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(54) Title: DEPOSITOR APPARATUS INCLUDING FLOW METERS

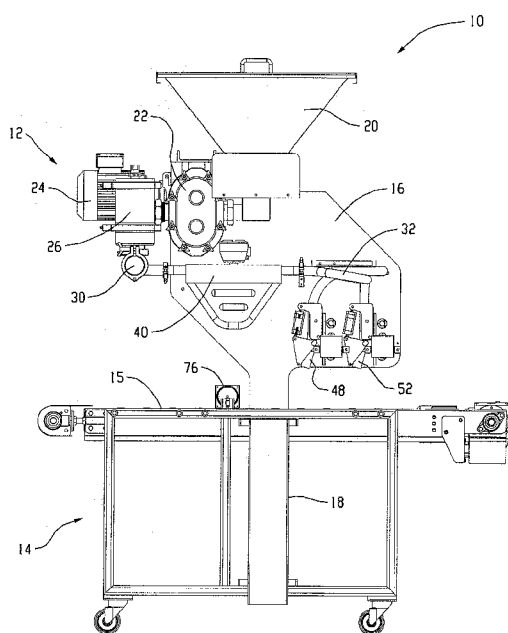


Fig. 1

(57) Abstract: A depositor apparatus includes a product source, a product source, a supply manifold for receiving product from the product source and a pump that pumps product from the product source to the supply manifold. Multiple deposit valves are connected to receive product from the manifold along respective flow paths. Each flow path includes a respective flow meter that measures product flowing through the flow meter. Each flow meter may include a processor that controls opening and closing of its respective deposit valve to effect deposit of a set amount of product. The flow meters may be of a mass flow meter type.



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DEPOSITOR APPARATUS INCLUDING FLOW METERS**CROSS-REFERENCE**

[0001] This application claims the benefit of U.S. provisional application No. 61/122,618, filed December 15, 2008, and U.S. non-provisional application No. 12/490,035, filed June 23, 2009, the entireties of which are hereby incorporated by reference.

TECHNICAL FIELD

[0002] This application relates generally to flowable product depositors and, in particular, a depositor apparatus that uses flow meters for controlling food product deposits.

BACKGROUND

[0003] In the commercial food industry, it is frequently desired to meter out measured amounts of material, for example, such as cake batter for a baking operation. Depositors are employed that utilize pistons for depositing batter into cups of a baking pan. In high volume operations, it is desirable to accurately control the amount of batter or other food material deposited.

SUMMARY

[0004] In one aspect, a depositor apparatus for depositing discrete amounts of a flowable product includes a product source, a valve that dispenses the product and a pump that pumps the product from the food product source to the valve along a line. A flow meter is in communication with the line that measures product flowing through the flow meter. The flow meter includes a processor that controls the valve by closing the valve after a set amount of product has passed through the flow meter.

[0005] In another aspect, a depositor apparatus includes a product source, a supply manifold for receiving product from the product source and a pump that pumps product from the product source to the supply manifold. Multiple deposit valves are connected to receive product from the manifold along respective flow paths. Each flow path includes a respective flow meter that measures product flowing through the flow meter. Each deposit valve is controlled based upon flow information from its respective flow meter and independent of the other deposit valves to effect deposit of a set amount of product.

[0006] In a further aspect, the depositor is provided with a recirculation path for flowing product back to the product source when the deposit valves are closed. The

recirculation path includes a pressure regulation valve for varying flow along the recirculation path. A pressure sensor is located for detecting a supply pressure of product being delivered to the deposit valves, and the pressure regulation valve is responsively controlled to maintain a set supply pressure.

[0007] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0008] Fig. 1 is a side view of an embodiment of a depositor apparatus;
[0009] Fig. 2 is a front view of the depositor apparatus of Fig. 1;
[0010] Fig. 3 is an exploded, perspective view of the depositor apparatus of Fig. 1;
[0011] Fig. 4 is a side view of an embodiment of a mass flow meter for use with the depositor apparatus of Fig. 1;
[0012] Fig. 5 is a diagrammatic illustration of the mass flow meter of Fig. 4;
[0013] Fig. 6 is a method of controlling the depositor apparatus of Fig. 1;
[0014] Figs. 7-9 illustrate another embodiment of a depositor apparatus; and
[0015] Figs. 10A and 10B show another embodiment of a depositor apparatus including a food product recirculation path.

DETAILED DESCRIPTION

[0016] Referring to Figs. 1 and 2, one embodiment of a depositor system 10 includes an upper depositing portion 12 and a lower conveyor portion 14. The depositing portion 12 includes a depositor frame assembly 16 that connects to a conveyor frame assembly 18 of the lower conveyor portion 14. As will be described in detail below, the depositor system 10 is configured to deposit preselected amounts of a food product (e.g., cake batter, sauces such as gravy and salad dressing, etc.) into, for example, individual tray pockets of a tray for a cooking operation such as baking, as the trays are conveyed on a conveyor 15 by the conveyor portion 14.

[0017] Referring also to Fig. 3, the depositing portion 12 of the depositor system 10 includes an infeed hopper 20 that contains an amount of the food product, which is typically a viscous liquid or semi liquid mixture. A pump 22 and motor 24 operatively connected to the pump are provided for pumping the food product from the hopper 20 to a pair of accumulators 26 and 28. The accumulators 26 and 28 act as a pressure reservoir that holds the food product under controlled pressure for delivery.

[0018] Each accumulator 26 and 28 and pump 22 is connected to a distribution or supply manifold 30. The accumulators 26 and 28 are connected to the distribution manifold 30 by mountings 29 and 31 and the pump is connected to the distribution manifold by line 33 (Fig. 2). The distribution manifold 30 is connected to multiple product delivery lines, in this embodiment, product delivery lines 32, 34, 36 and 38. Each product delivery line 32, 34, 36 and 38 is connected to an input side of a respective flow meter 40, 42, 44 and 46. A suitable flow meter is a Coriolis mass flow meter (e.g., a bent tube mass flow meter or straight tube mass flow meter) commercially available from Micro Motion, Inc. of Boulder, Colorado. However, magnetic flow meters or other volumetric flow meters could also be used.

[0019] An output side of each mass flow meter 40, 42, 44 and 46 is connected to a respective shutoff or deposit valve 48, 50, 52 and 54 through which the food product is dispensed in predetermined amounts. As can be seen, some of the shutoff valves 52 and 54 are offset from the shutoff valves 48 and 50 in the conveying direction. Additionally, the shutoff valves 48, 50, 52 and 54 are moveably mounted to support rails 56 and 58 (Fig. 2) so that the positions of the shutoff valves are moveable in the cross-conveying direction to accommodate trays of different sizes. In some embodiments, all of the shutoff valves 48, 50, 52 and 54 are moveable relative to each other in the cross-conveying direction. Alternatively, two or more valves may be connected to that they move together relative to the other valves. The positions of the shutoff valves 48, 50, 52 and 54 may be adjustable manually or automatically using one or more actuators such as a motor or cylinder drive system.

[0020] Referring now to Fig. 4, the mass flow meters 40, 42, 44 and 46 include a housing 60, an infeed connector 62, an outfeed connector 64 and an electronics housing 66 with a processor located therein. Various mass flow meter details are described in U.S. Patent No. 4,491,025 and Re. 31,450.

[0021] Referring to Fig. 5, the mass flow meters 40, 42, 44 and 46 include a flow meter sensor 68 that provides an output to the flow meter electronics 70. The output provides various information to a controller or processor 72, which processes the output to provide, e.g., mass flow rate, total mass flow information, density, volume flow rate, etc. The processor 72 of each mass flow meter 40, 42, 44 and 46 is connected via port 53 to a shutoff valve control 55 (e.g., a solenoid, motor, etc.), thereby controlling operation of an associated shutoff valve, at least in part, based on the output received from the flow meter

sensor 68. Opening the shutoff valves 48, 50, 52 and 54 allows flow through the mass flow meters 40, 42, 44 and 46, while closing the shutoff valves prevents flow through the mass flow meters.

[0022] The processors 72 of the mass flow meters 40, 42, 44 and 46 are also connected to a master controller 74. The master controller 74 communicates instructions to the processors 72, for example, based on user input, a recipe saved in memory or otherwise accessible to the master controller, etc. For example, the master controller 74 may instruct the mass flow meters 40, 42, 44 and 46 to allow deposit of a particular or set amount of food product.

[0023] In some embodiments, the master controller 74 receives tray information from a detector 76. Referring also to Fig. 1, the detector 76 may be a proximity sensor (e.g., a photo eye) that detects a leading edge of a tray passing thereby. Once the leading edge of the tray is detected, the master controller 74 can instruct the processors 72 of the mass flow meters 40, 42, 44 and 46 when to begin a food product deposit based, at least in part, on the known velocity of the conveyor and tray dimensions.

[0024] In another embodiment, the detector 76 may comprise an antenna that is used in reading a tag (e.g., an RFID tag) carried by the tray. The tag may be read by the master controller 74 (or by a separate reader) using the antenna to identify the tray and a corresponding recipe saved in memory associated with identified tray. Other ways of identifying the tray are also contemplated. For example, the detector 76 may comprise a scanner that is used by the master controller 74 to scan an identifier such as a barcode located on the tray. The scanned barcode provides identifying information to the master controller 74 that can be used to identify a recipe associated with that identifying information. In some embodiments, a combination of detectors may be used, for example, a proximity sensor for detecting presence of the tray and an antenna or scanner with reader for identifying the tray.

[0025] The recipe can be used to set any number of operating parameters for the depositor system 10. The recipe may include information used to set the food product deposit amount, conveyor speed, pump speed, dimensions of the tray, number of cups per row and column of the tray, dimensions of each cup, etc. The recipe information can be used by the master controller 74 and the processors 72 to accurately meter out food product according to the recipe.

[0026] Use of the localized processors 72 at each mass flow meter 40, 42, 44 and

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46 allows for accurate control of the shutoff valves 48, 50, 52 and 54 as flow through each mass flow meter corresponds to the amount of food product deposited through the shutoff valves. Fig. 6 illustrates an exemplary method 80 for controlling deposit of food product. At step 82, tray identifying information is received by the master controller 74. As described above, the tray identifying information may be provided to the master controller 74 in a number of suitable ways, such as by manual entry by the operator or through automatic identification, such as by scanning a barcode or reading an RFID tag carried by the tray.

[0027] At step 84, positions of the one or more shutoff valves 48, 50, 52 and 54 may be adjusted based on, for example, dimensions of the particular type of tray. The positions of the shutoff valves 48, 50, 52 and 54 may be adjusted in one or both of the conveyor and cross-conveyor directions automatically and/or manually.

[0028] The master controller 74 identifies a recipe associated with the tray identifying information at step 86. The recipe includes information for completing a depositing operation for that identified tray or series of trays. In some embodiments, in addition to automatically identifying the tray, input may also be requested from some other source, such as from the operator. For example, the operator may input to the master controller 74 (e.g., via a user interface 77 or communications link 79) the type of food product to be deposited into the identified tray. Or, the depositor system 10 may list several operator selectable recipe options associated with the identified tray. Other possibilities are possible.

[0029] At step 88, the recipe information is communicated to each of the mass flow meters 40, 42, 44 and 46 from the master controller 74. In some embodiments, a pre-deposit operation may be performed in order to fill the accumulators, manifold and lines up to the shutoff valves 48, 50, 52 and 54 with food product.

[0030] At step 90, the leading edge of the tray is detected. Step 88 may also be part of step 84 or any other suitable step. Because the recipe information includes speed of the conveyor and tray dimensions, the mass flow meters 40, 42, 44 and 46 determine when to open the shutoff valves 48, 50, 52 and 54 and a shut off point for each valve. In another embodiment, the shut off points for the shutoff valves 48, 50, 52 and 54 are part of the recipe information.

[0031] In some embodiments, the shut off points for the shutoff valves 48, 50, 52 and 54 calculated or otherwise provided to the processors 72 are initial shut off points. The

processors 72 include logic for adjusting operation of each associated shutoff valve 48, 50, 52 and 54 based on the actual amount of food product deposited per deposit cycle at step 92 as determined by the mass flow meter. For example, at start up, an operator may set the system 10 to deposit a set amount of material, such as 400 grams. For the initial deposit, the processors 72 of the mass flow meters 40, 42, 44 and 46 may close the shutoff valves 48, 50, 52 and 54 when each mass flow meter determines that 400 grams of product has moved through the mass flow meters. In other words, the shut off point in this example is set at 400 grams. Due to delays and system configuration, it may be the case that more than 400 grams was actually delivered through one or more of the mass flow meters. The mass flow meters 40, 42, 44 and 46 determine at step 94 that the actual amount of product deposited in the previous deposit was more than the set amount of 400 grams, for example, 420 grams, and adjust the shutoff point accordingly. For example, during the next deposit, one or more of the processors 72 may close its respective shutoff valve 48, 50, 52 and 54 at 380 grams in order to bring the actual deposit closer to 400 grams. In some embodiments, the processors 72 use a rolling average of X previous deposits (e.g., between 2 and 20, such as about 10 previous deposits) to adjust the shut off point for each respective shutoff valve 48, 50, 52 and 54. In the case of volumetric flow meters, each meter would be configured to effect deposit of a specific volume of material, as opposed to mass.

[0032] The processor 72 of each mass flow meter 40, 42, 44 and 46 is capable of adjusting the shut off point of its associated shutoff valve 48, 50, 52 or 54 independent of the other mass flow meters, which can improve the accuracy of each deposit (e.g., to within about 1/4 percent to about 1/2 percent deviation from the required amount). Use of the local processors 72 of each mass flow meter 40, 42, 44 and 46 (rather than the master controller 74) allows for rapid adjustment of the shut off points for each shutoff valve 48, 50, 52 and 54, for example, from one deposit to the next. Various factors may affect the amount of food product deposited per open duration, such as line pressure to the shutoff valves 48, 50, 52, 54 (e.g., for pneumatically operated valves), viscosity of the food product, etc. However, it is recognized that an alternative to individual processor control at each mass flow meter, the master controller 74 could be used to control the shutoff point of each valve, but with each valve controlled independently of the others based upon information from the flow meter in the line associated with the valve.

[0033] Use of the mass flow meters 40, 42, 44 and 46 can allow the depositor system 10 to be cleaned-in-place, i.e., without removing components of the depositor

system. In some embodiments, a flushing fluid such as water may be run through the depositor system 10. The mass flow meters may be purged with air through use of purge fittings 98 and 100.

[0034] Referring now to Figs. 7-9, another depositor system 110 includes many of features described above including mass flow meters 112, 114, 116, 118 and 120 (which may be in-line mass flow meters having a processor 72 and operating in a fashion similar to that described above), accumulators (only accumulator fittings 122 and 124 are illustrated for clarity however the accumulators may operate in a fashion similar to that described above), a distribution manifold 126 and shutoff valves. In this embodiment, the distribution manifold 126 is connected to a moveable hopper unit 128 that includes wheels 130 for moving the hopper unit 128 from place to place. The hopper unit 128 includes a hopper 132 for holding food product and a pump 134 for pumping food product from the hopper 132 to the depositor system 110. A continuous feed system could also be used in lieu of the moveable hopper arrangement.

[0035] Other depositor system embodiments may not use accumulators. In these embodiments, line pressure may be controlled using one or more valves, which can close one or more portions of the fluid line to control pressure.

[0036] Referring now to the schematic system of Figs. 10A and 10B, an embodiment is shown in which a recirculation path is provided, with Fig. 10A showing the recirculation mode and Fig. 10B showing the deposit mode. Specifically, the depositor apparatus 200 includes a food product source in the form of hopper 202, which is connected to the input side of a pump 204, which is in turn connected to pump food product from the hopper to a supply manifold 206. Multiple deposit valves 208A – 208D (e.g., in the form of tubing pinch valves) are connected to receive food product from the manifold along respective flow paths 210A-210D. Each flow path includes a respective mass flow meter 212A-212D that measures mass of food product flowing through the mass flow meter. As indicated above, each mass flow meter 212A-212D includes a processor that controls opening and closing of its respective deposit valve 208A-208D to effect deposit of a set amount of food product, and operates independent of the other mass flow meters in determining when the set amount of food product has been deposited by its respective deposit valve.

[0037] A respective recirculation path 214A-214D is connected with each flow path 210A-210D to enable food product to be recirculated back toward the food product source

when the deposit valve is closed. Each recirculation path 214A-214D includes a corresponding recirculation valve 216A-216D (e.g., in the form of tubing pinch valves) for controlling flow or non-flow along the recirculation path. Each recirculation valve 216A-216D is also controlled by the mass flow meter 212A-212D of its associated flow path 210A-210D. Each recirculation path 214A-214D leads to a return manifold 216. A return line 218 runs from the return manifold back to the hopper 202, and a pressure regulation valve 220 (e.g., in the form of a variable tubing pinch valve or other variable valve capable of varying the degree of closure of the return line) is located along the return line 216. A pressure sensor 222 is located for detecting a supply pressure of food product of the supply manifold 206, and the pressure regulation valve 220 is responsively controlled to maintain a set supply pressure (e.g., closing of the return line slightly the supply pressure will increase and opening up the return line slightly the supply pressure will decrease). In this arrangement the pump 204 is generally operated at a constant speed, which could vary from operation to operation based upon type of food product being delivered and/or the set supply pressure desired (e.g., the recipe for a given operation could set the pump operating speed). The pressure sensor 222 may communicate directly with the supply manifold as shown, but could also be located elsewhere. In one implementation, the pressure sensor may be linked to control the pressure regulation valve 220 directly. In an alternative implementation the pressure sensor 222 could be linked to provide a pressure signal to the master controller 74 (see Fig. 5), which in turn is connected to effect control of the pressure regulation valve 220.

[0038] Each mass flow meter 212A-212D may effect simultaneous, but opposite operation of its corresponding deposit valve 208A-208D and corresponding recirculation valve 216A-216D to provide the recirculation mode and deposit mode. Specifically, in the recirculation mode of Fig. 10A deposit valves 208A-208D are shown closed and recirculation valves 216A-216D are shown open, such that flow in the system is from the hopper 202, through the pump 204, along each recirculation path 214A-214D to the supply manifold 216 and back along the return line 218 to the hopper. During the deposit mode (e.g., when a new tray or other food product receptacle has been positioned beneath each of the deposit valves 208A-208D by the system conveyor) the recirculation valves 216A-216D are closed and the deposit valves 208A-208D are open such that flow in the system is from the hopper 202, through the pump 204, to the supply manifold 206, along the flow paths 210A-210D to each mass flow meter 212A-212D and subsequently through each

deposit valve 208A-208D into a waiting food product receptacle.

[0039] In one embodiment, the deposit valves and the recirculation valves may be pneumatically controlled, with each valve being a pneumatic cylinder type and each valve pair (e.g., 208A and 216A) being connected to a common pressure control valve. When the common pressure control valve is in one position, pressurized air is delivered "oppositely" to each valve of the valve pair, such that one valve is closed and the other is opened. When the common pressure control valve is in another position the delivery of pressurized air to each valve of the valve pair is reversed, such that the one valve moves to its open position and the other valve moves to its closed position. Other variations for valve control are possible (e.g., such as electrically controlled valves, hydraulically controlled valves, etc.).

[0040] It is to be clearly understood that the above description is intended by way of illustration and example only, is not intended to be taken by way of limitation, and that other changes and modifications are possible. For example, while the embodiments are primarily described in the context of depositing flowable food product, it is recognized that the embodiments could be utilized in conjunction with other types of flowable products, specifically non-edible products of various types.

[0041] What is claimed is:

Claims

1. A depositor apparatus for depositing discrete amounts of a flowable product, the depositor apparatus comprising:
 - a product source;
 - a supply manifold for receiving product from the product source;
 - a pump that pumps product from the product source to the supply manifold;
 - multiple deposit valves connected to receive product from the supply manifold along respective flow paths;
 - each flow path including a respective flow meter that measures product flowing through the flow meter, each deposit valve is controlled based upon flow information of its respective flow meter and independent of the other deposit valves to effect deposit of a set amount of product.
2. The depositor apparatus of claim 1 wherein each flow meter includes a processor that controls opening and closing of its respective deposit valve to effect deposit of the set amount of product.
3. The depositor apparatus of claim 1 wherein the processor of each flow meter operates independent of the processors of the other flow meters in determining when the set amount of product has been deposited by its respective deposit valve.
4. The depositor apparatus of claim 3 wherein the processor of each flow meter includes logic for adjusting a shutoff point of its respective deposit valve based on a measured amount of product flowing through the flow meter.
5. The depositor apparatus of claim 4 wherein each flow meter comprises a mass flow meter.
6. The depositor apparatus of claim 4, further comprising a master controller configured to send recipe information to the processor of each flow meter.
7. The depositor apparatus of claim 6, wherein the recipe information includes an

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initial shutoff point, the processor of each flow meter including logic for adjusting the shutoff point of its respective deposit valve based on a measured amount of product flowing through the flow meter.

8. The depositor apparatus of claim 1 wherein the product source is a hopper or a continuous mixer, the apparatus further comprising a conveyor that conveys trays by the deposit valves, the deposit valves used to deposit discrete amounts of product on the trays.

9. The depositor apparatus of claim 2 wherein a respective recirculation path is connected with each flow path to enable product to be recirculated back toward the product source when the deposit valve is closed.

10. The depositor apparatus of claim 9 wherein each recirculation path includes a corresponding recirculation valve for controlling flow or non-flow along the recirculation path.

11. The depositor apparatus of claim 10 wherein each recirculation valve is controlled by a processor of the flow meter of its associated flow path.

12. The depositor of claim 11 wherein each flow meter effects simultaneous but opposite operation of its corresponding deposit valve and corresponding recirculation valve.

13. The depositor of claim 10 wherein each recirculation paths leads to a return manifold, a return line runs from the return manifold toward the product source, and a pressure regulation valve is located along the return line.

14. The depositor of claim 13 wherein a pressure sensor is located for detecting a supply pressure of product of the supply manifold, and the pressure regulation valve is responsively controlled to maintain a set supply pressure.

15. The depositor of claim 14 wherein the pressure regulator valve is a variable valve of the return line, the pressure sensor communicates directly with the supply manifold.

16. The depositor of claim 13 wherein the pump is operated continuously during normal operation of the depositor.
17. The depositor of claim 1, further comprising:
a master controller;
each flow meter is connected to provide flow information to the master controller, and the master controller is connected to control each deposit valve in accordance with the flow information received from the corresponding flow meter in line with the deposit valve.
18. A depositor apparatus for depositing discrete amounts of a product, the depositor apparatus comprising:
a product source;
a pump that pumps the product from the product source to at least a first deposit valve and a second deposit valve;
a first flow meter in communication with the first deposit valve, the first flow meter measures product flowing through the first flow meter, the first flow meter including a first processor that controls the first deposit valve by closing the first deposit valve at a first valve shutoff point; and
a second flow meter in communication with the second deposit valve, the second flow meter measures product flowing through the second flow meter, the second flow meter including a second processor that controls the second deposit valve by closing the second deposit valve at a second valve shutoff point.
19. The depositor apparatus of claim 18, wherein the first valve shutoff point is different than the second valve shutoff point.
20. The depositor apparatus of claim 18 wherein the pump operates continuously during a deposit mode of the apparatus, a recirculation path is provided for flowing product back to the product source when both the first deposit valve and second deposit valve are closed, the recirculation path includes a pressure regulation valve for varying flow along the recirculation path, a pressure sensor is located for detecting a supply pressure of

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product being delivered to the first and second deposit valves, and the pressure regulation valve is responsively controlled to maintain a set supply pressure.

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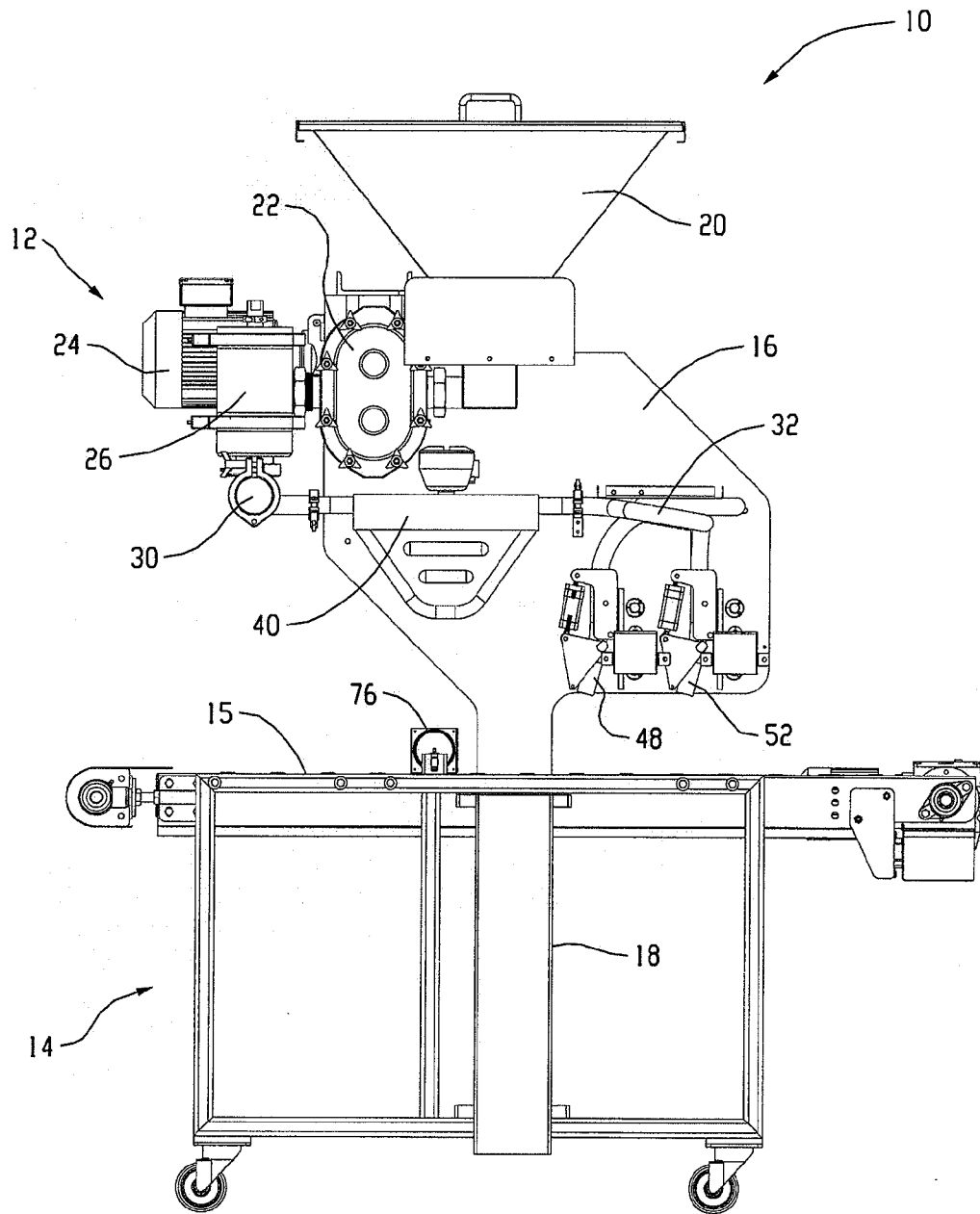


Fig. 1

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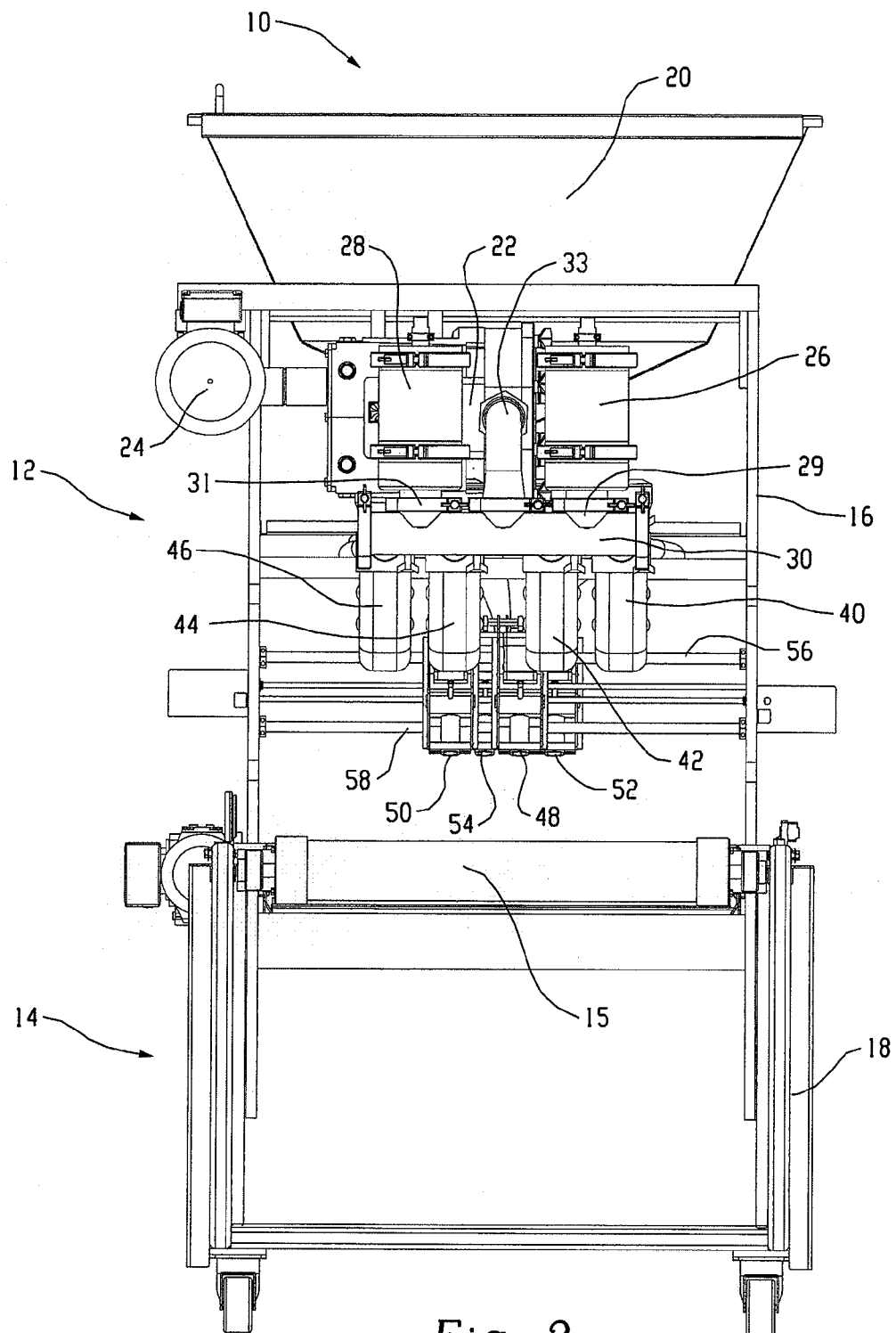


Fig. 2

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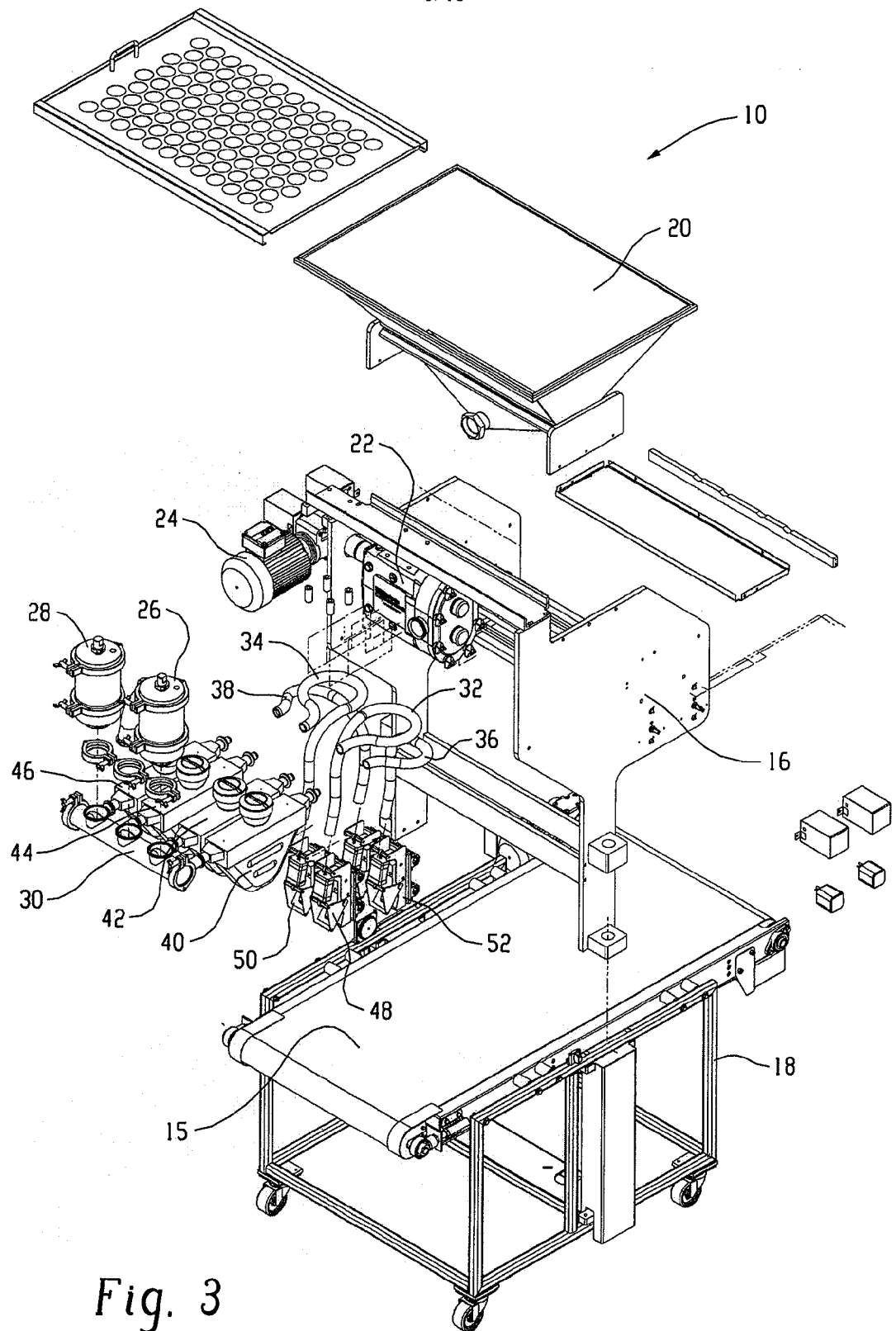
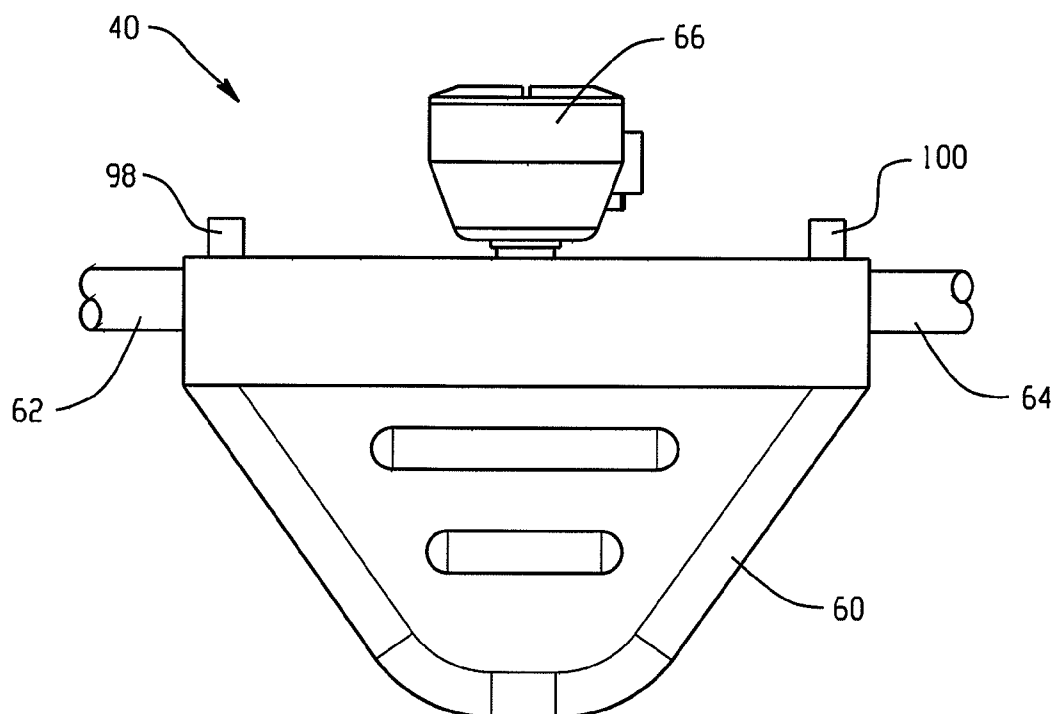
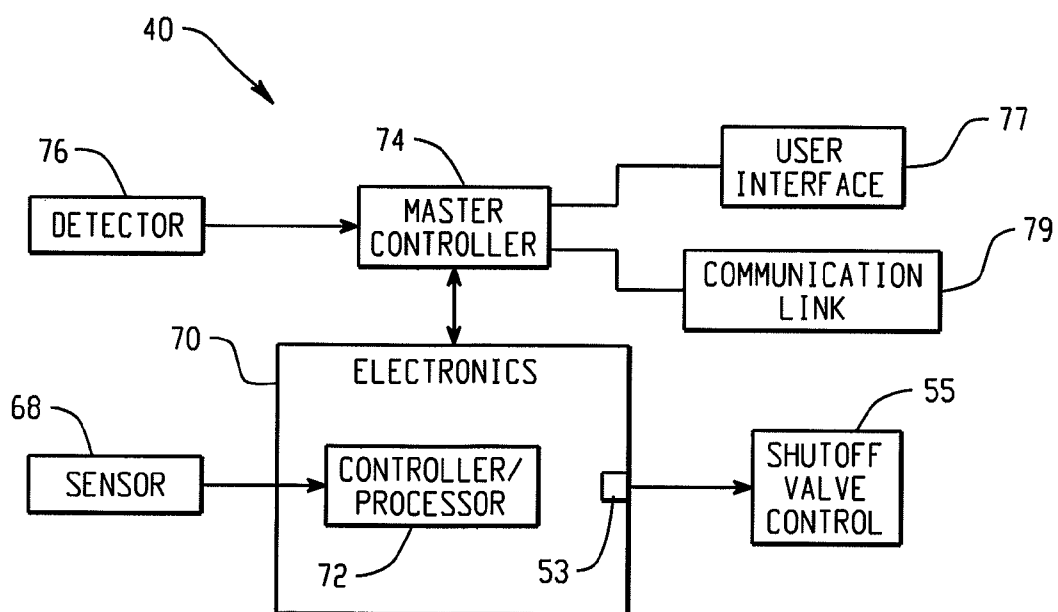
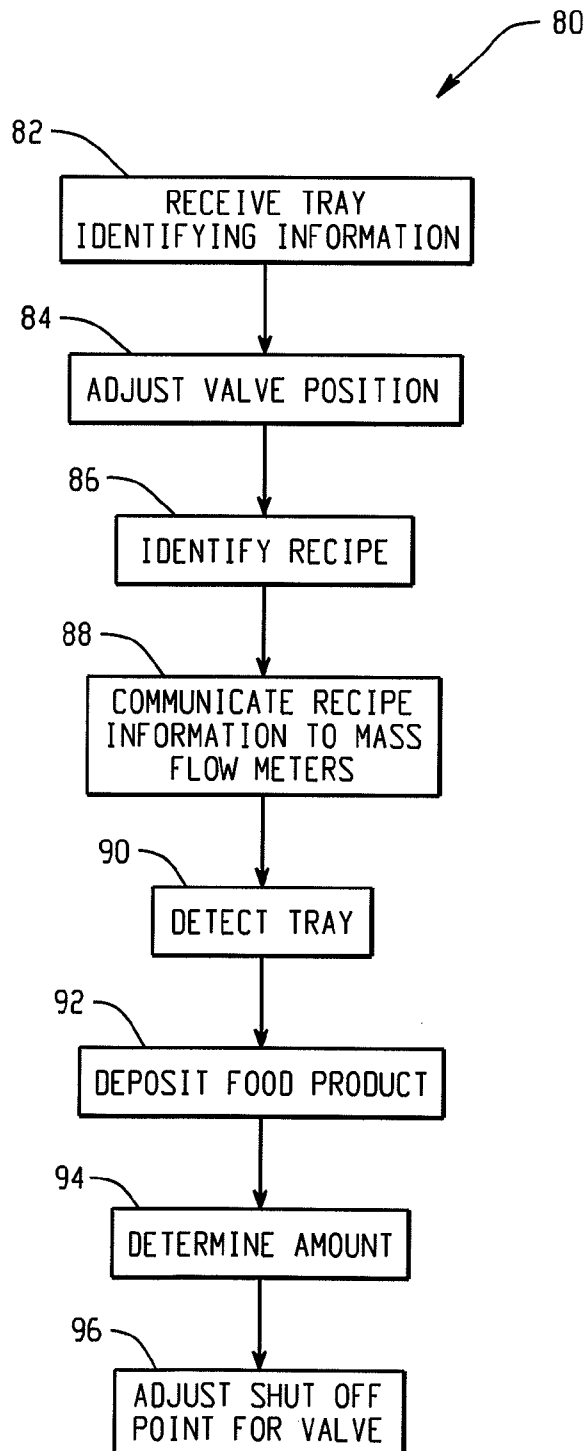


Fig. 3

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*Fig. 4**Fig. 5*

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*Fig. 6*

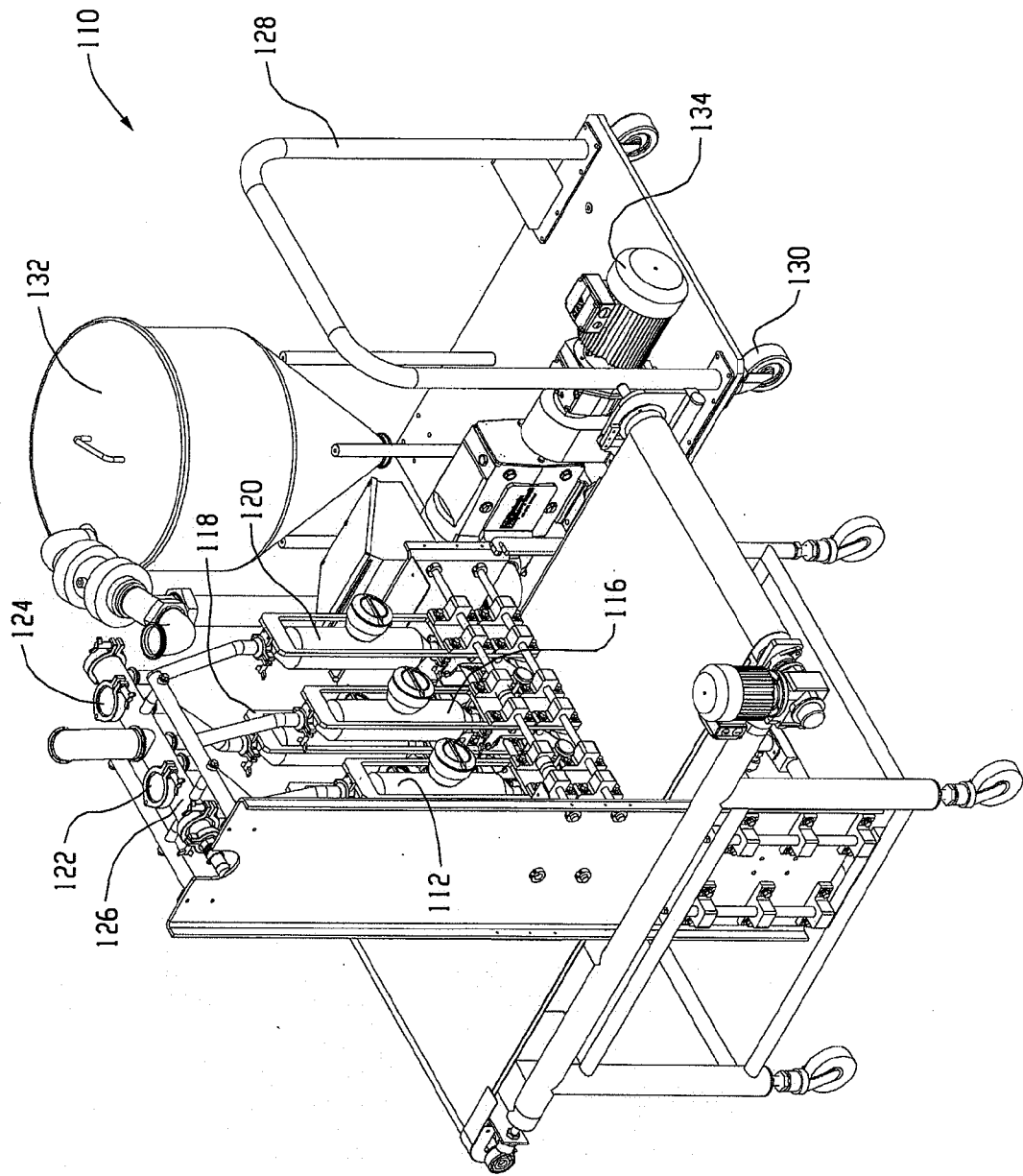


Fig. 7

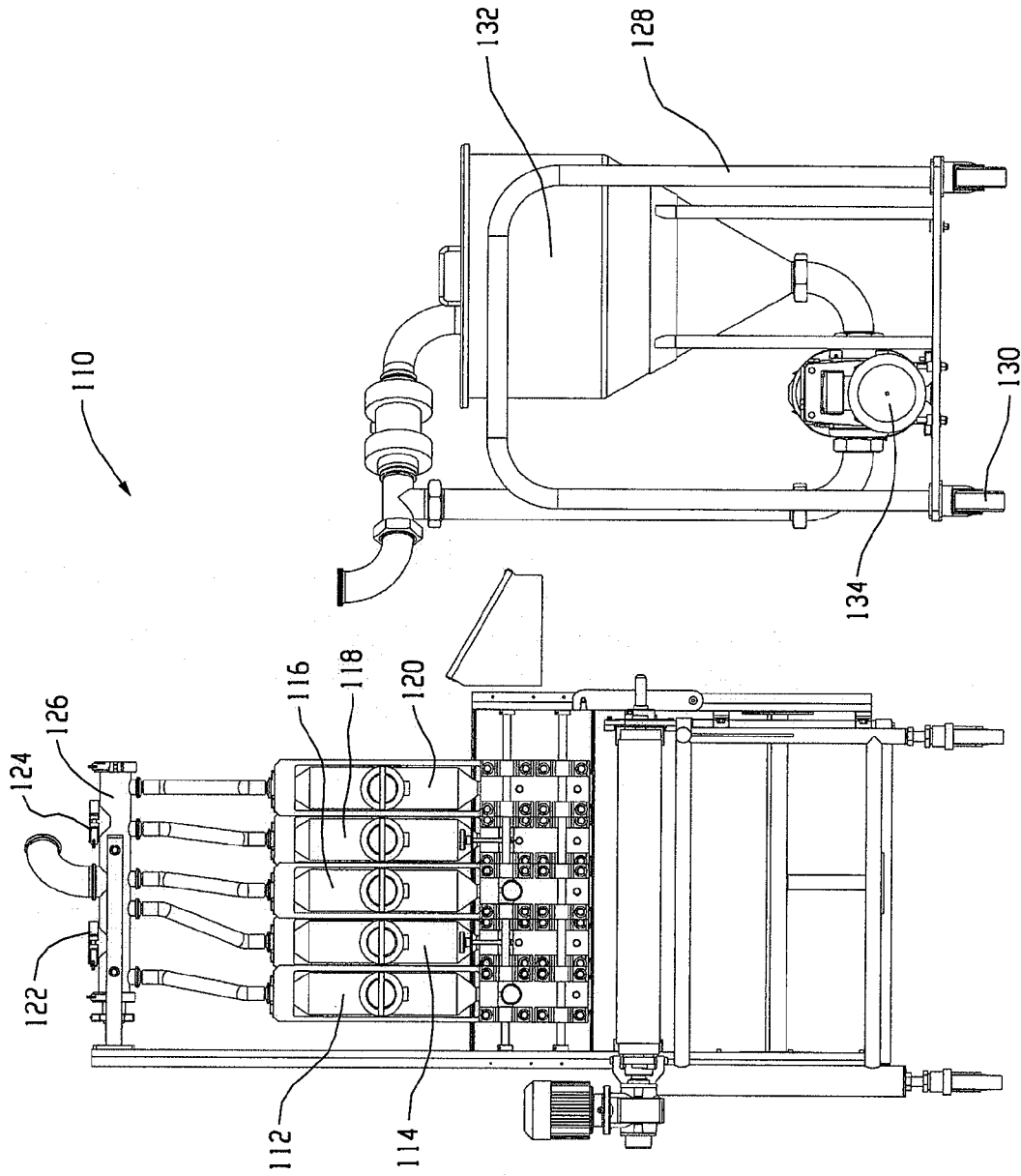


Fig. 8

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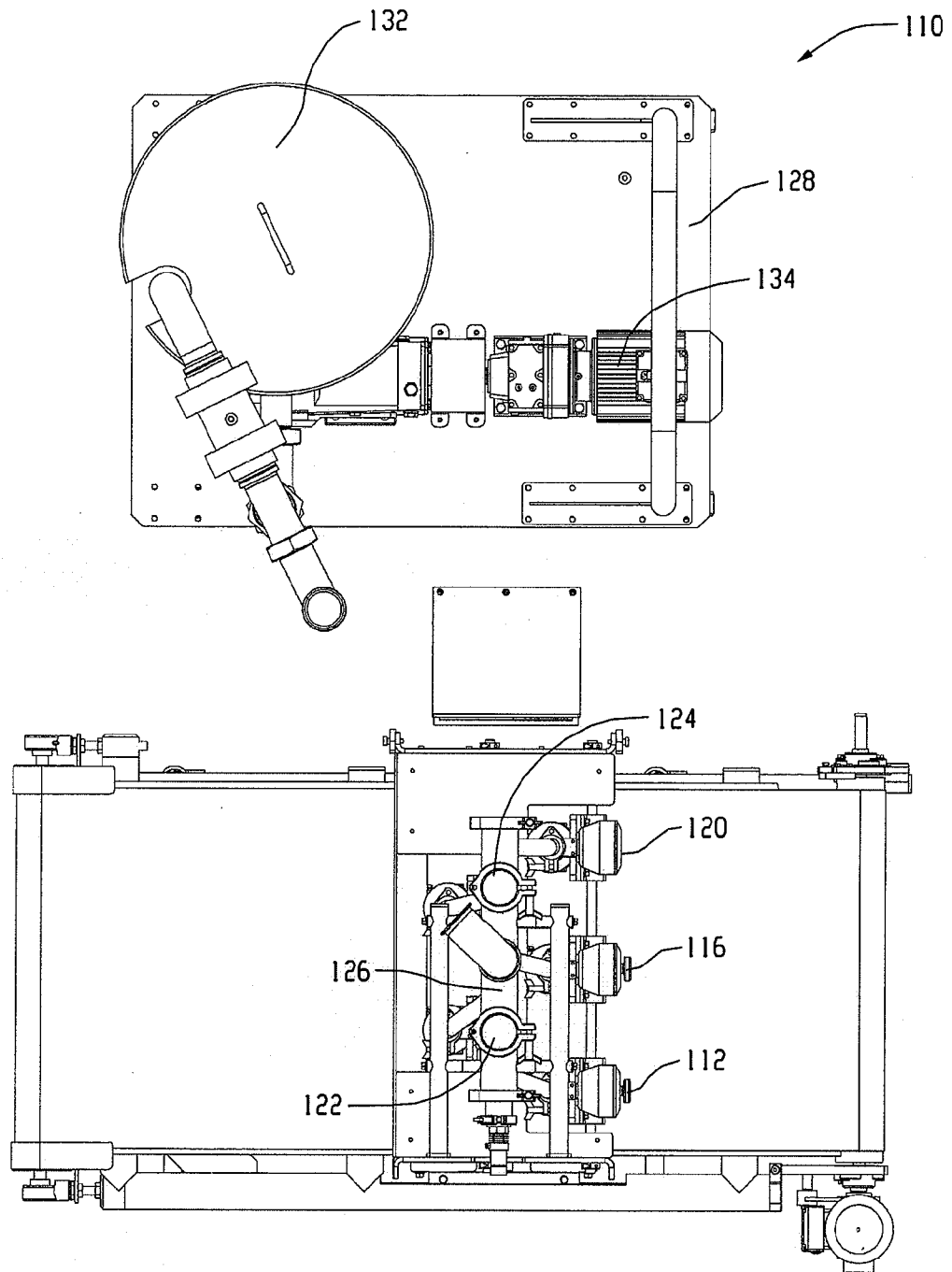


Fig. 9

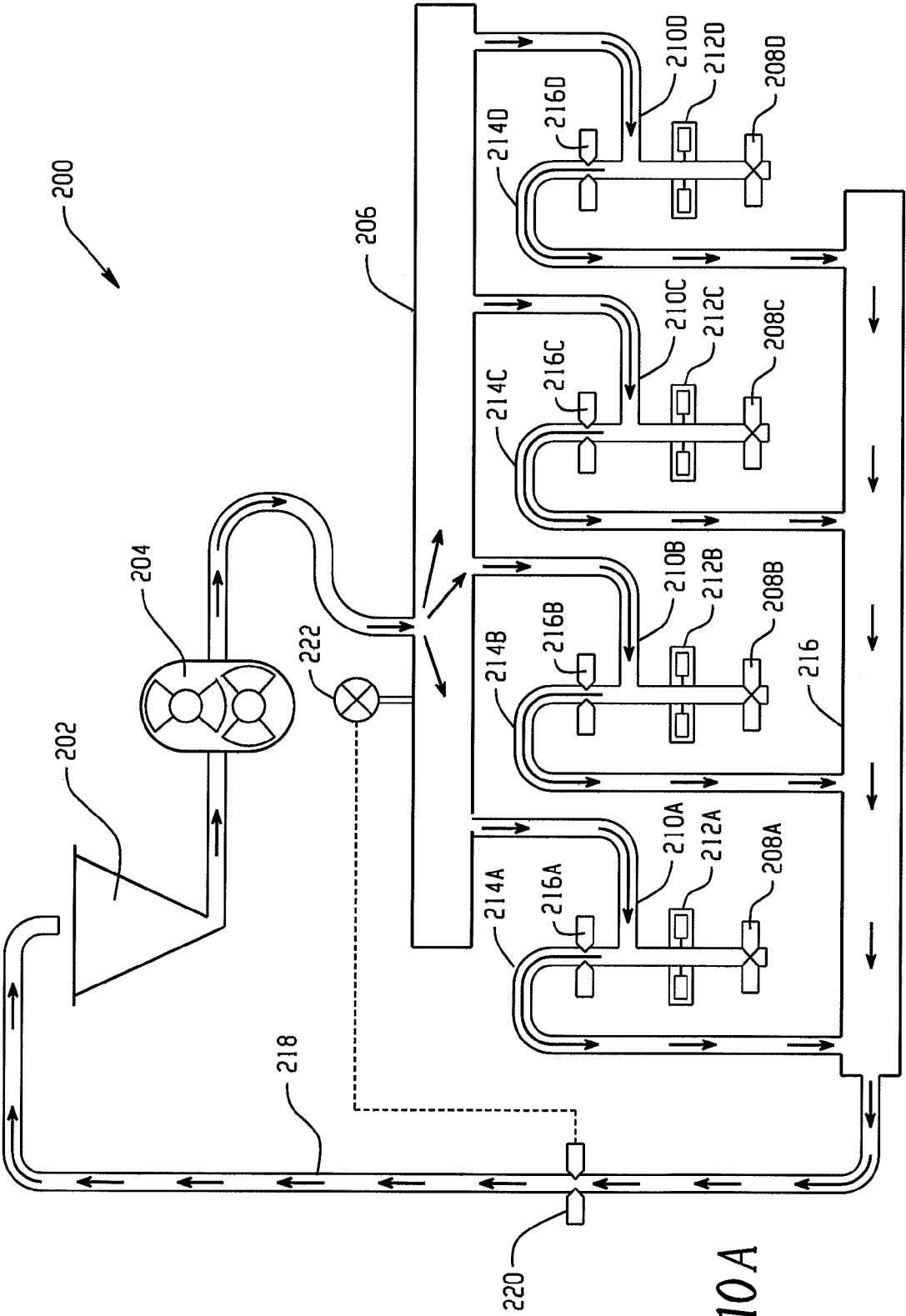


Fig. 10A

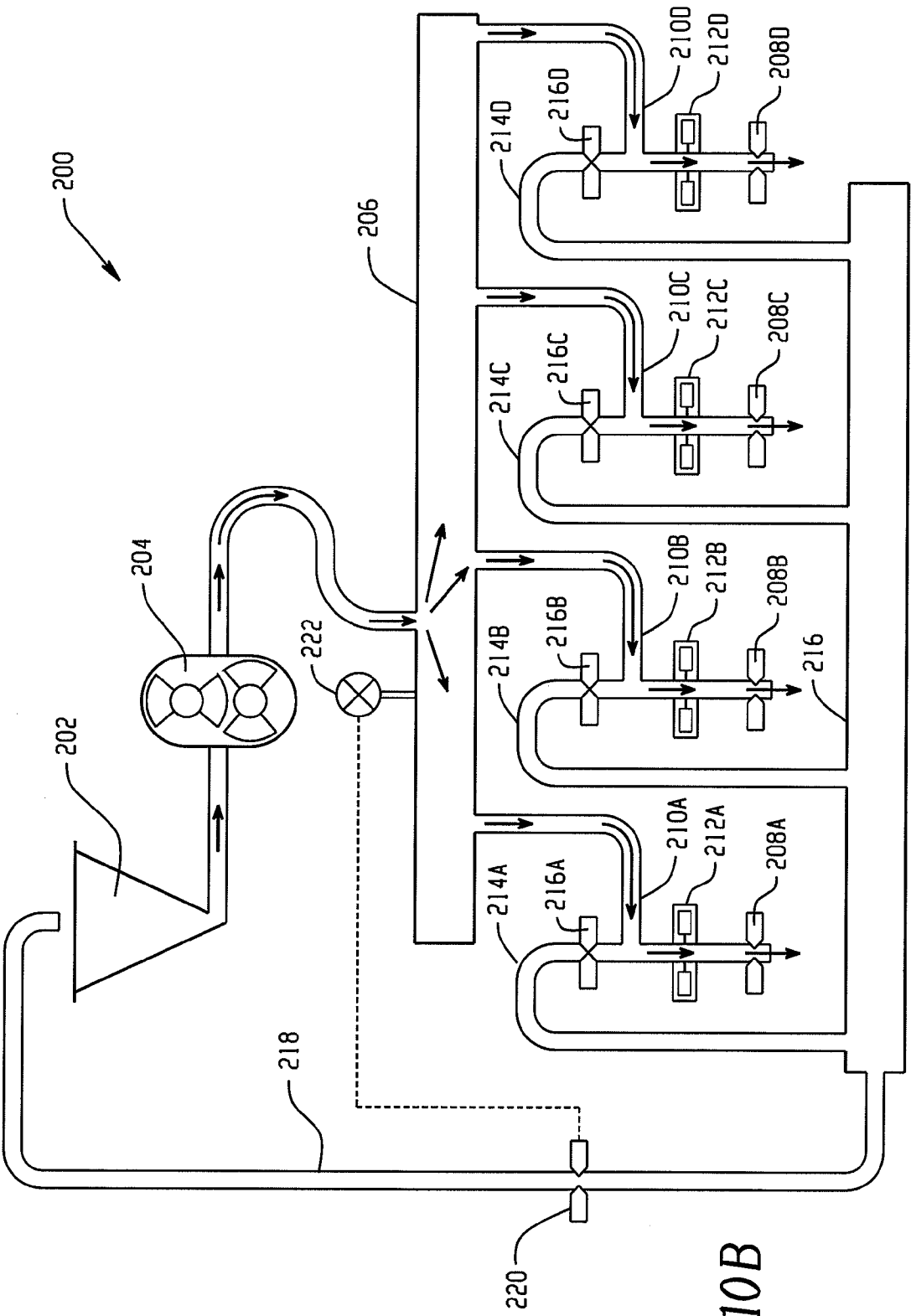


Fig. 10B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2009/067435

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B56B 3/26, B56B 3/00 (2010.01)

USPC - 141/83, 141/94, 141/237

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - B56B 3/26, B56B 3/00 (2010.01)

USPC - 141/83, 141/94, 141/237

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

MicroPatent, Freepatentsonline, Google, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,170,540 B1 (ROMERO) 09 January 2001 (09.01.2001) entire document	1-20
Y	US 6,186,193 B1 (PHALLEN et al) 13 February 2001 (13.02.2001) entire document	1-20
Y	US 5,996,650 A (PHALLEN et al) 07 December 1999 (07.12.1999) entire document	9-16, 20
A	WO 1999/021646 A1 (ALACK) 06 May 1999 (06.05.1999) entire document	1-20

☐ Further documents are listed in the continuation of Box C.


* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

31 January 2010

Date of mailing of the international search report

19 APR 2010

Name and mailing address of the ISA/US

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