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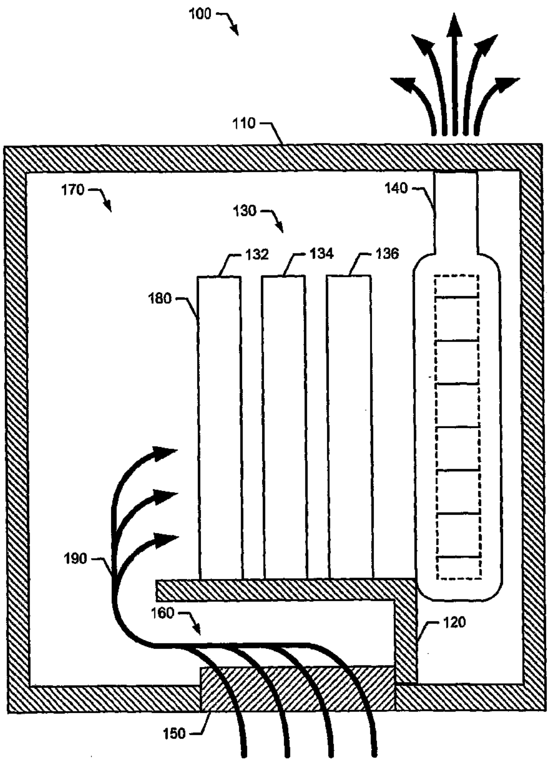
(54) Title: AIR FILTRATION AND PURIFICATION APPARATUS



(57) Abstract: A method and apparatus for processing air is described herein. An example apparatus includes a housing (310), a high-velocity air flow guide (320), a filter assembly (330), and a fan (340). The high-velocity air flow guide (320) includes a first portion (322) and a second portion (324). The first portion (322) is configured to form a passage (360)within the housing (310), and the second portion (324) is configured to divert and accelerate air flow of the ambient air from the passage (360) to a chamber (370) of the housing (310). The filter assembly (330) includes one or more filtering elements configured to receive the ambient air from the chamber (370). The fan (340) is configured to draw the ambient air from the chamber (320) through the filter assembly (330) and to generate processed air from the ambient air.

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AIR FILTRATION AND PURIFICATION APPARATUS

TECHNICAL FIELD

This application claims priority to U.S. non-provisional patent application Serial No. 11/098,202 filed 4 April, 2005.

The present disclosure relates generally to air filtration and purification, and more particularly, to a method and apparatus for processing air.

BACKGROUND ART

Concern over air quality has triggered some developments in the area of indoor air quality improvement and/or control. Such developments have typically resulted in the production of various types of air processing systems including air filtration systems. Air filtration systems are sometimes differentiated according to air filtering capabilities and may include air filtration devices designed to be integrated within a heating, ventilation and air conditioning (HVAC) system and local or unitary air filtration devices. Air filtration devices configured to be integrated with HVAC systems (i.e., integrated air filtration devices) are typically capable of filtering large amounts of ambient air such as, for example, an amount of ambient air that fills a warehouse, an office building, an apartment building, a house, an entertainment hall, etc. In contrast, local or unitary air filtration devices are typically configured to filter an amount of ambient air associated with a local area such as, for example, an office, a bedroom, a bathroom, etc.

Air filters in existing air filtration devices maybe inefficiently used because of the angle at which ambient air enters and is drawn through the air filters. In particular, in some cases, only a relatively small area or space of an air filter is used effectively to trap particles while the rest of the air filter remains unused. As a result, the maintenance cost of air filtration devices may increase because air filters may be prematurely replaced and/or air flow throughput may decrease because the air filtration devices may be frequently turned off for cleaning of the air filters.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts an example air processing system configured in an existing system.

FIG. 2 depicts a front view of a receiving surface of a filter assembly of the example air processing system of FIG. 1.

FIG. 3 depicts an example high-velocity air processing system configured in accordance with the teachings disclosed herein.

FIG. 4 depicts a front view of a receiving surface of a filter assembly of the example high-velocity air processing system of FIG. 3.

FIG. 5 is a block diagram representation of an example processor system that may be used to implement the example method and apparatus described herein.

DETAILED DESCRIPTION OF THE INVENTION

In general, a method and apparatus for processing air are disclosed herein. An example apparatus for processing air includes a housing, a filter assembly, a fan, and a high-velocity air flow guide. The filter assembly includes one or more filtering elements configured to generate filtered air based on ambient air in a chamber of the housing. The fan is configured to draw the ambient air from the chamber through the filter assembly and to generate processed air based on the ambient air. The high-velocity air flow guide includes an upstanding portion and a support portion having a first portion and a second portion. In particular, the first portion is configured to form a passage within the housing, and the second portion is configured to divert the ambient air from the passage to the chamber. Further, the second portion is configured to accelerate the air flow from a first speed to a second speed into the chamber prior to the fan drawing the ambient air from the chamber through the filter assembly. Thus, a cross section view of the air flow from the chamber is substantially the same as the surface area of the receiving portion of the filter assembly. By distributing a volume of ambient air over a greater portion of the front of the filter assembly, the air filters of the filter assembly are used in a relatively efficient manner, and the maintenance cost of the filter assembly may be reduced.

Referring to FIG. 1, an air processing system 100 configured in a known manner typically includes a housing 110, an air flow guide 120, a filter assembly 130, and a fan 140. In general, the air processing system 100 receives ambient air from an intake vent 150 of the housing 110 into a passage 160. The air flow guide 120 is configured to divert or guide the ambient air through the passage 160 and into a chamber 170 of the housing 110. The filter assembly 130 includes one or more air filters 132, 134, and 136, to filter the ambient air from the chamber 170. The fan 140 draws the ambient air from the chamber 170 into the filter assembly 130 via a receiving surface 180 of the filter assembly 130. Typically, the fan 140 immediately draws the ambient air from the passage 160 into the filter assembly 130 in a direction generally indicated by arrows 190. The air flow indicated by the arrows 190 does not permit the chamber 170 to fill with ambient air prior to the fan 140 drawing the ambient air through the filter assembly 130.

Turning to FIG. 2 as an example, the ambient air is substantially filtered through a lower-center portion 210 of the receiving surface 180 of the filter assembly 130. The upper, left, and right portions, generally shown as 220, 230, and 240, respectively, of the receiving surface 180 are substantially unused. Thus, each of the one or more filters of the filter assembly 130 traps contaminants and, thus, becomes clogged in the lower-center portion 210.

Turning now to FIG. 3, a high velocity air processing system 300 configured in accordance with the teachings of the present disclosure is illustrated. The high-velocity air processing system 300 includes a housing 310, a high-velocity air flow guide 320, a filter assembly 330, and a fan 340. In general, the high-velocity air processing system 300 receives ambient air from an intake vent 350 of the housing 310 via a passage 360. The intake vent 350 may be configured to operate in combination with the high-velocity air flow guide 320 as described in detail below by enabling ambient air to flow into a chamber 370 of the housing 310 in a direction generally indicated by arrows 390. The intake vent 350 may include a grate, a screen, and/or a large particle filter (none of which are shown). In one implementation, a layered configuration for the intake vent 350 may include the grate as the outermost layer followed by the screen, and the large particular filter as the innermost layer. The grate may be impact resistant to prevent damage to the screen, the large particle filter, and the portions of the high-velocity air processing system 300 located within the housing 310. The screen may be configured to prevent relatively large objects (e.g., paper, coins, food, etc.) from entering into the housing 310. The large particle filter may be configured to prevent relatively large particles (e.g., dust, hair, lint, liquid, etc.) from entering the housing 310.

Although the housing 310 is shown as having a relatively cubical structure, any other geometry or structure may be used to implement the housing 310 including, for example, a pyramidal structure, a cylindrical structure, a trapezoidal structure, etc. In the illustrated example, however, the housing 310 is cubical in shape and includes a bottom panel 311A, a plurality of upstanding side panels 311B, and a top panel 311C. The intake vent 350 is approximately centrally located in the bottom panel 31IA, thereby enabling air to be drawn into the chamber 370 through the bottom of the housing 310. The housing 310 may include at least one vertical riser (not shown) upon which the housing 310 sits, such that the intake vent 350 is elevated above a support structure of the housing (e.g. a floor), to allow air to flow into the chamber 370 through the intake vent 350.

The high-velocity air flow guide 320 includes an upstanding portion 320A extending upward from the bottom panel 311A, and a support portion 320B extending over and generally parallel to the face of the vent 350. The support portion 320B is adapted to support the filter assembly 330. As shown, the filter assembly 330 is centrally located in the housing 310 and rests upon the support portion 320B of the high-velocity air flow guide 320. While the filter assembly 330 is shown as extending less than the distance between the support portion 320B and the top panel 311C, the filter assembly 330 and each individual filter within the assembly 330 may extend any amount between the support portion 320B and the top panel 311C.

Also located with the housing 310 is the fan 340. The fan 340 is located to a side of the filter assembly 330 opposite the chamber 370. The fan 340 includes an output vent 342 located in the top panel 311C. The output vent 342 allows the fan 340 to draw air from the chamber 370 through the filter assembly 330 and exhaust out the vent 342.

The housing 310 may also include an access panel and/or a control panel (neither of which are shown). Th e access panel may be configured to enable access to the filter assembly 330 and/or the fan 340 within the housing 310 for maintenance, inspection, and/or any other purpose. The control panel may be mechanically and/or electrically coupled to the housing 310 and configured to provide data input and output capabilities for controlling and/or monitoring any aspect of the high-velocity air processing system 300. For example, the control panel may be used to control operational states of the high-velocity air processing system 300. In addition, the control panel may be used to access status information associated with operations and/or status of the high-velocity air processing system 300.

The support portion 320B of the high-velocity air flow guide 320 (e.g., an air flow guide) includes a first portion 322 and a second portion 324. The high-velocity air flow guide 320 may be implemented using plastic, metal, and/or other suitable material. The first portion 322 is configured to receive ambient air from the intake vent 350 (i.e., an intake structure) and form the passage 360 in conjunction with the intake vent 350. The second portion 324 is configured to accelerate the ambient air from the passage 360 into a chamber 370 of the housing 310 to generate a high-velocity air flow in a direction generally indicated by the arrows 390. In particular, the second portion 324 diverts or guides the ambient air into the chamber 370 so that the ambient air is generally evenly distributed relative to a receiving surface 380 of the filter assembly 330 as the fan 340 draws the ambient air from the chamber 370 through the filter assembly 330. The second portion 324 may be, for example, a radial portion or curved lip to accelerate the ambient air into the chamber 370 in the manner shown and described. For example, the air traveling through the passage 360 may accelerate over the radial second portion 324 so that the speed of the air after the radial second portion 324 is greater than the speed of the air in the passage 360.

Referring now to FIG. 4, in this example, the second portion 324 diverts or guides the ambient air from the passage 360 into the chamber 370 so that more area of the receiving surface 380 of the filter assembly 330 is used. By distributing the ambient air more evenly throughout the receiving surface 380, the second portion 324 increases air flow throughput. In contrast to the receiving surface 180 shown in FIGS. 1 and 2 for example, the second portion 324 diverts ambient air from the passage 360 and accelerates air flow of the ambient air into the chamber 370 prior to the fan 340 drawing the ambient air through the filter assembly 330. Thus, the time between filter replacements or cleanings may be extended. For example, the filter assembly 330 may be rated for operation based on an amount of time or a volume of air that is processed in particular, the filter assembly 330 may be rated to operate for a predetermined amount of time (at a constant flow) before needing to be replaced or cleaned. Alternatively, the filter assembly 330 may be rated to operate for a predetermined total volume of air before needing to be replaced or cleaned. By increasing the life of the filter assembly 330, maintenance costs may be reduced.

Although the high-velocity air flow guide 320 is depicted in FIG. 3 as a single, integrated structure, the upstanding portion 320A and the support portion 320B including the first portion 322 and the second portion 324 may be separate structures operatively coupled to each other. For example, the second portion 324 may be a separate structure, adjustably coupled to the first portion 322 so that the second portion 324 may be adjusted to increase/decrease the second air flow speed. For instance, the second portion 324 may be flexibly or pivotally attached to the first portion 322.

The filter assembly 330 may include a plurality of air filter elements, generally shown as a first filter 332, a second filter 334, and a third filter 336, to process the ambient air from the chamber 370. For example, the first filter 332 may be a pre-filter, the second filter 334 may be a High Efficiency Particulate Accumulator (HEPA) filter, and the third filter 336 may be a charcoal filter. In particular, the first filter 332 may be an electrostatic filter or a pleated filter having antimicrobial properties. The first filter 332 may be used to pre-filter the ambient air that is drawn into the housing 310 via the intake vent 350 to remove relatively large pollutants or particles (e.g., dust, lint, etc.) from the ambient air. The HEPA filter used to implement the second filter 334 may be used to capture many bacteria, viruses, allergens (e.g., pollens, spores, smoke, etc.), and other relatively small organisms or particles that may be found in ambient air. The charcoal filter used to implement the third filter 336 may be used to remove volatile organic compounds (VOC) (e.g., certain chemicals, gases, etc.) and odors from the ambient air.

Although the filter assembly 330 is depicted in FIG. 3 to include three filters, the filter assembly 330 may include more or fewer filters. Further, the illustrated filter assembly 330 is positioned so that the receiving surface 380 of the filter assembly 330 is substantially perpendicular relative to the intake vent 350. That is, the receiving surface 380 is parallel to a plane that is substantially perpendicular to the intake vent 350. In this manner, the ambient air is drawn into the housing 310 by the fan 340 via the intake vent 350 in a direction generally indicated by arrows 390. Alternatively, the filter assembly 330 may be skewed at an angle relative to the intake vent 350. For example, the receiving surface 380 may be parallel to a plane that intersects the intake vent 350 at an angle other than perpendicular. Further, one filter of the filter assembly 320 may be disposed in a first position relative to the intake vent 350 and another filter of the filter assembly 330 may disposed in a second position relative to the intake vent 350. For example, the first filter 332 may be skewed at an angle relative to the intake vent 350, whereas the second filter 334 may be substantially perpendicular relative to the intake vent 350.

The fan 340 may be a squirrel cage fan, or any other type of fan configured to draw ambient air from the intake vent 350 into the housing 310 through the filter assembly 330 and push or exhaust processed air out of the housing 310 through the vent 342. The fan 340 may be a variable speed fan communicatively coupled to and controlled by an information processing system 390 via a link 392. For example, the speed of the fan 340 may be controlled based on information received by the information processing system 390.

The information processing system 390 may be implemented using any processing system, including, by way of example, a computer, an application specific integrated circuit (ASIC), a processor system or other suitable device. In this example, the information processing system 390 is a processor system 2000 illustrated in FIG. 5 and configured to control and/or monitor operations of the high-velocity air processing system 300. The information processing system 390 may be communicatively coupled to the control panel (not shown) and configured to receive commands entered via the control panel by a person. In addition, the information processing system 390 may be configured to display information via the control panel, or other suitable display.

The method and apparatus disclosed herein may be integrated within devices such as, for example, a kiosk, an information booth, an automated teller machine, a public telephone, an advertisement apparatus, a computer terminal, etc. to process ambient air.

FIG. 5 is a block diagram of an example processor system 2000 adapted to be implemented as the information processing system 390. The processor system 2000 may be, for example, a desktop computer, a personal computer, a dedicated computer, a laptop computer, a notebook computer, a personal digital assistant (PDA), a server, an Internet appliance or any other type of computing device.

In this example, the processor system 2000 illustrated in FIG. 5 includes a chipset 2010, which includes a memory controller 2012 and an input/output (I/O) controller 2014. As is well known, a chipset typically provides memory and I/O management functions, as well as a plurality of general purpose and/or special purpose registers, timers, etc. that are accessible or used by a processor 2020. The processor 2020 is implemented using one or more processors. The processor 2020 includes a cache 2022, which may be implemented using a first-level unified cache (L1), a second-level unified cache (L2), a third-level unified cache (L3), and/or any other suitable structures to store data.

As is conventional, the memory controller 2012 performs functions that enable the processor 2020 to access and communicate with a main memory 2030 including a volatile memory 2032 and a non-volatile memory 2034 via a bus 2040. The volatile memory 2032 may be implemented by Synchronous Dynamic Random Access Memory (SDRAM), Dynamic Random Access Memory (DRAM), RAMBUS Dynamic Random Access Memory (RDRAM), and/or any other type of random access memory device. The non-volatile memory 2034 may be implemented using flash memory, Read Only Memory (ROM), Electrically Erasable Programmable Read Only Memory (EEPROM), and/or any other desired type of memory device.

The processor system 2000 also includes an interface circuit 2050 that is coupled to the bus 2040. The interface circuit 2050 may be implemented using any type of well known interface standard such as an Ethernet interface, a universal serial bus (USB), a third generation input/output interface (3GIO), and/or any other suitable type of interface. Additionally, the interface 2050 may couple the processing system to the fan 240 via the link 392.

One or more input devices 2060 are connected to the interface circuit 2050. The input device(s) 2060 permit a user to enter data and commands into the processor 2020. For example, the input device(s) 2060 may be implemented by a keyboard, a mouse, a touch-sensitive display, a track pad, a track ball, an isopoint, and/or a voice recognition system.

One or more output devices 2070 are also connected to the interface circuit 2050. For example, the output device(s) 2070 may be implemented by display devices (e.g., a light emitting display (LED), a liquid crystal display (LCD), a cathode ray tube (CRT) display, a printer and/or speakers). The interface circuit 2050 thus typically includes, among other things, a graphics driver card.

The processor system 2000 also includes one or more mass storage devices 2080 to store software and/or data. Examples of such mass storage device(s) 2080 include floppy disks and drives, hard disk drives, compact disks and drives, and digital versatile disks (DVD) and drives.

The interface circuit 2050 also includes a communication device such as a modem or a network interface card to facilitate exchange of data with external computers via a network. The communication link between the processor system 2000 and the network may be any type of network connection such as an Ethernet connection, a digital subscriber line (DSL), a telephone line, a cellular telephone system, a coaxial cable, etc.

Access to the input device(s) 2060, the output device(s) 2070, the mass storage device(s) 2080 and/or the network is typically controlled by the I/O controller 2014 in a conventional manner. In particular, the I/O controller 2014 performs functions that enable the processor 2020 to communicate with the input device(s) 2060, the output device(s) 2070, the mass storage device(s) 2080 and/or the network via the bus 2040 and the interface circuit 2050.

While the components shown in FIG. 5 are depicted as separate blocks within the processor system 2000, the functions performed by some of these blocks may be integrated within a single semiconductor circuit or may be implemented using two or more separate integrated circuits. For example, although the memory controller 2012 and the I/O controller 2014 are depicted as separate blocks within the chipset 2010, the memory controller 2012 and the 110 controller 2014 may be integrated within a single semiconductor circuit.

In one example of operation, the processor system 2000 may control the speed of the fan 340 to process air through the air processing system 300. For instance, the processor system 2000 may start the fan 340, causing air to be drawn into the system 300. The system 300 receives the ambient air from the intake vent 350 of the housing 310 wherein the ambient air is diverted by the air flow guide 320 in the chamber 370 through the passage 360. The air flow guide 320 accelerates the air flow from a first air flow speed to a greater second air flow speed as the second portion 324 of the support portion 320B diverts the air into the chamber 370. The second portion 324 diverts or guides the ambient air from the passage 360 into the chamber 370 so that more area of the receiving surface 380 of the filter assembly 330 is used. For instance, a cross sectional view of the air flow from the chamber 370 onto the filter assembly 330 is substantially the same as the area of the receiving surface 380 of the filter assembly 330. From there, the ambient air travels through the filter assembly 330, into the fan 340, and exhausts out the vent 342 as processed and filtered air.

Although certain example methods and apparatuses have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all embodiments and modifications falling within the scope of the appended claims either literally or under the doctrine of equivalents.

What is claimed is:

1. An apparatus for processing air comprising:

a filter assembly having one or more filtering elements configured to receive ambient air from a chamber of a housing, the filter assembly including a receiving surface having an area;

an air flow guide located proximate an intake vent of the housing and having a first portion and a second portion, the first portion being configured to form a passage within the housing between the input vent and the second portion, and the second portion being configured to divert and accelerate air flow of the ambient air from the passage to the chamber such that a cross sectional area of the air flow in the chamber is substantially the same as the area of the receiving surface of the filter assembly; and

a fan configured to draw the ambient air from the chamber through the filter assembly and to generate processed air based on the ambient air.

2. An apparatus as defined in claim 1, wherein the air flow guide is configured to cause the air flow to change from a first air flow speed to a second air flow speed greater than the first air flow speed.

3. An apparatus as defined in claim 1, wherein the one or more filtering elements comprise one or more filtering elements arranged substantially perpendicular to the intake vent of the housing.

4. An apparatus as defined in claim 1, wherein the second portion comprises a curved portion.

5. An apparatus as defined in claim 1, wherein the one or more filtering elements comprise an electrostatic filter element, a high efficiency particulate accumulator filter element, or a charcoal filter element.

6. An apparatus as defined in claim 1, wherein the second portion is flexibly or pivotally attached to the first portion.

7. An apparatus for processing air comprising:

a housing having a chamber and an intake vent configured to receive ambient air;

a filter assembly having one or more filtering elements configured to receive the ambient air from the chamber, the one or more filtering elements being one of perpendicular or skewed relative to the intake vent;

a fan configured to draw the ambient air from the chamber through a receiving surface of the filter assembly and to generate processed air based on the ambient air; and

an air flow guide located proximate the intake vent and having a first portion and a second portion, the first portion being configured to define a passage between the second portion and the intake vent, and the second portion being configured to divert the ambient air from the passage to the chamber prior to the fan drawing the ambient air through the filter assembly so that a cross section associated with the air flow of the ambient air from the chamber is substantially distributed across a surface area associated with the receiving portion of the filter assembly.

8. An apparatus as defined in claim 7, wherein the air flow guide is configured to cause the air flow to change from a first air flow speed to a second air flow speed greater than the first air flow speed.

9. An apparatus as defined in claim 7, wherein the second portion comprises a radial or curved portion.

10. An apparatus as defined in claim 7, wherein the one or more filtering elements comprise an electrostatic filter element, a high efficiency particulate accumulator filter element, or a charcoal filter element.

11. An air filtration system comprising:

a housing having a bottom wall, and at least on side wall supporting a top wall to enclose an inner chamber;

an intake vent formed in the bottom wall and adapted to intake air from outside the housing;

an air flow guide adapted to divert ambient air from the intake vent into a first portion of the inner chamber, the air flow guide having a first portion and a second portion, the first portion adapted to form a passage between the intake vent and the second portion, and the second portion adapted to divert and accelerate the air from the passage to the inner chamber to form an air flow;

a filter assembly supported on the air flow guide;

a fan located within a second portion of the inner chamber opposite the first portion of the inner chamber and adapted to draw air from the first portion of the inner chamber through the filter assembly; and

an output vent formed in the top wall and adapted to discharge air outside the housing.

12. The air filtration system of claim 11, wherein the second portion of the air flow guide comprises a radial portion.

13. The air filtration system of claim 11, wherein the intake vent is substantially centrally located in the bottom wall, and wherein the air flow guide diverts the ambient air from the intake vent toward the at least one side on the wall.

14. The air filtration system of claim 13, wherein the filter assembly is located above the intake vent.

15. The air filtration system of claim 11, wherein the filter assembly includes a receiving surface having a surface area, and wherein a cross section associated with the air flow of the air is substantially distributed across the surface area associated with the receiving surface of the filter assembly.

16. The air filtration system of claim 11, wherein the second portion is adjustably coupled to the first portion.

17. A method for processing air comprising:

receiving ambient air from an intake vent of a housing into a passage;

diverting the ambient air from the passage into a chamber of the housing via an air flow guide having a first portion and a second portion, the first portion and the intake vent being configured to form the passage;

accelerating air flow of the ambient air from a first air flow speed to a second air flow speed as the second portion diverts the ambient air into the chamber, the second air flow speed being greater than the first air flow velocity;

drawing the ambient air from the chamber into a filter assembly having one or more filtering elements configured to generate processed air; and discharging the processed air through an output vent of the housing.

18. A method as defined in claim 17, wherein drawing the ambient air from the chamber into the filter assembly comprises drawing the ambient air from the chamber so that a cross section associated with the air flow of the ambient air from the chamber is substantially distributed across a surface area associated with the receiving portion of the filter assembly.

19. A method as defined in claim 17, wherein accelerating the air flow of the ambient air comprises accelerating air flow about a curved portion of the second portion of the air flow guide.

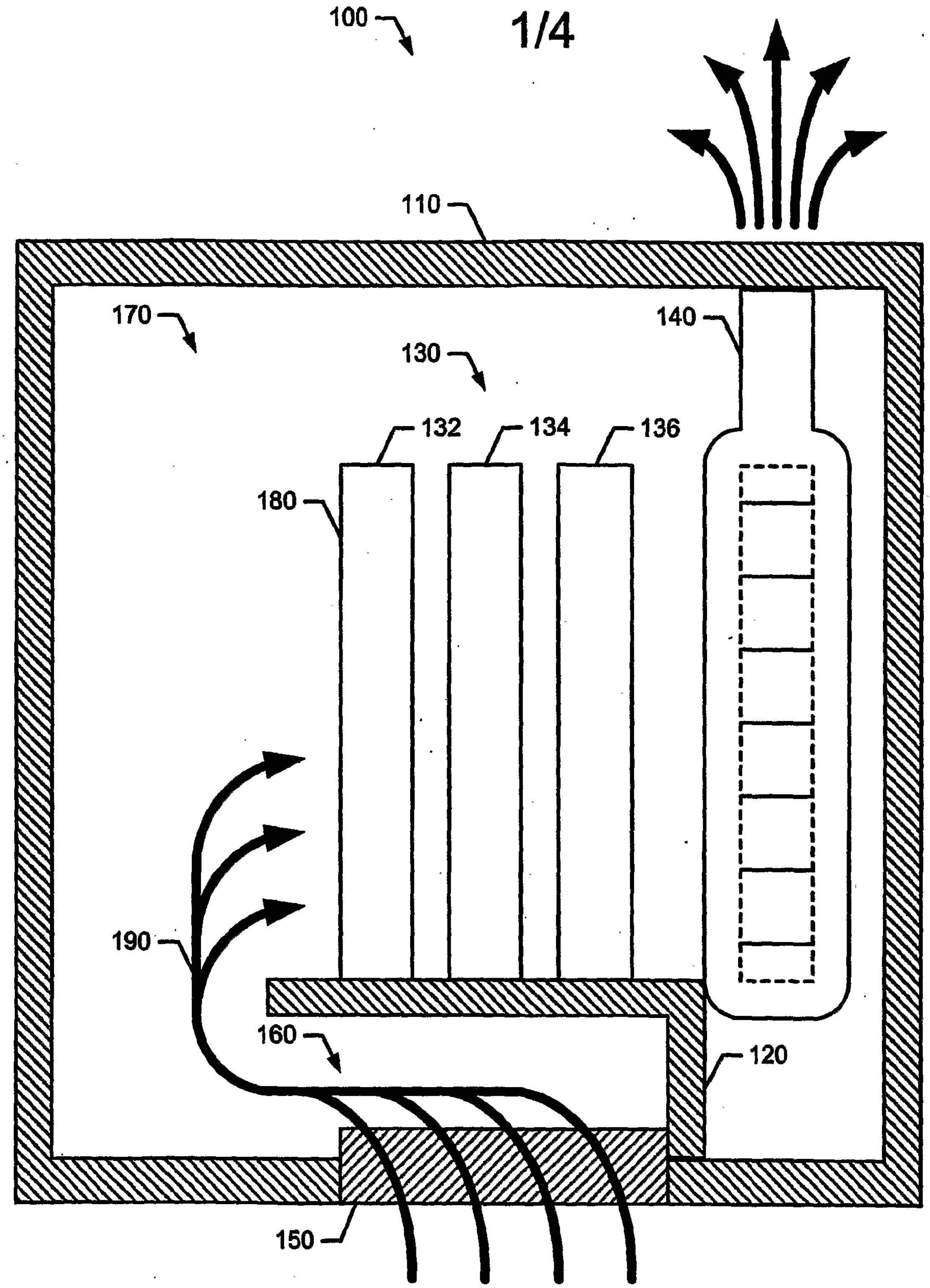
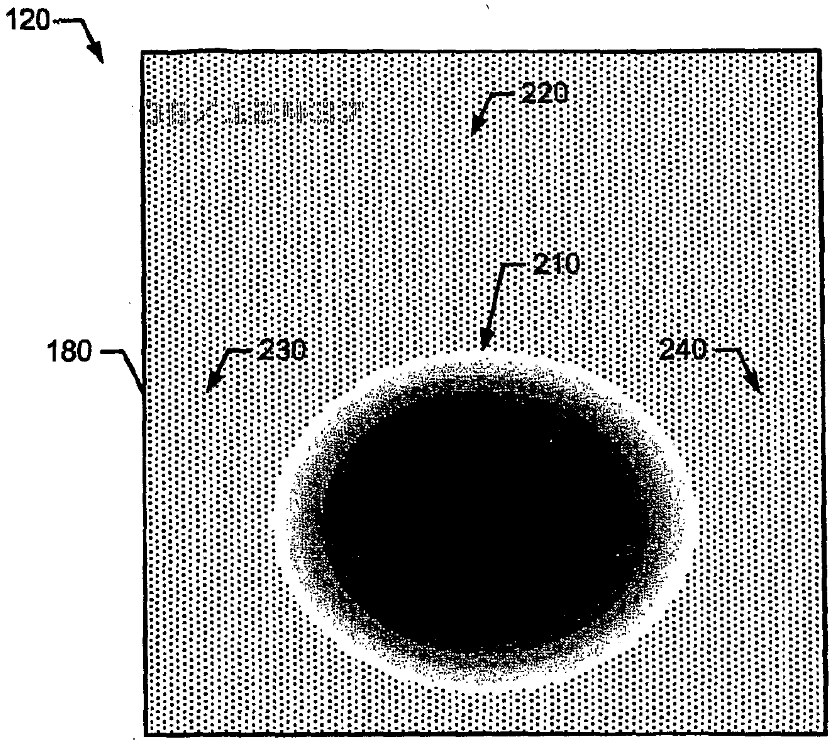


FIG. 1



(PRIOR ART)
FIG. 2

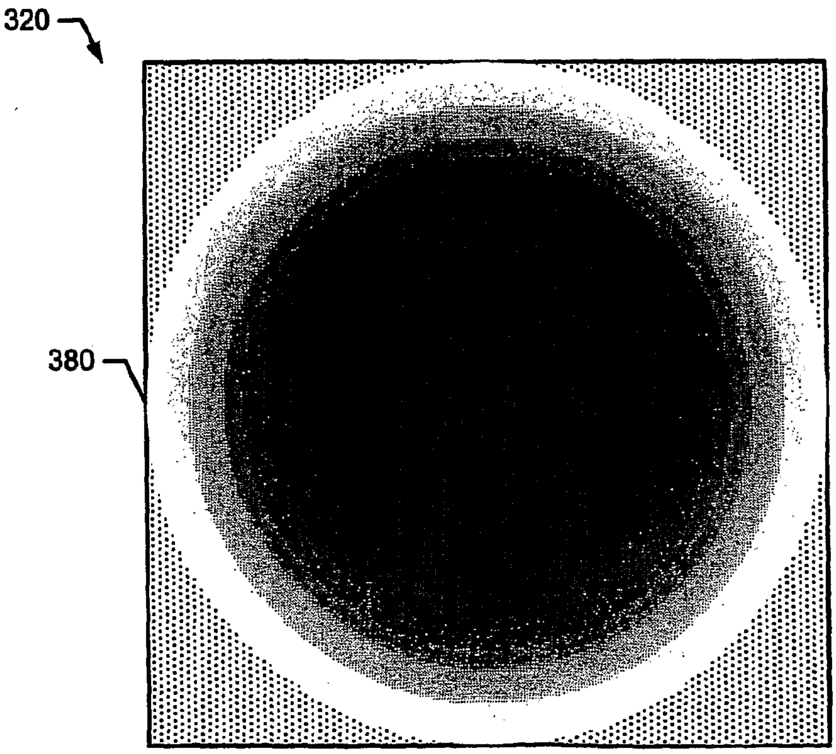
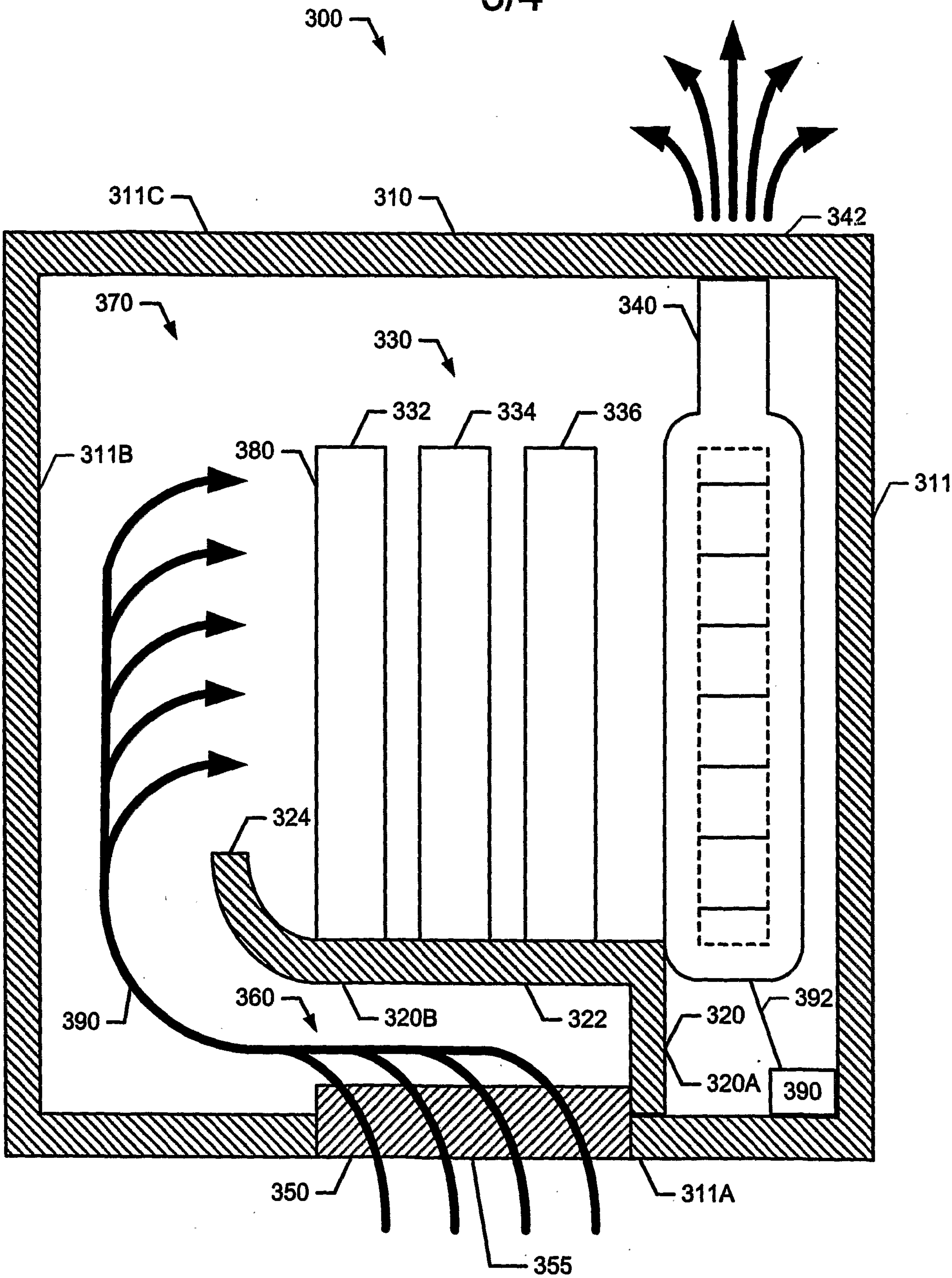


FIG. 4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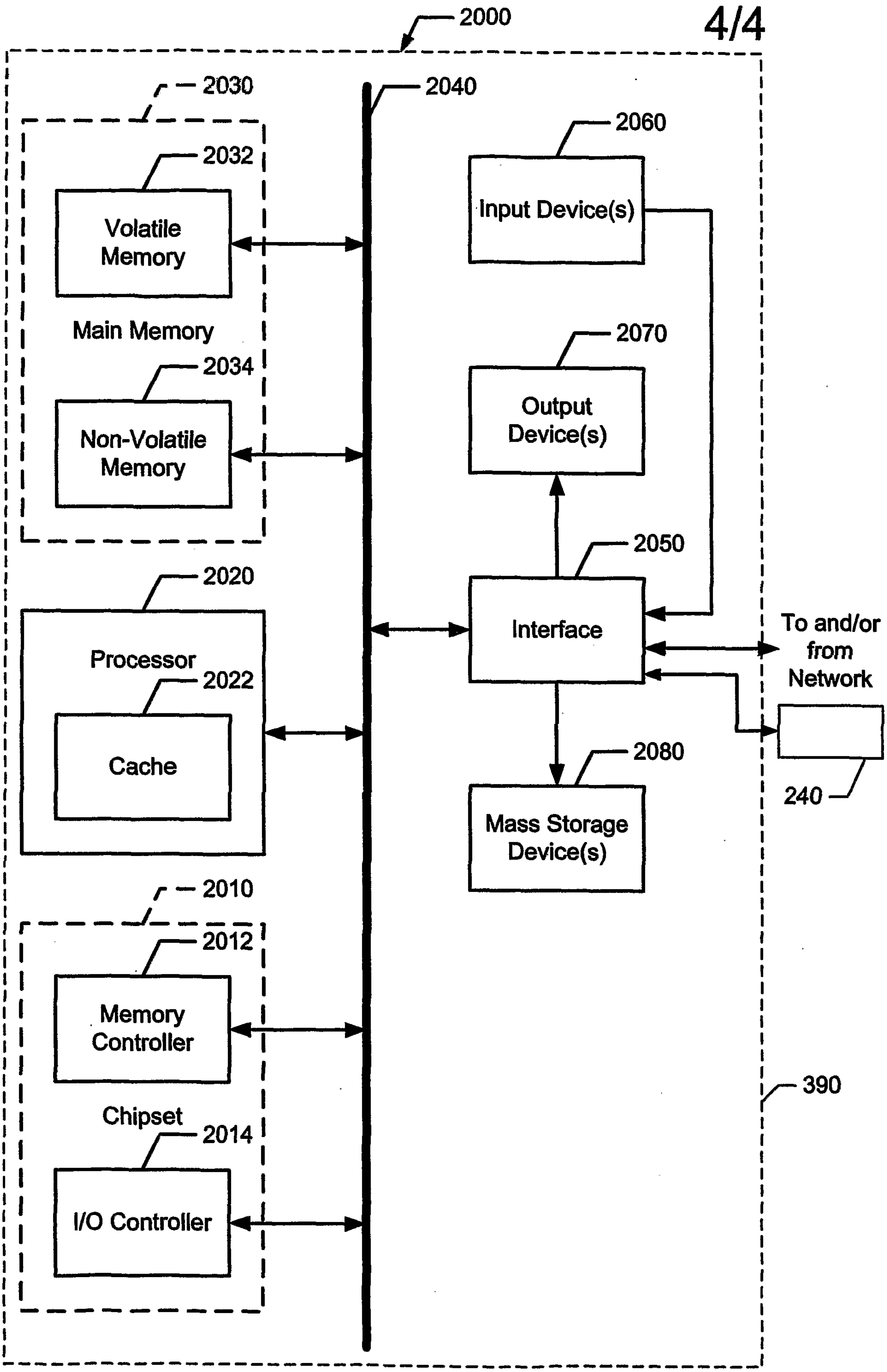
311A
355

FIG. 3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2030
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Main Memory
2034
Non-Volatile Memory
2020
Processor
2022
Cache
2010
2012
Memory Controller
Chipset
2014
I/O Controller
2040
2060
Input Device(s)
2070
Output Device(s)
2050
Interface
2080
Mass Storage Device(s)
To and/or from Network
240
390

FIG. 5