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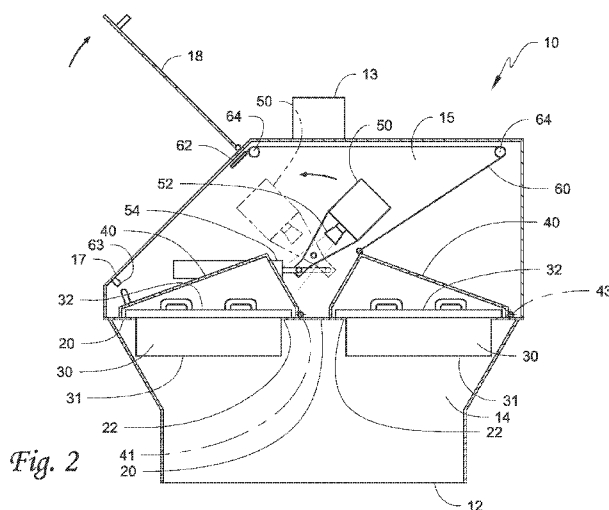
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(57) Abstract: Dust collectors with single side service access and methods of servicing the dust collectors are described herein. In one or more embodiments, the dust collectors include rotating accumulators within a clean air plenum of the dust collector. In one or more embodiments, the dust collectors described herein may include a reverse pulse cleaning system having a first cleaning position and a second cleaning position with the reverse pulse cleaning system pivoting between the two cleaning positions to provide pulses of pressurized gas to dislodge dust and debris from filter cartridges in different locations in the dust collector.

5 DUST COLLECTORS WITH SINGLE SIDE SERVICE ACCESS AND/OR
PIVOTING REVERSE PULSE CLEANING SYSTEMS

Dust collectors with single side service access and methods of servicing the dust collectors are described herein. Dust collectors with pivoting reverse pulse cleaning systems are also described herein.

10 Dust collectors take in unfiltered air, filter it, and exhaust clean air. Dust collectors are used in a variety of environments such as, e.g., factories, etc. The dust collectors typically include one or more filter cartridges for filtering and may also sometimes use reverse pulse cleaning systems to direct a pulse of pressurized gas (e.g., air) from the downstream side of the filter cartridge to the upstream side.
15 This helps to remove some of the dust and debris collected on the upstream side of the filter cartridge, which allows the filter cartridge to be used longer before the restriction becomes so high that it needs to be changed. Examples of such air filter assemblies are disclosed in, for example, U.S. Patent No. 6,090,173; 4,218,227; 4,395,269; 5,980,598; 6,322,618; DE 3905113; and US Patent Publication US
20 2006/0112667A1.

Despite the use of reverse pulse cleaning systems, the filter cartridges typically need to be replaced at some point. Replacing filter cartridges can be difficult and/or time consuming in dust collectors using multiple filter cartridges because access to the filter cartridges may be restricted. In some instances, access
25 may need to be provided to multiple sides of the dust collectors to allow for replacement of filter cartridges. Such access requires additional floor space, which may be at a premium in many facilities.

SUMMARY

Dust collectors with single side service access and methods of servicing the
30 dust collectors are described herein. Dust collectors with pivoting reverse pulse cleaning systems are also described herein.

replacement of the filter cartridges in two or more banks of filter cartridges can be accomplished from one side of the dust collector. The dust collectors include rotating accumulators within a clean air plenum of the dust collector that can
5 provide one or both of two different functions. One function that may be provided in one or more embodiments of the dust collectors described herein is that the rotating accumulators can also function to collect and direct pulsed jets of air (or any other suitable fluid) used in a reverse pulse cleaning system to remove dust and debris collected on the filter cartridges during operation while still allowing access
10 to the filter cartridges located beneath the accumulators so that filter cartridges can be serviced from a single service opening in the dust collector.

Another function that may be provided in one or more embodiments of the dust collectors described herein is the application of pressure to gaskets that seal the filter cartridges located under each accumulator against a tubesheet such that air
15 moving from the dirty air plenum to the clean air plenum is forced to pass through filter media in the filter cartridges.

In one or more embodiments, the dust collectors described herein may also include a reverse pulse cleaning system having a first cleaning position and a second cleaning position with the reverse pulse cleaning system pivoting between the two
20 cleaning positions to provide pulses of pressurized gas to dislodge dust and debris from filter cartridges in different locations in the dust collector.

In one aspect, one or more embodiments of a dust collector as described herein may include: a housing containing a tubesheet that separates the housing between a dirty air plenum and a clean air plenum, wherein a dirty air inlet is
25 configured to allow dirty air into the dirty air plenum and a clean air outlet is configured to allow clean air out of the clean air plenum, wherein the housing comprises a service opening configured to provide access to the clean air plenum; a plurality of apertures formed through the tubesheet, wherein the plurality of apertures are configured to allow fluid flow from the dirty air plenum into the clean
30 air plenum, wherein the plurality of apertures comprises at least a first aperture and a second aperture; a plurality of filter cartridges located in the housing, wherein the plurality of filter cartridges are positioned over the plurality of apertures in the tubesheet, and wherein the plurality of filter cartridges comprises at least a first filter

over the second aperture; and a pair of opposing accumulators located in the clean air plenum, the pair of opposing accumulators comprising a first accumulator positioned over the first aperture and a second accumulator positioned over the second aperture, wherein the first accumulator comprises an outlet that faces away from the service opening and wherein the second accumulator comprises an outlet that faces towards the service opening; wherein the first accumulator is located between the service opening and the second accumulator; and wherein the first accumulator rotates about a first axis located proximate the outlet of the first accumulator and distal from the service opening, wherein rotating the first accumulator about the first axis moves the first accumulator from an operating position to a service position, wherein a base of the first accumulator contacts the tubesheet in the operating position and wherein the base of the first accumulator is raised from the tubesheet in the service position; and further wherein the second accumulator rotates about a second axis located on an end of the second accumulator that is distal from the outlet of the second accumulator and the service opening, wherein rotating the second accumulator about the second axis moves the second accumulator from an operating position to a service position, wherein a base of the second accumulator contacts the tubesheet in the operating position and wherein the base of the second accumulator is raised from the tubesheet in the service position.

In one or more embodiments of the dust collectors described herein, the first axis is aligned with the second axis.

In one or more embodiments of the dust collectors described herein, the dust collector comprises a remote lift apparatus attached to the second accumulator, wherein the remote lift apparatus comprises a lift member connected to the second accumulator, wherein the lift member is connected to a handle and wherein moving the handle from a first position to a second position applies tension to the lift member to rotate the second accumulator from its operating position to its service position. In one or more embodiments, the lift member comprises a cable. In one or more embodiments, the housing comprises a handle retainer configured to retain the handle in the second position.

In one or more embodiments of the dust collectors described herein, the dust collector comprises a gasket between the tubesheet and the first filter cartridge, and

cartridge, the gasket and the tubesheet such that air passing through the first aperture passes through the first filter cartridge.

In one or more embodiments of the dust collectors described herein, the first
5 filter cartridge is one filter cartridge of a plurality of filter cartridges in a first bank of filter cartridges, and wherein the first accumulator is positioned over the first bank of filter cartridges, and further wherein the second filter cartridge is one filter cartridge of a plurality of filter cartridges in a second bank of filter cartridges, and wherein the second accumulator is positioned over the second bank of filter
10 cartridges. In one or more embodiments, the first accumulator comprises a plurality of outlets, wherein the plurality of outlets in the first accumulator face away from the service opening, and wherein the second accumulator comprises a plurality of outlets, wherein the plurality of outlets in the second accumulator face toward the service opening. In one or more embodiments, the plurality of outlets in the first
15 accumulator comprises a number of outlets that is equal to the number of filter cartridges in the first bank of filter cartridges.

In one or more embodiments of the dust collectors described herein, the dust collector further comprises a reverse pulse cleaning system that comprises: a manifold located in the clean air plenum; a nozzle attached to the manifold, wherein
20 pressurized gas exits from the manifold through the nozzle; and an actuator connected to the manifold and configured to pivot the manifold about a manifold axis between a first cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the first accumulator and a second cleaning position in which the nozzle is configured to direct the pressurized
25 gas from the manifold into the outlet of the second accumulator.

In one or more embodiments of the dust collectors including a reverse pulse cleaning system as described herein, the manifold axis is aligned with the first axis about which the first accumulator rotates and the second axis about which the second accumulator rotates.

30 In a second aspect, one or more embodiments of the dust collectors described herein include: a housing containing a tubesheet that separates the housing between a dirty air plenum and a clean air plenum, wherein a dirty air inlet is configured to allow dirty air into the dirty air plenum and a clean air outlet is configured to allow

opening configured to provide access to the clean air plenum; a plurality of apertures formed through the tubesheet, wherein the plurality of apertures are configured to allow fluid flow from the dirty air plenum into the clean air plenum, wherein the plurality of apertures comprises at least a first aperture and a second aperture; a plurality of filter cartridges located in the housing, wherein the plurality of filter cartridges are positioned over the plurality of apertures in the tubesheet, and wherein the plurality of filter cartridges comprises at least a first filter cartridge positioned over the first aperture and a second filter cartridge positioned over the second aperture; and a pair of opposing accumulators located in the clean air plenum, the pair of opposing accumulators comprising a first accumulator positioned over the first aperture and a second accumulator positioned over the second aperture, wherein the first accumulator comprises an outlet that faces away from the service opening and wherein the second accumulator comprises an outlet that faces towards the service opening, and wherein the first accumulator is located between the service opening and the second accumulator. The dust collector further includes a reverse pulse cleaning system that comprises: a manifold located in the clean air plenum; a nozzle attached to the manifold, wherein pressurized gas exits from the manifold through the nozzle; and an actuator connected to the manifold and configured to pivot the manifold about a manifold axis between a first cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the first accumulator and a second cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the second accumulator.

In one or more embodiments of the dust collectors including a reverse pulse cleaning system as described herein in the second aspect, the first filter cartridge is one filter cartridge of a plurality of filter cartridges in a first bank of filter cartridges, and wherein the first accumulator is positioned over the first bank of filter cartridges, and further wherein the second filter cartridge is one filter cartridge of a plurality of filter cartridges in a second bank of filter cartridges, and wherein the second accumulator is positioned over the second bank of filter cartridges. In one or more embodiments, the reverse pulse cleaning system comprises a plurality of nozzles attached to the manifold, wherein pressurized gas exits from the manifold

nozzles in the reverse pulse cleaning system comprises a number of nozzles that is equal to the number of filter cartridges in the first bank of filter cartridges.

In one or more embodiments of the dust collectors including a reverse pulse
5 cleaning system as described herein in the second aspect, the first accumulator
comprises a plurality of outlets, wherein the plurality of outlets in the first
accumulator face away from the service opening, and wherein the second
accumulator comprises a plurality of outlets, wherein the plurality of outlets in the
second accumulator face toward the service opening. In one or more embodiments,
10 the reverse pulse cleaning system comprises a plurality of nozzles attached to the
manifold, wherein pressurized gas exits from the manifold through the plurality of
nozzles. In one or more embodiments, the plurality of nozzles in the reverse pulse
cleaning system comprises a number of nozzles that is equal to the number of outlets
in the first accumulator. In one or more embodiments, the plurality of nozzles in the
15 reverse pulse cleaning system comprises a number of nozzles that is equal to the
number of filter cartridges in the first bank of filter cartridges.

In a third aspect, the methods of servicing a dust collector as described
herein may include: opening a service opening in a housing to access a clean air
plenum in the housing, wherein the clean air plenum is separated from a dirty air
20 plenum in the housing by a tubesheet; rotating a first accumulator in the housing
about a first axis, wherein the first accumulator comprises an outlet facing away
from the service opening and wherein the first axis is located proximate the outlet of
the first accumulator and distal from the service opening, wherein rotating the first
accumulator about the first axis moves the first accumulator from an operating
25 position to a service position; replacing a filter cartridge located in a first aperture in
the tubesheet after rotating the first accumulator to the service position; rotating the
first accumulator to the operating position after replacing the filter cartridge in the
first aperture; rotating a second accumulator in the housing about a second axis,
wherein the second accumulator comprises an outlet that faces towards the service
30 opening and the first accumulator is located between the service opening and the
second accumulator, and wherein the second axis is located on an end of the second
accumulator that is distal from the outlet of the second accumulator and the service
opening, wherein rotating the second accumulator about the second axis moves the

filter cartridge located in a second aperture in the tubesheet after rotating the second accumulator to the service position; and rotating the second accumulator to the operating position after replacing the filter cartridge in the second aperture.

5 In one or more embodiments of the methods of servicing a dust collector as described herein, the first accumulator is in the operating position when replacing the filter cartridge located in the second aperture in the tubesheet.

 In one or more embodiments of the methods of servicing a dust collector as described herein, rotating the first accumulator to the operating position after
10 replacing the filter cartridge in the first aperture forms a seal between the filter cartridge, a gasket and the tubesheet such that air passing through the first aperture passes through the filter cartridge in the first aperture. In one or more embodiments, rotating the second accumulator to the operating position after replacing the filter
15 cartridge in the second aperture forms a seal between the filter cartridge, a gasket and the tubesheet such that air passing through the second aperture passes through the filter cartridge in the second aperture.

 In a fourth aspect, one or more embodiments of methods of cleaning filter cartridges in a dust collector as described herein may include: pivoting a manifold of a reverse pulse cleaning system in a clean air plenum of a dust collector about a
20 manifold axis, wherein the manifold is pivoted from a first cleaning position in which a nozzle is configured to direct pressurized gas from the manifold into an outlet of a first accumulator in the clean air plenum to a second cleaning position in which the nozzle is configured to direct pressurized gas from the manifold into an outlet of a second accumulator in the clean air plenum; delivering pressurized gas
25 from the nozzle into the outlet of the second accumulator when the manifold is in the second cleaning position, wherein the pressurized gas passes through a filter cartridge located in a second aperture in a tubesheet of the dust collector after passing into the outlet of the second accumulator; pivoting the manifold to the first cleaning position after delivering pressurized gas into the outlet of the second
30 accumulator; and delivering pressurized gas from the nozzle into the outlet of the first accumulator when the manifold is in the first cleaning position, wherein the pressurized gas passes through a filter cartridge located in a first aperture in a tubesheet of the dust collector after passing into the outlet of the first accumulator.

implementation of the dust collectors and methods of servicing them as described herein. Rather, a more complete understanding of the invention will become apparent and appreciated by reference to the following Description of Illustrative Embodiments and claims in view of the accompanying figures of the drawing.

BRIEF DESCRIPTIONS OF THE VIEWS OF THE DRAWING

FIG. 1 is a perspective view of one illustrative embodiment of a dust collector as described herein.

FIG. 2 is a side elevation view in cross-section of the dust collector depicted in FIG. 1 with the accumulators located therein in their operating positions.

FIG. 3 depicts the flow of air through the dust collector of FIG. 2.

FIG. 4 is a side elevation view in cross-section of the dust collector of FIG. 2, with the first accumulator located in a service position and the second accumulator located in its operating position.

FIG. 5 is a side elevation view of the dust collector of FIG. 2, with the second accumulator located in its service position and the first accumulator located in its operating position.

FIG. 6 is a perspective view of the accumulators, tubesheet and associated filter cartridges used in the dust collectors depicted in FIGS. 1-5..

FIG. 7 is a perspective view of one illustrative embodiment of a pivoting manifold and associated nozzles that may be used in a reverse pulse cleaning system that, in turn, may be used in the dust collectors described herein.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

In the following description of illustrative embodiments, reference is made to the accompanying figures of the drawing which form a part hereof, and in which are shown, by way of illustration, specific embodiments. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

One illustrative embodiment of a dust collector 10 as described herein is depicted in FIGS. 1-7. The dust collector 10 has an unfiltered or dirty air inlet 12 and a filtered or clean air outlet 13. In general, unfiltered air enters the dust

20 that separates the interior volume of the dust collector 10 between an unfiltered or dirty air plenum 14 and a filtered or clean air plenum 15. Air filter cartridges 30 are located in apertures 22 in the tubesheet 20. Air moving from the dirty air
5 plenum 14 to the clean air plenum 15 passes through upstream flow faces 31 of the filter cartridges 30 located within the apertures 22 in the tubesheet 20 to remove dust and other particulate from the air. The clean, filtered air exits from the filter cartridges 30 through the downstream flow faces 32 into the clean air plenum 15 and is exhausted from the dust collector 10 through the clean air outlet 13.

10 The illustrative embodiment of the dust collector 10 also includes one illustrative embodiment of a reverse pulse cleaning system that is constructed and arranged to emit a pulse of gas (e.g., air) into the clean air plenum 15 so that the pulse travels through the downstream flow faces 32 of each of the air filter cartridges 30. By delivering such pulses through the downstream flow faces 32 of
15 the filter cartridges 30, at least a portion of the dust and other debris clogging the upstream flow surfaces 31 of the air filter cartridges 30 may be dislodged from the air filter cartridge 30 so that the filter cartridges 30 can be used longer before they need to be replaced.

The depicted embodiment of the reverse pulse cleaning system includes at
20 least one manifold 50 and at least one nozzle 52. In one or more embodiments, the reverse pulse cleaning system may include a separate nozzle 52 for each filter cartridge 30 in an aperture 22 in the upper wall 20 of the tubesheet. The nozzles 52 are in air flow communication with the manifold 50 which is connected to a source of pressurized gas, e.g., air. The reverse pulse cleaning system periodically sends a
25 pulse through the manifold 50 to the nozzles 52. The pulse leaves each nozzle 52 and flows through a filter cartridge 30 in an aperture 22 in a reverse direction as compared to the normal direction of air flow through the air filter cartridges 30 (where the normal direction is the direction of air flow during the filtering process).

The filter cartridges 30 in the embodiment of the dust collector 10 depicted
30 in FIGS. 1-7 are arranged in two banks on opposite sides of the tubesheet 20. Each bank of filter cartridges 30 is covered by an accumulator 40 located on the clean air plenum 15. In some embodiments, at least a portion of the pulse of air from the nozzles 52 can be trapped by using an accumulator 40 positioned over a filter

shaped to retain and direct the pulses from the nozzles 52 over the downstream end 34 of the filter cartridge 30.

5 In the depicted embodiments, each accumulator 40 includes a base plate 42 and a face 44 that is oriented towards the face 44 of the opposing accumulator 40 in the dust collector 10. Each accumulator face 44 includes one or more outlets (see, e.g., outlets 48 in FIG. 6). The nozzles 52 of the reverse pulse cleaning system are, in the depicted embodiment, oriented so that air delivered through the nozzles 52 is directed into the outlets 48 in the faces 44 of the accumulators 40.

10 Although the depicted accumulators 40 include separate outlets 48 through which nozzles 52 deliver pulses for each of the filter cartridges 30, in one or more other embodiments, the accumulator may include fewer outlets 48 than filter cartridges 30 located underneath the accumulator 40. For example, an accumulator 40 may include a single outlet 48 through which pulses are delivered from a reverse pulse cleaning system to move dust or debris from one or more filter cartridges 30. 15 The same outlets 48 are also used as a passageway for clean air to exit the accumulators 40 and move into the remainder of the clean air plenum 15.

In one or more alternative embodiments, the accumulators 40 may be provided with internal baffles or other structures to further direct air flow through 20 the accumulators 40. For example, the accumulators 40 may include baffles that at least partially control air flow passing through the filter cartridges 30 into the clean air plenum 15 and/or partially control pulses delivered into the accumulator from a reverse pulse cleaning system. In still one or more other embodiments, each filter cartridge 30 may be provided with a dedicated accumulator located over the filter 25 cartridge 30 as disclosed in, e.g., US Patent Publication No. US 2011/0185689 (Raether et al.).

The accumulators 40 described herein function to collect and redirect pulses from the reverse pulse cleaning system to clean the filter cartridges 30 during operation of the dust collector 10. In addition, in one or more embodiments, the 30 accumulators 40 may also function to retain the filter cartridges 30 within apertures 22 in the tubesheet 20. In the depicted embodiment, the base plate 42 of each of the accumulators 40 preferably acts on the filter cartridges 30 and the gaskets surrounding the filter cartridges 30 so that an adequate seal is formed between the

sufficient to force air passing from the dirty air plenum 14 into the clean air plenum 15 through the filter cartridges 30 located in the apertures 22 of the tubesheet 20. Details regarding potentially suitable gasket structures and their interaction with
5 suitable filter cartridges 30 can be found in, for example, US Patent Publication No. US 2011/0185689 (Raether et al.).

As discussed herein, the dust collectors 10 are designed to allow service access from a single side of the dust collector 10. Referring to FIGS. 1-5, the dust collector 10 may, in one or more embodiments, include a service opening 17
10 through which all of the filter cartridges in the dust collector 10 can be serviced. In the context of the present application, servicing typically includes removing a used filter cartridge and replacing it with a fresh filter cartridge. It should, however, be understood that other types of servicing may be accomplished through the same service opening used to service filter cartridges as described herein.

15 In the embodiment depicted in FIGS. 1-5, the service opening 17 is covered by a door 18 during use of the dust collector. When access into the clean air plenum 14 is needed, the door 18 may be opened as depicted in, e.g., FIG. 2. The accumulators 40 located within the clean air plenum 15 are arranged such that face 44 containing the outlet of the accumulator 40 closest to the service opening 17
20 faces away from the service opening 17. The accumulator 40 located closest to the service opening 17 will be referred to in the following discussion as the first accumulator 40. The accumulator 40 located furthest from the service opening 17 includes a face 44 containing an outlet that faces towards the service opening 17. The accumulator located furthest from the service opening 17 will be referred to in
25 the following discussion as the second accumulator 40. In such an arrangement, the first accumulator 40 closest to the service opening 17 may be described as being located between the service opening 17 and the second accumulator 40.

Because the accumulators 40 cover the filter cartridges 30 located in the dust collector 10, removal of the filter cartridges for replacement requires that the
30 accumulators 40 be raised or otherwise removed to allow access to the filter cartridges 30 located underneath the accumulators 40. In the dust collectors 10 described herein, the accumulators 40 are preferably attached to the tubesheet 20 in a manner that allows them to rotate from an operating position to a service position.

underneath the accumulator 40. Although the accumulators 40 are attached to the tubesheet 20 in the depicted embodiments, in other embodiments the accumulators 40 may be attached to other portions of the dust collector 10 (e.g., the housing of the dust collector 10, etc.) as long as they still provide the functions of the accumulators 40 as described herein.

Air flow through the dust collector 10 is depicted in FIG. 3, where dirty air enters the dirty air plenum 14 of the dust collector 10 through a dirty air inlet 12 and passes into the clean air plenum 15 of the dust collector 10 through the filter cartridges 30 which are located in apertures 22 in the tubesheet 20 as described herein. The clean air in the clean air plenum 15 leaves the dust collector 10 through a clean air outlet 13. As seen in FIG. 3, the clean air entering the clean air plenum 15 passes through the accumulators 40 before entering the remainder of the clean air plenum 15.

As discussed herein, the filter cartridges 30 used to remove dust and debris from the dirty air entering the dirty air plenum 14 must periodically be replaced and doing so requires moving the accumulators 40 to a service position within the dust collector 10. FIG. 4 depicts an arrangement of dust collector 10 in which the first accumulator 40 is rotated about a first axis 41 to its service position within the clean air plenum 15. In the service position, the first accumulator 40 is raised sufficiently to allow access to the filter cartridges 30 located underneath the accumulator 40. The filter cartridges 30 can then be removed and replaced with fresh filter cartridges 30 as needed.

After servicing the filter cartridges 30 underneath the first accumulator 40, the first accumulator 40 can be moved back to its operating position as depicted in FIG. 5. In the operating position, the base plate 42 of the first accumulator 40 is, in one or more embodiments, in contact with the tubesheet 20 and/or the filter cartridges 30 as seen in, e.g., FIG. 5.

With the first accumulator 40 in its operating position as depicted in FIG. 5, the second accumulator 40 located furthest from the service opening 17 can be moved from its operating position in which its base plate 44 is raised so that it no longer contacts the tubesheet 20. With the second accumulator 40 raised to its service position as depicted in FIG. 5, the filter cartridges 30 located underneath the

as needed.

Movement of the second accumulator 40 from its operating position to its service position (as seen in FIG. 5) is, in one or more embodiments as described herein, accomplished by rotating the second accumulator 40 about a second axis 43. Because access to the clean air plenum 15 is limited to the service opening 17, the second axis 43 is located on an end of the accumulator 40 that is distal from the outlet 48 of the second accumulator 40 and the service opening 17. In other words, the second axis 43 is located on an opposite end of the second accumulator 40 as compared to the location of the first axis 41 about which the first accumulator 40 rotates when moving from its operating position to its service position. Placement of the second axis 43 about which the second accumulator 40 rotates does, however, allow access to the filter cartridges 30 located underneath the second accumulator 40 from the same service opening 17 used to access the filter cartridges 30 underneath the first accumulator 40.

In one or more embodiments, such as that depicted in FIGS. 4 to 6 the first axis 41 and the second axis 43 about which the first and second accumulators 40 rotates when moving from their respective operating positions to their respective service positions may be aligned with each other (e.g., the axes may be parallel or roughly parallel). It should, however, be understood that this arrangement of the axes 41 and 43 may not necessarily be required in all embodiments so long as rotation of the accumulators 40 provides access to the filter cartridges from a single service opening in the dust collector.

In or more embodiments, the dust collectors described herein may include an interlock such that the dust collector cannot be operated unless the accumulators in the dust collector are all in their operating positions. In one or more embodiments, the interlock may be designed to prevent closing of the door 18 over the service opening 17 when one or more of the accumulators 40 are in the service position.

In one or more embodiments, moving the second accumulator 40, which is located furthest from the service opening 17, between its operating position and its service position can be difficult because of the distance of the second accumulator 40 from the service opening 17. In the embodiment depicted in FIGS. 4 and 5 the dust collector 10 includes an optional remote lift apparatus that is operably attached

embodiment, includes a lift member 60 and handle 62 that is located proximate the service opening 17.

5 Movement of the handle 62 from a first position (as seen in, e.g., FIG. 2), to a second position (as seen in, e.g., FIG. 5), moves the second accumulator 40 from its operating position to its service position. The remote lift apparatus also includes, in the depicted embodiment, a handle retainer 63 located proximate the service opening 17 to retain the handle 62 and its second position such that the second accumulator 40 also remains in its service position during the servicing of filter
10 cartridges 30 located beneath the second accumulator 40. The lift member 60 may be in the form of, e.g., a cable or other flexible member and the remote lift apparatus may include guides 64 (such as e.g., pulleys, etc.) that direct the lift member 60 through the dust collector 10 between the second accumulator 40 and the handle 62.

The embodiment of remote lift apparatus depicted in connection with the
15 dust collector 10 is only one illustrative embodiment of a remote lift apparatus that could be used to move the second accumulator 40 between its operating position and its service position. Many other techniques, structures, etc. could be used in place of the lift member 60, handle 62, handle retainer 63, and guides 64 as described herein. For example, hydraulic pistons, a rack and pinion, servomotors, in many other
20 different mechanisms could be used to rotate the second accumulator 40 from its operating position to its service position. The depicted embodiment provides only one convenient and relatively simple technique for moving the second accumulator 40 between its operating position and its service position.

FIG. 6 is a perspective view of accumulators 40 on tubesheet 20 isolated
25 from the rest of a dust collector in which these components are located to provide an opportunity for further discussion of the accumulators and filter cartridges in dust collectors as described herein. The accumulators 40 as depicted in FIG. 6 include three outlets 48 in the faces 44, with each of the outlets being aligned with the filter cartridges 30 that are located within apertures 22 in the tubesheet 20 underneath the
30 accumulator 40.

Although the accumulators 40 are depicted with three outlets 48 and covering three filter cartridges 30, one or more other embodiments of the dust collectors described herein may include accumulators that have one or more outlets

accumulator may or may not be the same as the number of filter cartridges over which the accumulator is positioned. For example, an accumulator may include one outlet in its face and cover one, two, three or more filter cartridges. In one or more
5 other embodiments, an accumulator may include two or more outlets in a face and cover one or more filter cartridges.

The accumulators 40 rotate about axes 41 and 43 which are located relative to a service opening (not shown) so that access to filter cartridges 30 beneath both accumulators 40 can be provided for service as described herein. The accumulators
10 40 may also include base plates 42 which provide a force that assists in sealing the filter cartridges 30 within apertures 22 in the tubesheet 20 (e.g., as described in US Patent Publication No. US 2011/0185689 (Raether et al.)). The accumulators 40 may also include clamps 49 that can be used to secure the accumulators 40 in their operating position. The clamps 49 may also provide compressive force that assists
15 in forming the seals between the filter cartridges 30 and apertures 22 as described herein.

Another optional feature depicted in FIG. 6 is the handle 47 on the accumulator 40 located on the left side of FIG. 6. That handle 47 may be used to assist in moving the accumulator 40 from its operating position to its service
20 position because the left side accumulator 40 may be located closer to a service opening in a dust collector in which the accumulators 40 are located. The accumulator 40 on the right side of the tubesheet 20 as depicted in FIG. 6 can be opened by any suitable remote lift apparatus as described herein.

The dust collectors described herein may also include a reverse pulse
25 cleaning system that includes a manifold 50 and one or more nozzles 52 as described herein. Reverse pulse cleaning systems are known. However, the reverse pulse cleaning system depicted in FIGS. 2 and 7 of the dust collectors described herein include an actuator 54 that is operably connected to the manifold 50 and the manifold 50 is configured to pivot about an axis 51 between a first cleaning position
30 and a second cleaning position. The manifold 50 is depicted in the first cleaning position in FIG. 2 and, in that position, the nozzle or nozzles 52 on the manifold 50 are arranged to direct pulses of pressurized gas into the one or more outlets in the face 44 of the first accumulator 40. The manifold 50 and its nozzle or nozzles 52 are

cleaning position, the nozzle or nozzles 52 on the manifold 50 are arranged to direct pulses of pressurized gas to one or more outlets in the face 44 of the second accumulator 40.

5 By pivoting the manifold 50 between the first and second cleaning positions, a single manifold 50 and its associated nozzle or nozzles 52 can be used to provide pulses of pressurized gas to both banks of filter cartridges 30 located underneath the first and second accumulators 40. As a result, the dust collector 10 includes fewer reverse pulse cleaning components as compared to a dust collector in which multiple
10 manifolds and associated nozzles are required to provide reverse pulse cleaning to different banks of filter cartridges located within the dust collector. An additional potential benefit is that air flow through the clean air plenum 15 may be disrupted less because fewer components are located within the clean air plenum 15, which may reduce pressure drops across the dust collectors 10. Yet another potential
15 advantage in one or more embodiments that include a pivoting manifold 50 is that service access to the valves 53 located on the manifold 50 opposite the nozzles 52 may be facilitated when the manifold 50 is in the first cleaning position (as depicted in, e.g., FIG. 2). Still another potential advantage that may be associated with dust collectors including a reverse pulse cleaning system with a pivoting manifold is that
20 the size of the dust collector may be reduced as compared to dust collectors that do not use a pivoting manifold in the reverse pulse cleaning system.

The manifold 50, which is depicted in a perspective view in FIG. 7, pivots about axis 51 as described herein. The dust collector 10 preferably includes an actuator 54 (see, e.g., FIG. 2) in the form of a piston (e.g., pneumatic, hydraulic,
25 etc.) or other device that acts, in the depicted embodiment, on an extension 56 that is located at one end of the manifold arms 58. Many other mechanisms and arrangements for pivoting the manifold 50 between different cleaning positions can be used in place of the depicted embodiment.

As discussed herein, the dust collectors described herein are designed for use
30 with filter cartridges that can be removed and cleaned or replaced when they have reached the end of their service life in the collector. Specific construction details with respect to the filter cartridges used in connection with the dust collectors described herein may vary. Examples of some potential suitable filter cartridge

media packs may be found in one or more of the following documents: U.S. Patent Nos. 4,925,561; 5,049,326; 5,562,825; 5,613,992; 5,772,883; 5,792,247; 5,820,646; 5,895,574; 5,902,364; 6,039,778; 6,179,890; 6,190,432; 6,210,469; 6,235,195;
5 6,350,296; 6,673,136; 7,282,075; 7,959,702; Des. 396,098; Des. 398,046; Des. 399,944; Des. 428,128; and Des. 437,401; International Publications WO 1997/040918; WO 2004/007054; WO 2004/082795; and US Patent Application Publications US 2006/0091084; US 2010/0078379; and US 2009/0127211.

The complete disclosure of the patents, patent documents, and publications
10 identified herein are incorporated by reference in their entirety as if each were individually incorporated.

Illustrative embodiments of dust collectors and other components such as accumulators and pivoting reverse pulse cleaning systems are discussed and reference has been made to possible variations. These and other variations and
15 modifications in the invention will be apparent to those skilled in the art without departing from the scope of the invention, and it should be understood that this invention is not limited to the illustrative embodiments set forth herein. It is noted that not all the specific features described herein need to be incorporated in the dust collectors or filter cartridges described herein to have some selected advantage
20 according to the present disclosure.

1. A dust collector comprising:

a housing containing a tubesheet that separates the housing between a dirty air plenum and a clean air plenum, wherein a dirty air inlet is configured to allow dirty air into the dirty air plenum and a clean air outlet is configured to allow clean air out of the clean air plenum, wherein the housing comprises a service opening configured to provide access to the clean air plenum;

a plurality of apertures formed through the tubesheet, wherein the plurality of apertures are configured to allow fluid flow from the dirty air plenum into the clean air plenum, wherein the plurality of apertures comprises at least a first aperture and a second aperture;

a plurality of filter cartridges located in the housing, wherein the plurality of filter cartridges are positioned over the plurality of apertures in the tubesheet, and wherein the plurality of filter cartridges comprises at least a first filter cartridge positioned over the first aperture and a second filter cartridge positioned over the second aperture; and

a pair of opposing accumulators located in the clean air plenum, the pair of opposing accumulators comprising a first accumulator positioned over the first aperture and a second accumulator positioned over the second aperture, wherein the first accumulator comprises an outlet that faces away from the service opening and wherein the second accumulator comprises an outlet that faces towards the service opening;

wherein the first accumulator is located between the service opening and the second accumulator;

and wherein the first accumulator rotates about a first axis located proximate the outlet of the first accumulator and distal from the service opening, wherein rotating the first accumulator about the first axis moves the first accumulator from an operating position to a service position, wherein a base of the first accumulator contacts the tubesheet in the operating position and wherein the base of the first accumulator is raised from the tubesheet in the service position,

and further wherein the second accumulator rotates about a second axis located on an end of the second accumulator that is distal from the outlet of the

accumulator about the second axis moves the second accumulator from an operating position to a service position, wherein a base of the second accumulator contacts the tubesheet in the operating position and wherein the base of the second accumulator is raised from the tubesheet in the service position.

2. A dust collector according to claim 1, wherein the first axis is aligned with the second axis.
3. A dust collector according to any one of claims 1 to 2, wherein the dust collector comprises a remote lift apparatus attached to the second accumulator, wherein the remote lift apparatus comprises a lift member connected to the second accumulator, wherein the lift member is connected to a handle and wherein moving the handle from a first position to a second position applies tension to the lift member to rotate the second accumulator from its operating position to its service position.
4. A dust collector according to claim 3, wherein the lift member comprises a cable.
5. A dust collector according to claim 3, wherein the housing comprises a handle retainer configured to retain the handle in the second position.
6. A dust collector according to any one of claims 1 to 5, wherein the dust collector comprises a gasket between the tubesheet and the first filter cartridge, and wherein the first accumulator is configured to form a seal between the first filter cartridge, the gasket and the tubesheet such that air passing through the first aperture passes through the first filter cartridge.
7. A dust collector according to any one of claims 1 to 6, wherein the first filter cartridge is one filter cartridge of a plurality of filter cartridges in a first bank of filter cartridges, and wherein the first accumulator is positioned over the first bank of filter cartridges, and further wherein the second filter cartridge is one filter cartridge of a plurality of filter cartridges in a second bank of filter cartridges, and

cartridges.

8. A dust collector according to claim 7, wherein the first accumulator comprises a plurality of outlets, wherein the plurality of outlets in the first accumulator face away from the service opening, and wherein the second accumulator comprises a plurality of outlets, wherein the plurality of outlets in the second accumulator face toward the service opening.

9. A dust collector according to claim 8, wherein the plurality of outlets in the first accumulator comprises a number of outlets that is equal to the number of filter cartridges in the first bank of filter cartridges.

10. A dust collector according to any one of claims 1 to 9, wherein the dust collector further comprises a reverse pulse cleaning system that comprises:

- a manifold located in the clean air plenum;
- a nozzle attached to the manifold, wherein pressurized gas exits from the manifold through the nozzle; and
- an actuator connected to the manifold and configured to pivot the manifold about a manifold axis between a first cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the first accumulator and a second cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the second accumulator.

11. A dust collector according to claim 10, wherein the manifold axis is aligned with the first axis about which the first accumulator rotates and the second axis about which the second accumulator rotates.

12. A dust collector comprising:

- a housing containing a tubesheet that separates the housing between a dirty air plenum and a clean air plenum, wherein a dirty air inlet is configured to allow dirty air into the dirty air plenum and a clean air outlet is configured to allow clean

configured to provide access to the clean air plenum;

a plurality of apertures formed through the tubesheet, wherein the plurality of apertures are configured to allow fluid flow from the dirty air plenum into the clean air plenum, wherein the plurality of apertures comprises at least a first aperture and a second aperture;

a plurality of filter cartridges located in the housing, wherein the plurality of filter cartridges are positioned over the plurality of apertures in the tubesheet, and wherein the plurality of filter cartridges comprises at least a first filter cartridge positioned over the first aperture and a second filter cartridge positioned over the second aperture;

a pair of opposing accumulators located in the clean air plenum, the pair of opposing accumulators comprising a first accumulator positioned over the first aperture and a second accumulator positioned over the second aperture, wherein the first accumulator comprises an outlet that faces away from the service opening and wherein the second accumulator comprises an outlet that faces towards the service opening, and wherein the first accumulator is located between the service opening and the second accumulator; and

a reverse pulse cleaning system that comprises:

a manifold located in the clean air plenum;

a nozzle attached to the manifold, wherein pressurized gas exits from the manifold through the nozzle; and

an actuator connected to the manifold and configured to pivot the manifold about a manifold axis between a first cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the first accumulator and a second cleaning position in which the nozzle is configured to direct the pressurized gas from the manifold into the outlet of the second accumulator.

13. A dust collector according to claim 12, wherein the first filter cartridge is one filter cartridge of a plurality of filter cartridges in a first bank of filter cartridges, and wherein the first accumulator is positioned over the first bank of filter cartridges, and further wherein the second filter cartridge is one filter cartridge of a plurality of

accumulator is positioned over the second bank of filter cartridges.

14. A dust collector according to claim 13, wherein the reverse pulse cleaning system comprises a plurality of nozzles attached to the manifold, wherein pressurized gas exits from the manifold through the plurality of nozzles.

15. A dust collector according to claim 14, wherein the plurality of nozzles in the reverse pulse cleaning system comprises a number of nozzles that is equal to the number of filter cartridges in the first bank of filter cartridges.

16. A dust collector according to claim 13, wherein the first accumulator comprises a plurality of outlets, wherein the plurality of outlets in the first accumulator face away from the service opening, and wherein the second accumulator comprises a plurality of outlets, wherein the plurality of outlets in the second accumulator face toward the service opening.

17. A dust collector according to claim 16, wherein the reverse pulse cleaning system comprises a plurality of nozzles attached to the manifold, wherein pressurized gas exits from the manifold through the plurality of nozzles.

18. A dust collector according to claim 17, wherein the plurality of nozzles in the reverse pulse cleaning system comprises a number of nozzles that is equal to the number of outlets in the first accumulator.

19. A dust collector according to claim 18, wherein the plurality of nozzles in the reverse pulse cleaning system comprises a number of nozzles that is equal to the number of filter cartridges in the first bank of filter cartridges.

20. A method of servicing a dust collector, the method comprising:

opening a service opening in a housing to access a clean air plenum in the housing, wherein the clean air plenum is separated from a dirty air plenum in the housing by a tubesheet;

accumulator comprises an outlet facing away from the service opening and wherein the first axis is located proximate the outlet of the first accumulator and distal from the service opening, wherein rotating the first accumulator about the first axis moves the first accumulator from an operating position to a service position;

replacing a filter cartridge located in a first aperture in the tubesheet after rotating the first accumulator to the service position;

rotating the first accumulator to the operating position after replacing the filter cartridge in the first aperture;

rotating a second accumulator in the housing about a second axis, wherein the second accumulator comprises an outlet that faces towards the service opening and the first accumulator is located between the service opening and the second accumulator, and wherein the second axis is located on an end of the second accumulator that is distal from the outlet of the second accumulator and the service opening, wherein rotating the second accumulator about the second axis moves the second accumulator from an operating position to a service position;

replacing a filter cartridge located in a second aperture in the tubesheet after rotating the second accumulator to the service position; and

rotating the second accumulator to the operating position after replacing the filter cartridge in the second aperture.

21. A method according to claim 20, wherein the first accumulator is in the operating position when replacing the filter cartridge located in the second aperture in the tubesheet.

22. A method according to any one of claims 20 to 21, wherein rotating the first accumulator to the operating position after replacing the filter cartridge in the first aperture forms a seal between the filter cartridge, a gasket and the tubesheet such that air passing through the first aperture passes through the filter cartridge in the first aperture.

23. A method according to claim 22, wherein rotating the second accumulator to the operating position after replacing the filter cartridge in the second aperture forms

through the second aperture passes through the filter cartridge in the second aperture.

24. A method of cleaning filter cartridges in a dust collector, the method comprising:

- pivoting a manifold of a reverse pulse cleaning system in a clean air plenum of a dust collector about a manifold axis, wherein the manifold is pivoted from a first cleaning position in which a nozzle is configured to direct pressurized gas from the manifold into an outlet of a first accumulator in the clean air plenum to a second cleaning position in which the nozzle is configured to direct pressurized gas from the manifold into an outlet of a second accumulator in the clean air plenum;

- delivering pressurized gas from the nozzle into the outlet of the second accumulator when the manifold is in the second cleaning position, wherein the pressurized gas passes through a filter cartridge located in a second aperture in a tubesheet of the dust collector after passing into the outlet of the second accumulator;

- pivoting the manifold to the first cleaning position after delivering pressurized gas into the outlet of the second accumulator; and

- delivering pressurized gas from the nozzle into the outlet of the first accumulator when the manifold is in the first cleaning position, wherein the pressurized gas passes through a filter cartridge located in a first aperture in a tubesheet of the dust collector after passing into the outlet of the first accumulator.

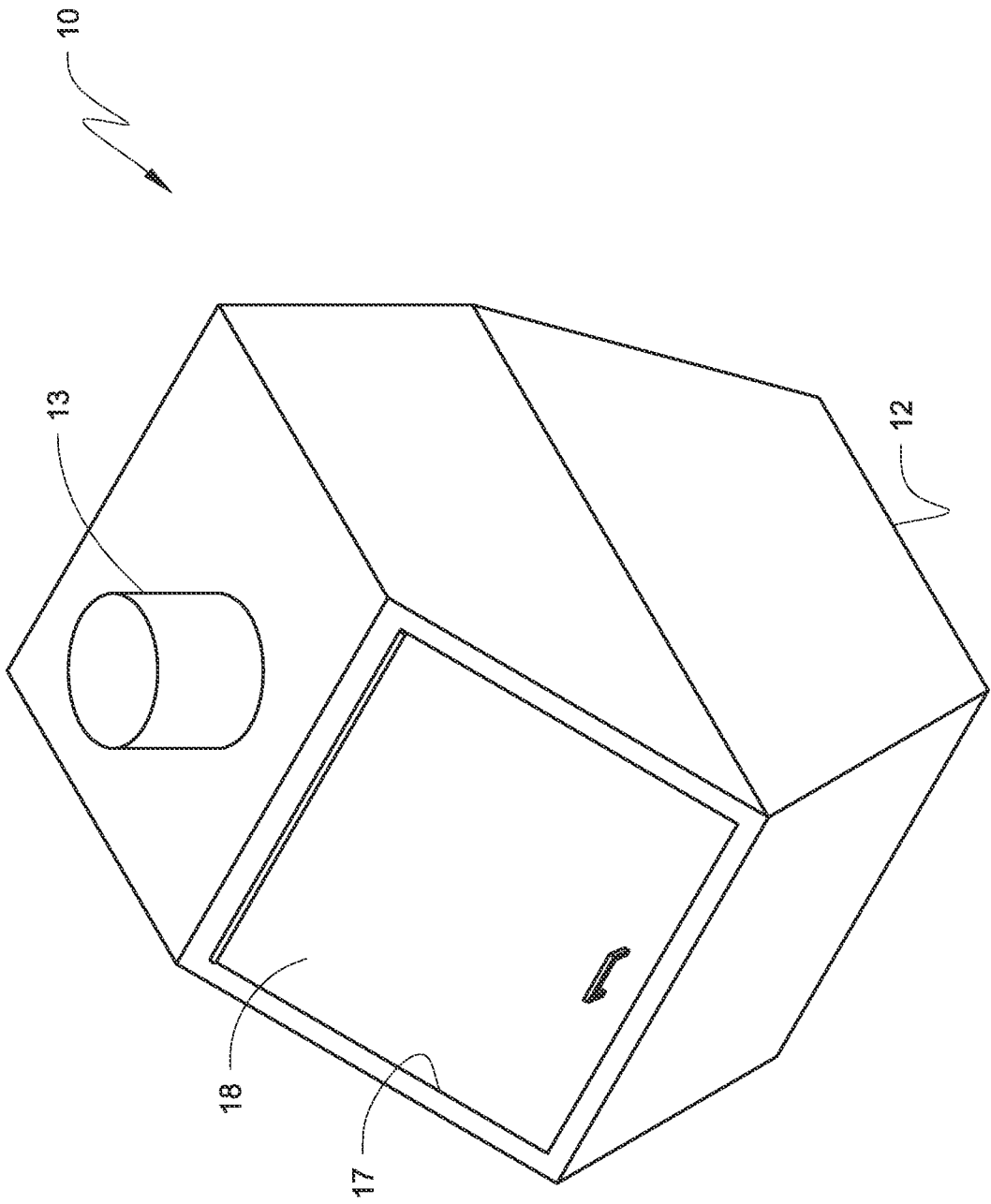


Fig. 1

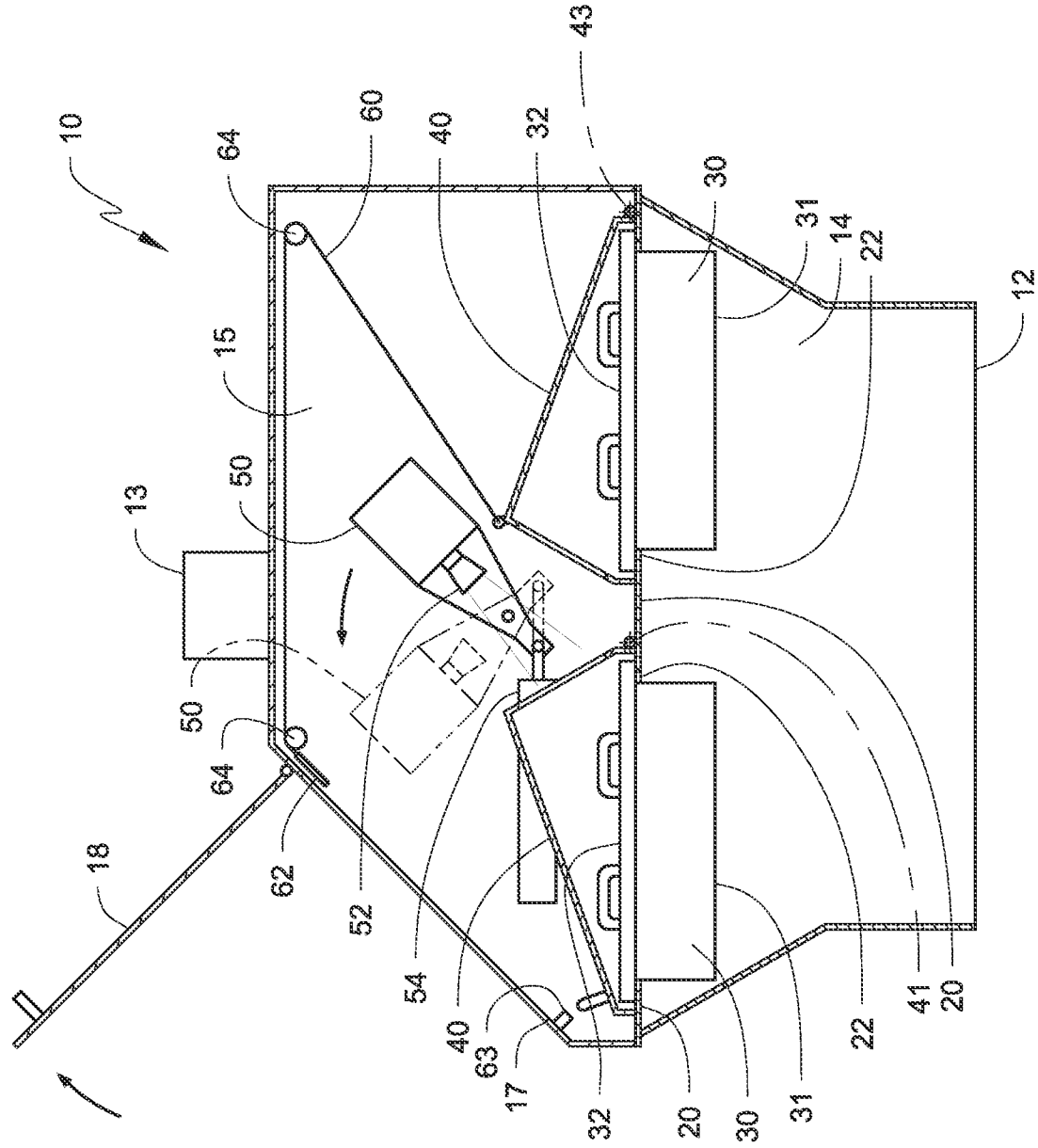
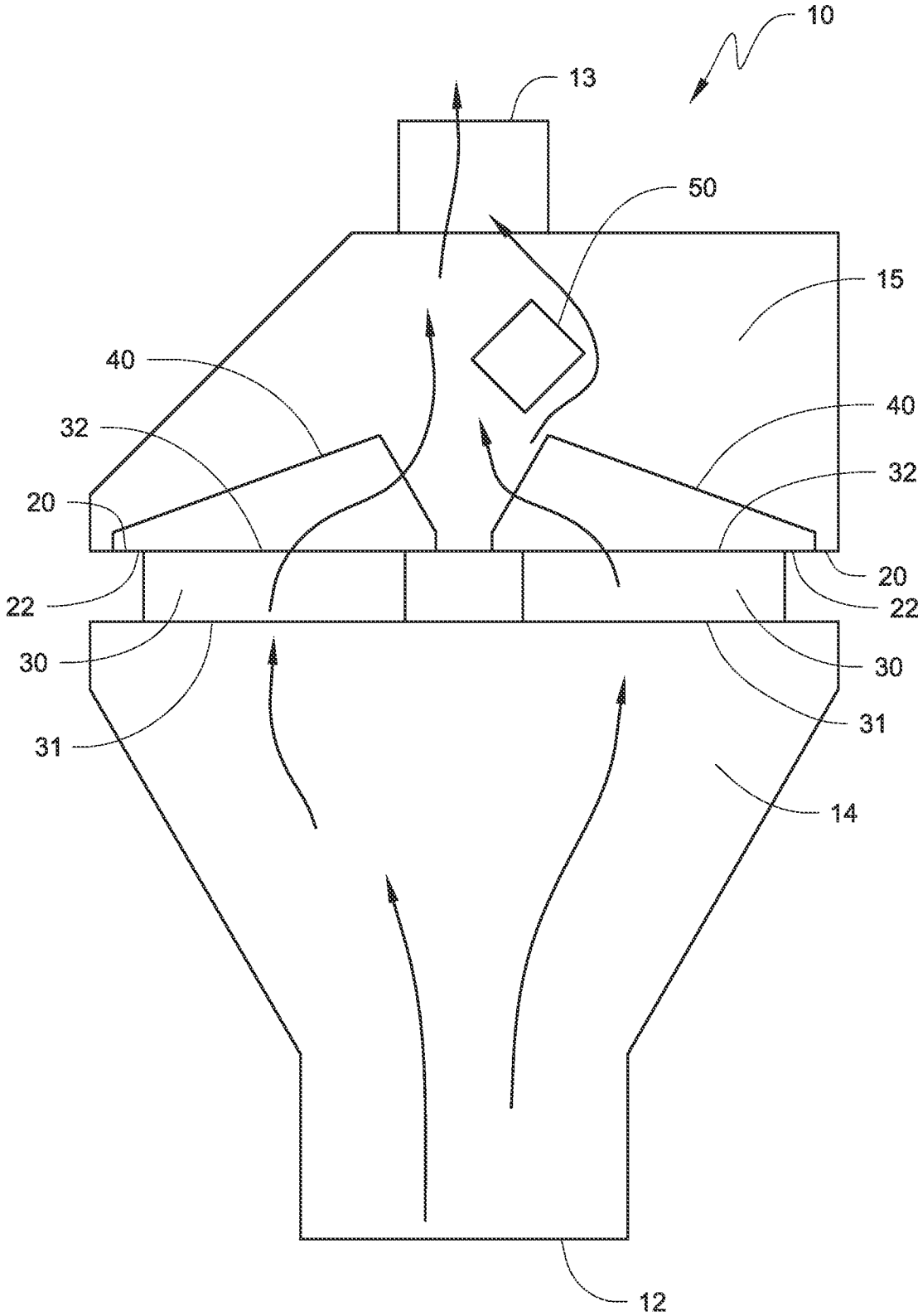


Fig. 2

Fig. 3

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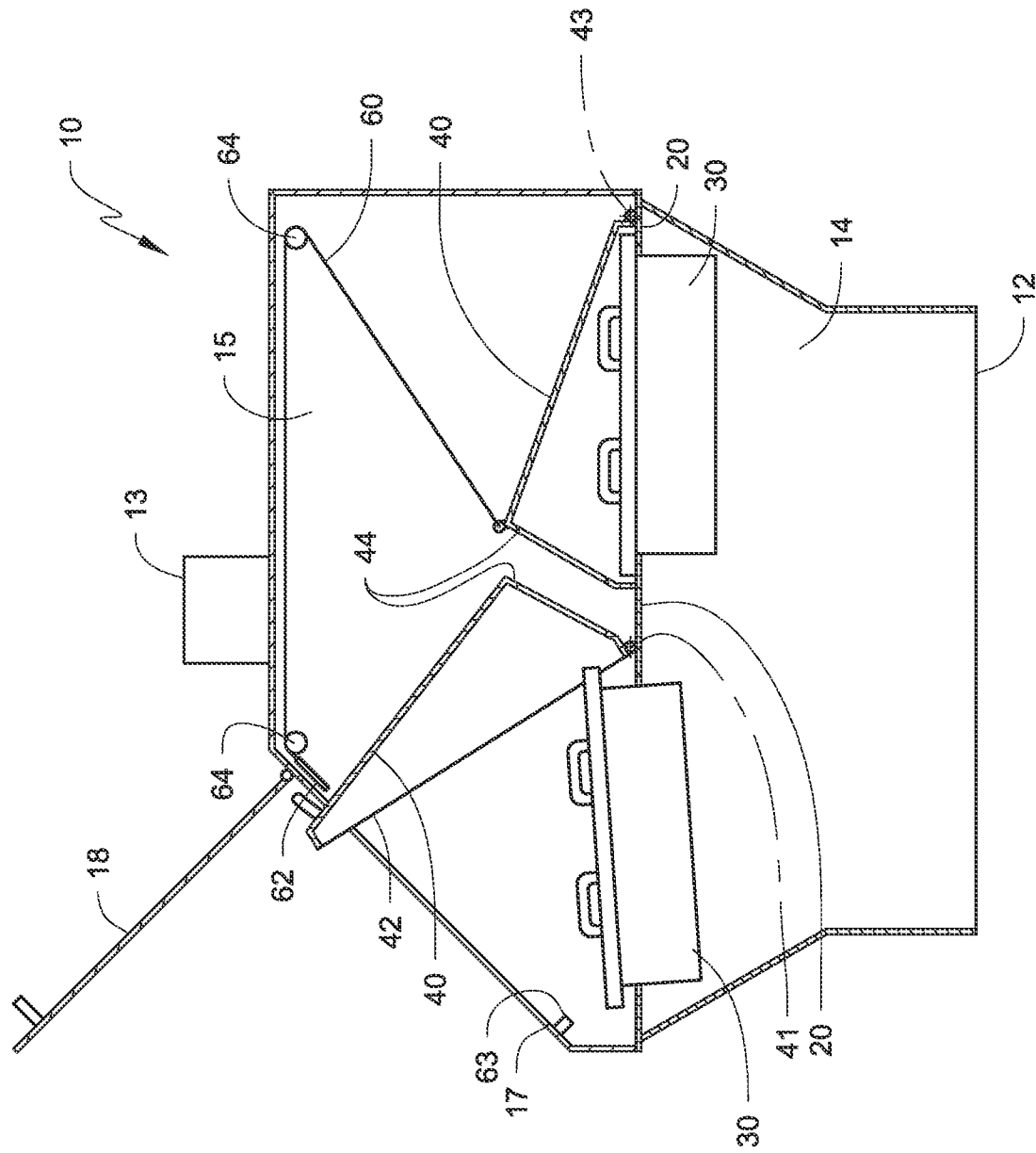


Fig. 4

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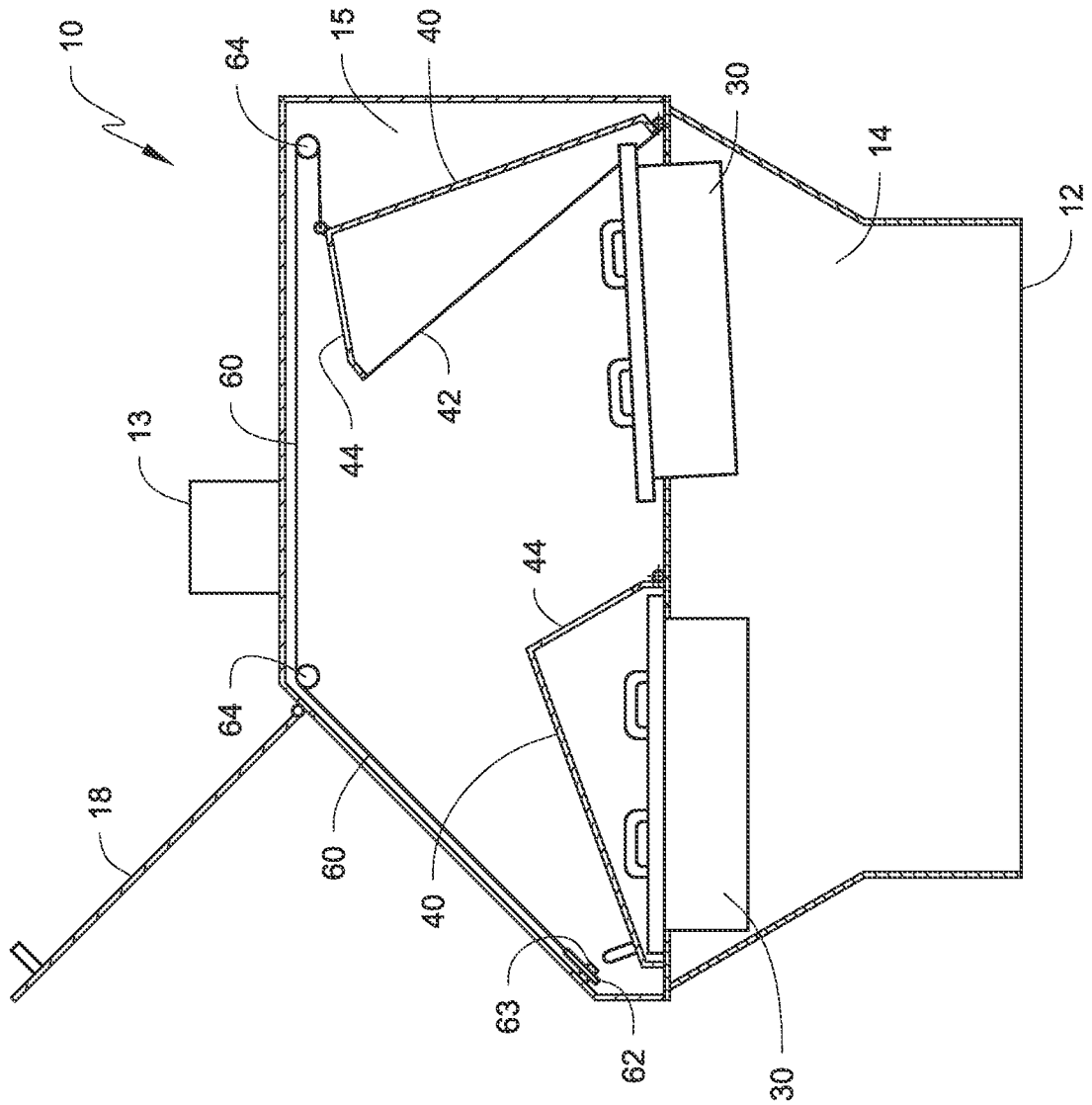


Fig. 5

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Fig. 6

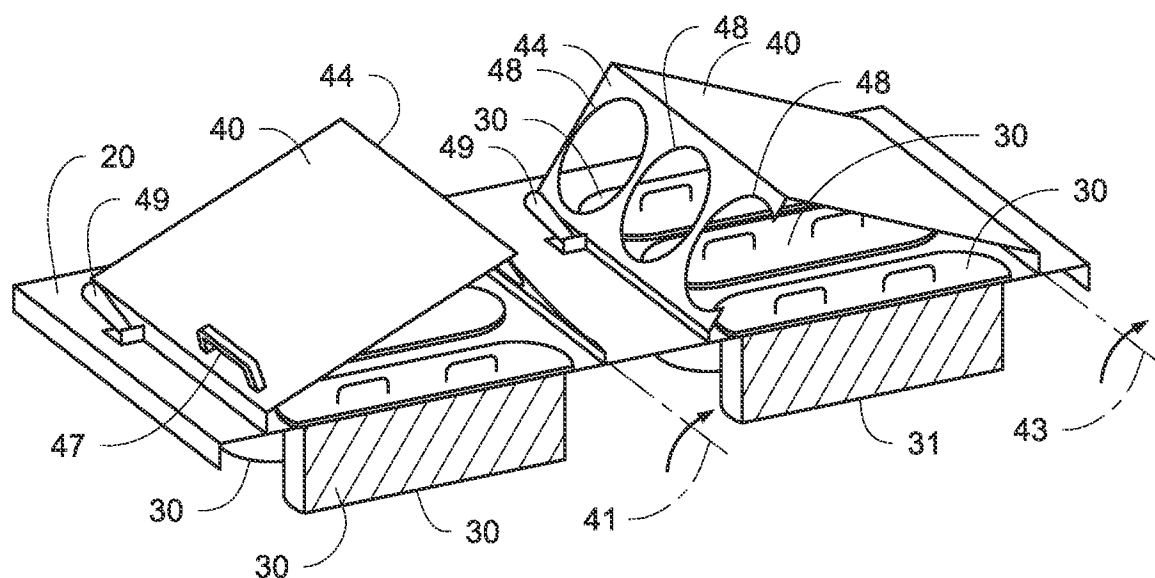
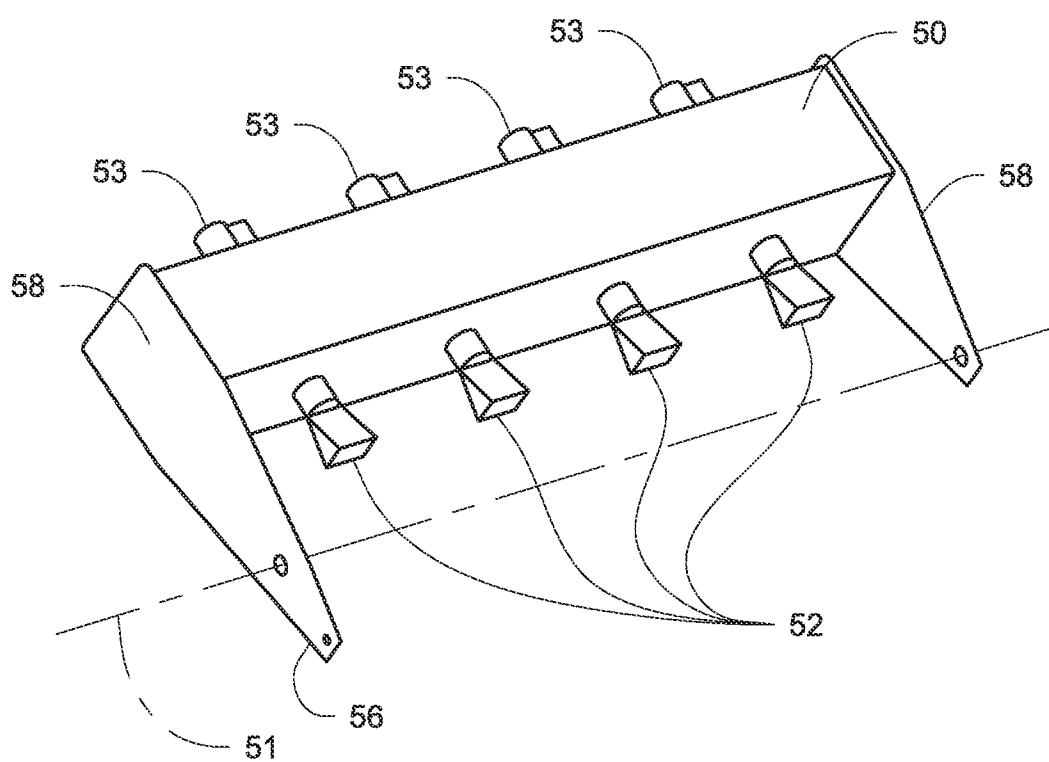


Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 12/62140

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B01D 51/00 (2012.01)
USPC - 96/376

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) - B01D 51/00 (2012.01)
USPC - 96/425, 96/428; 55/282, 55/294 and 55/302

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
(Text search - See terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase and Google - Search terms: dust, collector, housing, chamber, cover, tubesheet, frame, mount, aperture, opening, port, portal, phelum, channel, passage, opening, chimney, filter, filtration, screen, sieve, accumulator, cover, diverter, concentrator, funnel, clean, purify, remove, filter, air, gas, rotate, pivot, revolve, move, movable, ax

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/0185689 A1 (Raether et al.) 04 August 2011 (04.08.2011) Entire document, especially Fig 18 and 18A it 313,328, 332, 420, 421 and 481 and para [0002] [0005], [0061], [0062] and para [0124] - [0136], [0163] and [0166].	1-5 and 12-24
A	US 6,746, 500 B1 (Park et al.) 08 June 2004 (08.06.2004) Entire document, especially 5, In 12-17	1-5 and 20-23
A	US 4,434,861 A (Howeth) 06 March 1984 (06.04.1984) Entire document, especially col 10, In 26-40	3-5
A	US 4,655,799 A (Bosworth et al.) 07 April 1987 (07.04.1987) Entire document, especially col 5, In 2-12	12-19 and 24

☐ 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

09 December 2012 (09.12.2012)

Date of mailing of the international search report

09 JAN 2013

Name and mailing address of the ISA/US

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Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/62140

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 6-11
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.