**.

[0101] As shown in **FIG. 8**, drive motor **126** is operationally coupled with blades **108** for providing rotation power. Motor **126** has a first terminal, which is connected to V−, the negative pole of a power source, e.g., DC adapter **134**, which is shown in **FIG. 1**, and a second terminal, which is connected to the collector terminal of a PNP bipolar transistor **51**. The emitter terminal of transistor **51** is connected to V+, the positive pole of a power source, e.g., DC adapter **134**, which is shown in **FIG. 1**. Associated with motor **126** is a linkage mechanism **52**, which cooperates with a single pole, double throw switch **53**, such that the shaft angle of motor **126** controls the switching position. Switch **53** includes a single pole **54**, which is connected to the first end of a capacitor **55**. Pole **54** may be switched alternately between two throw positions as represented by RUN and REST. The reference RUN refers generally to the position of blades **108** when in sweeping. On the other hand, the reference REST refers generally to the position of blades **108** when in dwelling. The RUN position represents substantially a large portion of a whole round of rotation angle of the motor shaft, e.g., over **80**%. The RUN position is associated with V− and the REST position is associated with V+.

[0102] A main switch **56** is provided for activating and deactivating the intermittent operation provided by circuit **50**. Switch **56** has a first terminal connected to V− and a second terminal connected to the first end of a variable resistor **58**.

[0103] The second end of capacitor **55** is connected to the second end of resistor **58**. Also connected to the second end of capacitor **55** are the base of transistor **51** and the second end of a resistor **59**. The first end of resistor **59** is connected to the first terminal of a STIR switch **60**, which can activate a STIR feature, a manually activated continuous operation. The second terminal of switch **60** is associated with V−. The first end of resistor **59** is also connected to the second end of a capacitor **61**. The first end of capacitor **61** is connected to V−.

[0104] Switch **60** is a push button switch for activating the STIR feature. When switch **60** is pushed, the two terminals are connected, which causes the connection of the first end of resistor **59** to V− and, at the same time, causes capacitor **61** to be short-circuited.

[0105] With switch **56** in the activated position and switch **60** in the deactivated position, circuit **50** will operate blades **108** intermittently with a variable dwell period at the end of each sweeping cycle. This intermittent operation is achieved through the circuit of transistor **51**, switch **53**, capacitor **55**, and resistor **58**.

[0106] Now, to start with, suppose motor **126** has not been operating because switch **56** has been in the deactivated position. Also suppose switch **53** has been in the REST position, and thus capacitor **55** has been discharged.

[0107] When switch **56** is activated, the potential at the second end of resistor **58** will be lowered to cause transistor **51** to switch to conductive state, thereby energizing motor **126**. As soon as motor **126** begins to rotate, switch **53** will be thrown to the RUN position, which causes the first end of capacitor **55** to be connected to V−. Capacitor **55** will then begin to charge so as to make the second end of capacitor **55** positive with respect to the first end thereof. Sufficient base current will be provided through the base of transistor **51** to cause transistor **51** to remain conductive even after capacitor **55** becomes fully charged, thereby causing motor **126** to continue to rotate throughout a full rotation cycle until switch **53** is cycled back to the REST position. When switch **53** cycles back to the REST position, the first end of capacitor is then connected to V+ and capacitor **55** begins to discharge through resistor **58** until the potential at the second end of resistor **58** becomes sufficiently negative relative to V+. During this period of time, transistor **51** is switched to and remains in non-conductive state, thereby stopping motor **126** for a predetermined interval of time. And then, sufficient base current flow resumes, causing transistor **51** to become conductive again, and a new cycle starts.

[0108] The length of the dwell interval is determined by the time required for capacitor **55** to discharge. Proper selection of capacitor **55** and resistor **58** will provide desirable dwell intervals.

[0109] With resistor **59** and capacitor **61** in addition, a manually activated continuous blade-sweeping feature can be achieved in addition to and in combination with the controllable variable dwell feature. This performance feature is achieved regardless of whether switch **56** is in the activated position or not when switch **60** is pushed. Moreover, it will be seen if switch **56** is in the activated position when switch **60** is pressed, there will be an immediate override of the intermittent operation. The continuous operation will keep on going without any dwell for a predetermined number of cycles, for example, one or two, after switch **60** is released, before the intermittent operation is resumed. If switch **56** is in the deactivated position when switch **60** is pressed, motor **126** will immediately start to rotate. After switch **60** is released, motor **126** will continue for a predetermined number of continuous sweeping cycles and then stops.

[0110] When switch **60** is pressed, the first end of resistor **59** is connected to V−. This allows sufficient current to flow through the base of transistor **51** to switch transistor **51** to conductive state, thereby causing motor **126** to start and operate. By proper selection of the value of resistor **59**, this mode of operation will occur regardless of the positions of switches **53** and **56**, so long as switch **60** is depressed.

[0111] At the same time, pressing switch **60** causes capacitor **61** to be short-circuited such that any charge stored therein is discharged through the short circuit to V−. When switch **60** is released, the current flow out of the base of transistor **51** will continue through discharged capacitor **61** until capacitor **61** recharges. As a result, transistor **51** will continue in conductive state and motor **126** will continue to operate at the normal speed. Transistor **51** will continue in conductive state for a predetermined period of time based on the time constant provided by resistor **59** and capacitor **61**, which are preferably selected to provide one or two continuous sweeping cycles without any dwell after switch **60** is released.

[0112] One important point worth mentioning is that if power-drive assembly **110** has a rotation reduction mechanism, linkage **52** should be set between the output shaft of assembly **110** and switch **53**, instead of between motor **126** and switch **53**.

[0113] If multiple rounds of sweeping are desired for a stirring cycle, before one dwell period, e.g., two rounds of sweeping before one dwell period, a pair of gears, or some other mechanisms, should be provided, with the smaller one installed on the output shaft and the larger one cooperating with switch **53**. The transfer-ratio should be 1:2.

[0114] The intermittent operation of blade sweeping can be alternatively achieved using a mechanically controlled timer, e.g., a spring-driven timer (not shown). Numerous discrete contact poles can be provided on a circular plate, such that when a needle is rotating around a central shaft, the needle engages with each contact pole in sequence. The angle range of each pole represents a stirring cycle. At the end of each stirring cycle, there is a predetermined dwell period, which is represented by the angle range in between two adjacent poles.

[0115] Reference is made to **FIG. 9**, which illustrates a schematic diagram of a control circuit **70** for providing the intermittent venting operation for frying apparatus **100**.

[0116] As shown in **FIG. 9**, blowing motor **214** is operationally coupled with fan **216** for forcing fresh air into frying apparatus **100**. Motor **214** has a first terminal, which is connected to V−, and a second terminal, which is connected to the collector terminal of a PNP bipolar transistor **71**. The emitter terminal of transistor **71** is connected to V+. The base of transistor **71** is connected to the second end of a variable resistor **72**. The first end of resistor **72** is connected to the second end of a capacitor **73**. The first end of capacitor **73** is connected to V−.

[0117] Also connected to the first end of resistor **72** are the second terminal of a magnetically activated switch **74** and the first terminal of a VENT switch **75**. The first terminal of switch **74** and the second terminal of switch **75** are connected to V−.

[0118] Switch **74** is provided for activating and deactivating the intermittent venting operation provided by circuit **70**. Switch **74** cooperates with motor **126**, such that when motor **126** is in working state, switch **74** is activated and remains in activated condition until motor **126** ceases to work. Switch **75** is a push button switch, which is provided for activating a manually activated continuous venting feature.

[0119] When either switch **74** or switch **75** is activated, the first end of resistor **72** is connected to V− and, at the same time, capacitor **73** is short circuited to V−.

[0120] With switch **74** in the activated position and switch **75** in the deactivated position, circuit **70** will operate fan **216** intermittently with a variable dwell period at the end of each venting cycle. This intermittent venting operation is achieved through the circuit of transistor **71**, resistor **72**, capacitor **73**, and switch **74**, which is conditioned by motor **126**.

[0121] When motor **126** is in working state, switch **74** is activated, such that the first end of resistor **72** is connected to V−, and capacitor **73** is short circuited to V−. The potential at the second end of resistor **72** is lowered to cause transistor **71** to switch to conductive state, thereby energizing motor **214**. As soon as motor **126** stops, switch **74** is deactivated. The current flow out of the base of transistor **71** will continue through discharged capacitor **73** until capacitor **73** recharges. As a result, transistor **71** will continue in conductive state and motor **214** continue to operate at the normal speed. Transistor **71** will continue in conductive state for a predetermined period of time based on the time constant provided by resistor **72** and capacitor **73**, which are preferably selected to provide a multiple of a sweeping cycle of blades **108**, e.g., five continuous blade sweeping cycles. Motor **214** then dwells for a predetermined interval of time until the next cycle of the intermittent operation of blades **108** starts, when motor **126** activates switch **74**, again.

[0122] With switch **75** in addition, a manually activated continuous venting performance feature can be achieved in addition to and in combination with the controllable variable dwell feature. This performance feature is achieved regardless of whether switch **74** is in the activated position or not when switch **75** is pushed. Moreover, it will be seen if switch **74** is in the activated position when switch **75** is pressed, there will be an immediate override of the intermittent

venting operation. The continuous operation will keep on going without any dwell for a predetermined interval of time after switch **75** is released, before the intermittent venting operation is resumed. If switch **74** is in the deactivated position when switch **75** is pressed, motor **214** will immediately start to rotate. After switch **75** is released, motor **214** will continue for a predetermined interval of time, and then stops.

[**0123**] **FIG. 10** illustrates a perspective view of a perforated basket **168** for use with frying apparatus **100**. Basket **168**, provided primarily for deep-frying foods, is preferably cylindrical in configuration and has an upstanding inner cylindrical wall **168***a* defining a central aperture, a plurality of open slots, generally designated as **168***b*, for removably receiving blades **112**, as shown in **FIG. 11**, and a basket handle **168***c* for handling basket **168**.

[**0124**] **FIG. 11** illustrates a cross-sectional view of basket **168** in an operation position. Wall **168***a* is installed on the central bottom of basket **168**, so as to emanate up toward the upper portion thereof, and removably receives cylindrical wall **102***b* therethrough. Slots **168***b* slidably receive blades **112**, and whereby basket **168** is maintained in position. Handle **168***c* is installed on the upper portion of basket **168**. A small recession, disposed on the upper edge of container **102**, is provided to allow the metal rods connecting the main body of handle **168***c* and the main body of basket **168** to extend from inside to outside of frying apparatus **100**. Wall **168***a* is routed over wall **102***b* and wall **106***a* is routed over both walls **102***b* and **168***a*.

[**0125**] In operation, a user:

[**0126**] First, charges container **102** with oil, and then preheats the oil to a predetermined temperature, preferably, halfway boiling. This step can be one step of a cooking program.

[**0127**] Second, charges container **102** with the food to be fried.

[**0128**] Third, selects an oil temperature, a time duration, a stirring blades rotation speed, and a blowing motor speed, or a program for frying foods, and then pushes on start button for activating the frying process.

[**0129**] The whole frying process is hand-free. The user does not have to be involved with the frying process until the frying is accomplished. The frying apparatus will then beep to remind the user when the frying process is done. The fried food is, now, ready for serving.

[**0130**] Reference is made to **FIG. 12**, which illustrates an alternative design of frying apparatus **100** of **FIG. 1**, a frying apparatus **100***a*. In this alternative design, a heating element support bracket **170** is provided for supporting heating element **114**. Bracket **170** is removably supported by container support **116**. Heating element **114** is fixedly installed on bracket **170**. Temperature sensor **118** is installed on cap **130** or some other suitable components. Container **102** is removably installed inside container support **116**, such that container **102** can be easily taken out for food and used oil handling and for cleaning after use. When container **102** is secured inside the opening of support **116** in an operating position, heating element **114** and sensor **118** are in physical contact with the bottom of container **102**.

[**0131**] Reference is made to **FIG. 13**, which illustrates a cross-sectional view of another embodiment of the present invention, a frying apparatus **300**. Some components or devices of frying apparatus **300** are similar to those of frying apparatus **100**. Similarity is in the sense of both functionality and configuration. Therefore, similar components or devices are denoted with similar reference numbers for avoiding repetitive explanations. Reference is made to frying apparatus **100** of **FIG. 1** for detailed information about these similar components or devices.

[**0132**] A container **302**, having an open top, is provided for holding foods and cooking oil. A central aperture is provided on the bottom of container **302** for allowing a main shaft **304** to thread therethrough.

[**0133**] A coupling device **306**, having a hollow cylindrical lower portion, is provided for coupling main shaft **304** and stirring blades **108** for transferring rotation power. The lower portion of coupling device **306** is fixedly engaged with blades **108**. The lower portion of coupling device **306** also has a cross-channel coupling element **306***a*, or other types of coupling elements, which lockably receives main shaft **304** via pin **122**. The upper end of coupling device **306** extends upward to substantially the open top of container **302**. In operation, the upper portion of main shaft **304** threads inside the inner opening of the lower portion of coupling device **306**. Minimal clearance is desired between main shaft **304** and the cylindrical wall of the lower portion of coupling device **306** for ideal performance.

[**0134**] The lower end of shaft **304** has an inner gear **304***a*, as more clearly shown in **FIG. 14**, for removably receiving a motor shaft **126***a*, which has a square or gear head, such that the lower end of shaft **304** loosely and removably engages with motor shaft **126***a*. This kind of coupling dramatically reduces the co-axial requirement on main shaft **304** and motor shaft **126***a* and facilitates the assembly process for manufacturing.

[**0135**] A seal assembly **308** is provided for sealing between shaft **304** and container **302**, as shown in **FIG. 14**, which illustrates an exploded cross-sectional view of seal assembly **308**. Seal assembly **308** comprises a seal flange **310**, a gland nut **312**, and a compression packing **314**.

[**0136**] Flange **310** is co-axial to shaft **304**. The first end of flange **310** is sealingly installed on the outside surface of the central bottom of container **302**. Gland nut **312** is engaged with the second end of flange **310** by means of screw. Packing **314** creates a seal by being squeezed between the throat of the stuffing box formed by flange **310** and gland nut **312**. The squeeze force pushes the material against the throat of the box and rotating shaft **304**.

[**0137**] When leakage occurs, gland nut **312** is tightened further. This is a typical application of compression packings for low speed rotating shafts, such as shaft **304**.

[**0138**] Materials are extremely important when selecting the proper packing for an application. Metallic packings are used in high-temperature applications. Shafts for copper and aluminum packings must be hardened to 500 Brinell hardness number (Bhn). Copper and aluminum packings can handle 538° C. (1000° F.) application temperature.

[**0139**] Seal assembly **308** can, alternatively, take many other forms, such as bushing and labyrinth seals, or com-

binations of multiple forms for ideal performance, as known to those skilled in the art and suggested by this invention disclosure.

[0140] **FIG. 15** illustrates an exploded cross-sectional view of an alternative design of seal assembly **308** of **FIG. 14**. In this alternative design, seal assembly **308** is installed inside container **302** on the central bottom thereof, instead of being installed outside of container **302**. The first end of flange **310** is fixedly installed on the inner surface of the bottom of container **302** and the second end of flange **310** extends upward to a predetermined height above. Gland nut **312** and compression packing **314** are engaged with the second end of flange **310**.

[0141] There is an important advantage of the alternative design illustrated by **FIG. 15**. For most applications, seal assembly **308** is higher than the oil level, such that the sealing surface is not immersed in cooking oil or hot liquid. Therefore, the requirement on seal assembly **308** is significantly reduced. In addition, shaft **304** is much better supported at a higher level. In operation, the lower portion of coupling device **306** is routed over seal assembly **308**.

[0142] Other features of frying apparatus **300** are similar to those of frying apparatus **100**.

[0143] Reference is made to **FIG. 16**, which illustrates an alternative design of frying apparatus **300** of **FIG. 13**, a frying apparatus **300***a*. In this alternative design, a heating element support bracket **170** is provided for supporting heating element **114**. Bracket **170** is removably supported by container support **116**. Heating element **114** is fixedly installed on bracket **170**. Temperature sensor **118** is installed on cap **130** or some other suitable components. Container **302** is removably installed inside container support **116**, such that container **302** can be easily taken out for food and used oil handling and for cleaning after use. When container **302** is secured inside the opening of support **116** in an operating position, heating element **114** and sensor **118** are in physical contact with the bottom of container **302**.

[0144] Other features of frying apparatus **300***a* are similar to those of frying apparatus **300**.

[0145] Reference is made to **FIG. 17**, which illustrates a cross-sectional view of a further more embodiment of the present invention, a frying apparatus **400**. Some components or devices of frying apparatus **400** are similar to those of frying apparatus **100**. Similarity is in the sense of both functionality and configuration. Therefore, similar components or devices are denoted with similar reference numbers for avoiding repetitive explanations. Reference is made to frying apparatus **100** for detailed information about these similar components or devices.

[0146] A container **402**, having an open top and a closed bottom, is provided for holding foods and cooking oil. A central shaft **404** is provided for guiding a coupling device **406** in position. The lower end of shaft **404** is fixedly installed on the central bottom of container **402** and the upper end thereof extends upward toward the open top of container **402**.

[0147] Coupling device **406** is provided for operationally transferring rotation power from a power-drive assembly **408** to stirring blades **108**. Coupling device **406** has a general configuration of a cylindrical tube forming a central aperture routed over shaft **404**. The lower end of coupling device **406** is engaged with blades **108** and the upper end thereof extends upward to substantially the open top of container **402**. A coupling element **406***a* is provided on the upper portion of coupling device **406** for transferring rotation power.

[0148] A motor housing **410**, disposed above lid **104**, is pivotally installed on the upper portion of control housing **138** via a hinge **412**. Housing **410** maintains substantially horizontal when secured in an operational position and can be conveniently lifted up via a handle **414**.

[0149] A drive motor **416** is installed inside housing **410**. A motor pulley **418** is fixedly engaged on the motor shaft for transferring rotation power from motor **416** to a main shaft **420** via a belt **422** and a drive pulley **424**. Main shaft **420** is installed onto housing **410** via a plurality of bearing elements, generally designated as **426**. The lower end of shaft **420** extends downward through the floor of housing **410**. A coupling element **428**, fixedly engaged on the lower portion of shaft **420** outside housing **410**, is provided for driving an intermediate coupling device **430**, which is installed on lid **104**.

[0150] Coupling device **430** includes an intermediate shaft **432**, an upper coupling element **434**, and a lower coupling element **436**.

[0151] The upper end of shaft **432** is fixedly engaged with coupling element **434**, which is removably coupled with coupling element **428**. Coupling element **434** can be specially designed, such that couple element **434** also serves as a lid handle. The lower end of shaft **432** extends downward through a central aperture on lid **104** and is fixedly engaged with coupling element **436**, which is removably coupled with coupling element **406***a*.

[0152] Intermediate coupling device **430** is rotatably installed on lid **104** via a bearing element **438**.

[0153] Other features of frying apparatus **400** are similar to those of frying apparatus **100**.

[0154] Reference is made to **FIG. 18**, which illustrates an alternative design of frying apparatus **400** of **FIG. 17**, a frying apparatus **400***a*. In this alternative design, a heating element support bracket **170** is provided for supporting heating element **114**. Bracket **170** is removably supported by container support **116**. Heating element **114** is fixedly installed on bracket **170**. Temperature sensor **118** is installed on container support **116**, or some other suitable components. Container **402** is removably installed inside container support **116**, such that container **402** can be easily taken out for food and used oil handling and for cleaning after use. When container **402** is secured inside the opening of support **116** in an operating position, heating element **114** and sensor **118** are in physical contact with the bottom of container **402**.

[0155] Other features of frying apparatus **400***a* are similar to those of frying apparatus **400**.

[0156] For all the embodiments discussed above, when the container is large, the stirring device is consequently big, such that it may not be quite convenient to use or handle. In order to solve this problem, for the frying apparatus having a large container, the lower portion of the container can be adapted to taper inward, such that the bottom of the con-

tainer has a smaller diameter. Consequently, the stirring device can be designed smaller.

[0157] Accordingly, readers will see that this frying apparatus of the present invention can be used to prepare tasteful fried foods for both deep and shallow frying. The frying process is fully automatic, thereby minimizing human involvement and chore of the frying process. This frying apparatus is used with the lid fully covering on top of the container, thereby eliminating the possibility of grease splattering and the risk of oil burns to people. At the same time, the grease-laden air generated during the frying process is forced out through a venting device and filtered before being discharged into the room, thereby avoiding long-term hazards to the people and home environment.

[0158] The stirring blades sweep across food pieces intermittently, such that the blades dwell for a predetermined dwell period starting near the end of each stirring cycle. This intermittent operation favors better agitation of food pieces and affords relief from constant stirring at a higher speed.

[0159] The present invention has been described in an illustrative manner. It is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

[0160] Although this invention has been described in its preferred forms and structures with a certain degree of particularity, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention.

[0161] For examples, although this invention has been described in a form of home frying apparatuses, it can have potential business use, such as use in restaurants. Therefore, this invention can alternatively be described as food processing equipment. Although the forced venting system of this invention has been described in a form of blowing fresh air into the frying apparatus, it is understood that rearrangement of the motor, fan, and filters, such that, instead of blowing fresh air into the frying apparatus, the fan actually draws the moisture-laden and grease-laden air out of the frying apparatus, is perfectly inline with the spirit of the forced venting concept of this invention. Such rearrangement is, therefore, covered by the present invention.

[0162] Thus it is understood that the present disclosure of the preferred forms can be changed in the details of construction and in the combination and arrangement of parts without departing from the spirit and the scope of the invention as hereinafter claimed.

1. (canceled)
2. (canceled)
3. (canceled)
4. (canceled)
5. (canceled)
6. (canceled)
7. A frying apparatus, said frying apparatus comprising:

a container having an open top for holding foods and oil;

a lid covering on top of said container for closing up said open top of said container;

heating means for heating said foods and oil disposed inside said container;

stirring means installed inside said container for stirring foods;

a power-drive assembly operationally coupled with said stirring means for driving said stirring means through repeating stirring cycles;

a blowing device for forcing fresh air into said frying apparatus during frying processes, thereby, facilitating moisture removal from inside said frying apparatus; and

a venting device for exhausting cooking fumes.

8. A frying apparatus as defined in claim 7, wherein said venting device includes filter means for cooking fume treatment.

9. (canceled)

10. (canceled)

11. A frying apparatus as defined in claim 7, wherein said blowing device includes a one-way valve for preventing cooking fumes from escaping therethrough.

12. A frying apparatus as defined in claim 7, said frying apparatus further including control means for automatically de-energizing said power-drive assembly near the end of each stirring cycle for a predetermined dwell period.

13. A frying apparatus as defined in claim 7, said frying apparatus further including control means, said control means dividing the blowing operation of said blowing device into repeating blowing cycles of predetermined length and automatically de-energizing said blowing device near the end of each blowing cycle for a predetermined dwell period.

14. A frying apparatus, said frying apparatus comprising:

a container having an open top and an upstanding inner cylindrical wall for holding foods and oil;

a lid covering on top of said container for closing up said open top of said container;

heating means for heating said foods and oil disposed inside said container;

stirring means installed inside said container for stirring foods;

a power-drive assembly disposed below said container and operationally coupled with said stirring means for driving said stirring means through repeating stirring cycles; and

a coupling device having an inner cylindrical wall and an outer cylindrical wall, engaged with each other on the upper portion thereof, wherein said outer cylindrical wall of said coupling device is routed over said upstanding inner cylindrical wall of said container and the lower portion of said outer cylindrical wall of said coupling device is engaged with said stirring means, and wherein said inner cylindrical wall of said coupling device includes a coupling element on the lower portion thereof for lockably receiving a drive shaft from said power-drive assembly.

15. A frying apparatus as defined in claim 14, wherein said container includes co-rotation preventing means installed inside said container on the sidewall thereof for preventing food pieces from co-rotating with said stirring means, as said stirring means rotates.

16. A frying apparatus as defined in claim 14, wherein said container includes supporting means installed on the inside

bottom thereof for supporting said stirring means, thereby avoiding excessive scraping of said stirring means on the bottom of said container, reducing the friction therebetween, and prolonging the life of said stirring means.

17. A frying apparatus as defined in claim 14, wherein said drive shaft includes supporting means installed on the upper portion thereof for operationally supporting said drive shaft against said upstanding inner cylindrical wall of said container.

18. A frying apparatus as defined in claim 14, said frying apparatus further including control means for automatically de-energizing said power-drive assembly near the end of each stirring cycle for a predetermined dwell period.

19. A frying apparatus as defined in claim 14, said frying apparatus further including a basket having an open top and a central aperture on the bottom thereof removably receiving said upstanding inner cylindrical wall of said container for use to deep-fry foods.

20. A frying apparatus, said frying apparatus comprising:

a container having an open top and a central aperture on the bottom thereof for holding foods and oil;

a lid covering on top of said container for closing up said open top of said container;

heating means for heating said foods and oil disposed inside said container;

stirring means installed inside said container for stirring foods;

a power-drive assembly disposed below said container and operationally coupled with said stirring means for driving said stirring means through repeating stirring cycles, said power-drive assembly including a drive shaft threading through said central aperture of said container;

a sealing assembly installed on the bottom of said container for sealing between the bottom of said container and said drive shaft; [and]

wherein said sealing assembly includes a compression-packing adapted to be squeezed against said drive shaft from said power-drive assembly and said central aperture on the bottom of said container for generating a sealing thereof; and

a coupling device engaged with said stirring means and adapted for lockably receiving said drive shaft from said power-drive assembly.

21. A frying apparatus as defined in claim 20, wherein said container includes co-rotation preventing means installed inside said container on the sidewall thereof for preventing food pieces from co-rotating with said stirring means, as said stirring means rotates.

22. (canceled)

23. A frying apparatus as defined in claim 20, wherein said container includes supporting means installed on the inside bottom thereof for supporting said stirring means, thereby, avoiding excessive scraping of said stirring means on the bottom of said container, reducing the friction therebetween, and prolonging the life of said stirring means.

24. A frying apparatus as defined in claim 20, said frying apparatus further including control means for automatically de-energizing said power-drive assembly near the end of each stirring cycle for a predetermined dwell period, and wherein said control means controls said power-drive assembly to drive said stirring means to perform an intermittent stirring operation across foods.

25. A frying apparatus as defined in claim 20, said frying apparatus further including a basket having an open top and a central aperture on the bottom thereof removably receiving said drive shaft for use to deep-fry foods.

26. A frying apparatus, said frying apparatus comprising:

a container having an open top, a closed bottom, and an upstanding central shaft installed on the central bottom thereof for holding foods and oil;

a lid covering on top of said container for closing up said open top of said container;

heating means for heating said foods and oil disposed inside said container;

stirring means installed inside said container for stirring foods;

a power-drive assembly disposed above said container and operationally coupled with said stirring means for driving said stirring means through repeating stirring cycles; and

a coupling device having a hollow cylindrical lower portion for removably receiving said upstanding central shaft, wherein said hollow cylindrical lower portion of said coupling device is engaged with said stirring means, and wherein said coupling device includes a coupling element on the upper portion thereof for operationally transferring rotation power from said power-drive assembly to stirring means.

27. A frying apparatus as defined in claim 26, wherein said container includes co-rotation preventing means installed inside said container on the sidewall thereof for preventing food pieces from co-rotating with said stirring means, as said stirring means rotates.

28. A frying apparatus as defined in claim 26, wherein said container includes supporting means installed on the inside bottom thereof for supporting said stirring means, thereby, avoiding excessive scraping of said stirring means on the bottom of said container, reducing the friction therebetween, and prolonging the life of said stirring means.

29. A frying apparatus as defined in claim 26, said frying apparatus further including control means for automatically de-energizing said power-drive assembly near the end of each stirring cycle for a predetermined dwell period.

30. A frying apparatus as defined in claim 26, said frying apparatus further including a basket having an open top and a central aperture on the bottom thereof removably receiving said upstanding central shaft for use to deep-fry foods.

31. (canceled)

32. (canceled)

33. (canceled)

34. A frying apparatus as defined in claim 7, said frying apparatus further including a housing, wherein said container is removably disposed inside said housing, and whereby it is easier to load and unload foods and to clean said container after use.

35. A frying apparatus as defined in claim 7, wherein said venting device is installed on said lid, and wherein said venting device includes a fabric or paper filter for capturing the grease content in cooking fumes.

36. A frying apparatus as defined in claim 8, wherein said filter means includes a mesh filter for capturing the grease content in cooking fumes, and wherein said mesh filter is washable and reusable.

37. (original) A frying apparatus as defined in claim 36, wherein said filter means includes a fabric or paper filter for capturing the grease content in cooking fumes.

38. A frying apparatus as defined in claim 8, wherein said filter means includes a fabric or paper filter for capturing the grease content in cooking fumes.

39. A frying apparatus as defined in claim 8, wherein said filter means includes a activated carbon filter for capturing the grease content and removing cooking odors in cooking fumes.

40. A frying apparatus as defined in claim 14, wherein said upstanding inner cylindrical wall of said container extends upwards to a predetermined height above the bottom of said container, and said frying apparatus further including a sealing assembly for sealing between said drive shaft from said power-drive assembly and the upper portion of said upstanding inner cylindrical wall of said container.

41. A frying apparatus as defined in claim 40, wherein said sealing assembly includes a compression-packing adapted to be squeezed against said drive shaft from said power-drive assembly and the upper portion of said upstanding inner cylindrical wall of said container for generating a sealing thereof.

42. (canceled)

43. A frying apparatus as defined in claim 20, wherein said sealing assembly is installed on the bottom of said container and disposed underneath the bottom of said container.

44. A frying apparatus as defined in claim 20, wherein said sealing assembly is installed on the bottom of said container and disposed inside said container, wherein said compression-packing is disposed at a predetermined height above the bottom of said container, whereby for most applications of said frying apparatus said compression-packing is disposed above boiling oil or hot liquids, and whereby the requirement on said sealing assembly is significantly reduced.

45. (canceled)

46. A frying apparatus as defined in claim 20, said frying apparatus further including control means for controlling various functions of said frying apparatus, whereby frying processes can be accomplished in a programmed automatic manner for minimizing human involvement and chore in preparing foods.

47. (canceled)

48. (canceled)

49. (canceled)

50. (canceled)

51. A frying apparatus as defined in claim 20, said frying apparatus further including a venting device for exhausting cooking fumes.

52. A frying apparatus as defined in claim 51, wherein said venting device includes a mesh filter for capturing the grease content in cooking fumes, and wherein said mesh filter is washable and reusable.

53. A frying apparatus as defined in claim 51, wherein said venting device includes a fabric or paper filter for capturing the grease content in cooking fumes.

54. A frying apparatus as defined in claim 51, wherein said venting device includes an activated carbon filter for capturing the grease content and removing cooking odors in cooking fumes.

55. A frying apparatus as defined in claim 20, said frying apparatus further including a blowing device for forcing fresh air into said frying apparatus during frying processes, thereby, facilitating moisture removal from inside said frying apparatus.

56. (canceled)

57. A frying apparatus as defined in claim 20, said frying apparatus further including a housing, wherein said container is removably disposed inside said housing, and whereby it is easier to load and unload foods and to clean said container after use.

58. (canceled)

59. A frying apparatus as defined in claim 57, wherein said drive shaft includes a coupling mechanism disposed on the lower portion thereof for lockably receiving a shaft from said power-drive assembly.

* * * * *