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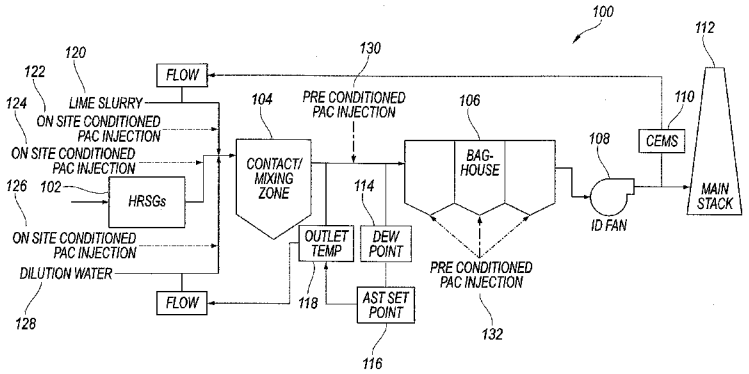


Fig. 1

(57) Abstract: The present technology is generally directed to systems and methods for removing mercury from emissions. More specifically, some embodiments are directed to systems and methods for removing mercury from exhaust gas in a flue gas desulfurization system. In one embodiment, a method of removing mercury from exhaust gas in a flue gas desulfurization system includes inletting the gas into a housing and conditioning an additive. In some embodiments, conditioning the additive comprises hydrating powder-activated carbon. The method further includes introducing the conditioned additive into the housing and capturing mercury from the gas.

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SYSTEMS AND METHODS FOR REMOVING MERCURY FROM EMISSIONS

TECHNICAL FIELD

[0001] The present technology is generally directed to systems and methods for removing mercury from emissions. More specifically, some embodiments are directed to systems and methods for removing mercury from exhaust gas in a flue gas desulfurization system.

BACKGROUND

[0002] Many industrial processes utilize emissions treatment systems to reduce the dissemination of various pollutants. Mercury, for example, is considered to be a toxic pollutant and its containment is heavily regulated. One of the most effective methods for removing pollutants such as mercury from industrial emissions is a treatment using activated carbon.

[0003] Activated carbon is a form of carbon processed to be riddled with small, low-volume pores that increase the surface area available for adsorption or chemical reactions. Powder activated carbon (PAC) is a particulate form of activated carbon, typically having fine granules less than 1.0 mm in size with an average diameter between .15 and .25 mm. PAC thus has a large surface to volume ratio with a small diffusion distance. In mercury treatment systems, PAC can adsorb vaporized mercury from flue gas and then be collected with fly ash in the treatment facility's particulate collection device, such as a bag house. However, PAC is somewhat hydrophilic and can compete for moisture with other compounds in an emissions treatment system.

[0004] For example, lime is used to remove acidic gases, particularly sulfur dioxide, from flue gases. In dry lime scrubbing treatments, lime is injected directly into flue gas to remove sulfur dioxide. A sulfur dioxide and lime contact zone, such as a spray dryer, provides space for mixing hot flue gas and lime slurry that is sprayed through an atomizer or nozzle. The lime slurry absorbs sulfur dioxide. The water in the lime slurry is then evaporated by the hot gas. A portion of the dried, unreacted lime and its reaction products fall to the bottom of the contact zone and are

removed. The flue gas then flows to a particulate control device (e.g., the bag house) to remove the remainder of the lime and reaction products.

[0005] Because of PAC's moisture-competitive quality, emissions treatment systems utilizing both PAC and lime slurry may require significantly more lime slurry to adequately remove sulfur dioxide as compared to systems not using PAC. Accordingly, there exists a need to improve the efficient control and treatment of pollutants such as mercury and sulfur dioxide within a single system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is a schematic illustration of an emissions handling system configured in accordance with embodiments of the technology.

[0007] Figure 2 is a schematic illustration of an additive slurry system configured in accordance with embodiments of the technology.

[0008] Figure 3 is an isometric, partially cut-away view of a silo feed system configured in accordance with embodiments of the technology.

[0009] Figure 4 is a schematic illustration of a conditioner silo configured in accordance with embodiments of the technology.

[0010] Figure 5 is a block diagram illustrating a method of removing mercury from exhaust gas in a flue gas desulfurization system in accordance with embodiments of the technology.

[0011] Figure 6 is a block diagram illustrating a method of controlling a moisture content of fly ash in a bag house in accordance with embodiments of the technology.

DETAILED DESCRIPTION

[0012] The present technology is generally directed to systems and methods for removing mercury from emissions. More specifically, some embodiments are directed to systems and methods for removing mercury from exhaust gas in a flue gas desulfurization system. In one embodiment, a method of removing mercury from exhaust gas in a flue gas desulfurization system includes inletting the gas into a housing and conditioning an additive. In some embodiments,

conditioning the additive comprises hydrating powder-activated carbon. The method further includes introducing the conditioned additive into the housing and capturing mercury from the gas.

[0013] Specific details of several embodiments of the technology are described below with reference to Figures 1-6. Other details describing well-known structures and systems often associated with emissions handling and/or coal processing have not been set forth in the following disclosure to avoid unnecessarily obscuring the description of the various embodiments of the technology. Many of the details, dimensions, angles, and other features shown in the Figures are merely illustrative of particular embodiments of the technology. Accordingly, other embodiments can have other details, dimensions, angles, and features without departing from the spirit or scope of the present technology. A person of ordinary skill in the art, therefore, will accordingly understand that the technology may have other embodiments with additional elements, or the technology may have other embodiments without several of the features shown and described below with reference to Figures 1-6.

[0014] Figure 1 is a schematic illustration of an emissions handling system 100 configured in accordance with embodiments of the technology. In several embodiments, the system 100 is an air pollution control system configured to handle, process, or contain emissions from a coal processing system, such as coke oven flue gases from a heat recovery plant. In the illustrated embodiment, for example, the emissions can pass from a heat recovery steam generator, or HRSG, 102. The emissions can initially contain various pollutants such as mercury. In further embodiments, the emissions can be generated in another mineral processing system, a power plant, a trash to steam plant, a carbon alloy processing system, a dry sulfur removal system, a hot ash circulator, or other similar system.

[0015] In some embodiments, the emissions pass from the HRSG 102 to a contact/mixing zone 104. The contact zone 104 can comprise any type of flow passageway or scrubber used to remove particulate and/or gases from the emissions. In some embodiments, the contact/mixing zone 104 comprises one or more of a riser, flow passageway, sulfur dioxide removal vessel, lime introduction vessel, Spray Dry Absorber (SDA), Circulating Fluidized Bed (CFB), Circulating Dry Scrubber (CDS), Gas Suspension Absorber (GSA), Dry Flue Gas Desulphurization (DFGD) System, or Enhanced All Dry Scrubber (EAD).

[0016] Upon exiting the contact zone 104, the emissions can pass to a bag house 106, fabric filter, or similar air pollution control device. In some embodiments, the emissions pass through a cyclone and/or electrostatic precipitator prior to entering the bag house 106. Upon exiting the bag house 106, the emissions can be pulled by an induced draft (ID) fan 108 and evaluated by a Continuous Emissions Monitoring System (CEMS) 110 and/or exit to the atmosphere via a main stack 112. In various embodiments, the CEMS 110 can monitor levels of mercury, sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, hydrogen chloride, airborne particulate matter, volatile organic compounds, oxygen, and/or other parameter. The CEMS 110 can include a sensor and emissions pathway redirection mechanism configured to redirect the emissions back through the contact zone if a sensed parameter doesn't satisfy a desired emissions level. In further embodiments, the system 100 can include additional or alternate sensors further upstream or downstream in the emissions pathway. For example, in some embodiments, tests for other factors such as dew point 114, Approach to Saturation Temperature (AST) set point 116, outlet temperature 118, pressure, water partial pressure, mercury level, or other factor can be made along the emissions pathway. These testing points can be at other locations in the system 100 than those illustrated in Figure 1. For example, in other embodiments, set point 116 is measured at the outlet of the contact/mixing zone 104 or the bag house 106. The level of any of these or other parameters can be adjusted to optimize pollutant removal while maintaining system functionality and throughput. In still further embodiments, the system 100 can redirect the emissions to an upstream point for further cleaning depending on a parameter reading.

[0017] In several embodiments, the system 100 can include one or more entry points for a conditioned additive. The additive can be selected to capture and/or oxidize mercury or otherwise treat other particulate in the emissions stream. In several embodiments, for example, the additive comprises non-brominated or brominated PAC. In further embodiments, the additive can comprise non-PAC carbon-based materials, promoted PAC, modified PAC, hydrogen bromide, dry absorbents, amended silicate, anhydrous hydrophilic materials, or other suitable materials. PAC can be considered a hydrophobic material having slight hydrophilicity; in some embodiments, other materials having similar characteristics can be used.

[0018] As will be described in further detail below, conditioning the additive can comprise various procedures that alter the behavior of the additive toward the emissions. For example, the conditioning can comprise hydrating the additive (e.g., with water or other substance), applying steam or heat to the additive, hydrating and then drying the additive, introducing the additive into a slurry, or other steps. The additive can be conditioned on site (e.g., during introduction or within an emissions housing, bag house or pathway) or can be conditioned prior to introduction. In a particular embodiment, the additive is conditioned immediately prior to introduction to the bag house 106. In some embodiments, the additive can be conditioned in situ and the conditioning agent can be preferential to the additive over other substances in the vicinity. In some embodiments, the additive can be selected and/or conditioned to control the moisture of fly ash in the bag house 106. For example, non-conditioned, dry PAC would be moisture-preferential in the bag house 106. However, by conditioning PAC additive through hydration, there can be sufficient moisture remaining in the fly ash to ensure sulfur dioxide removal by the lime. In some embodiments, the fly ash moisture content can be kept between about 1% and 7%, and the additive can be conditioned (i.e., hydrated) accordingly to achieve this level. In other embodiments, the fly ash can be hydrated or otherwise conditioned, which makes it less susceptible to the PAC removing moisture. In some embodiments, the fly ash moisture content can be affected by the means/timing of additive conditioning. In some embodiments, the additive is introduced with a carrier. In still further embodiments, the additive is combined with a surfactant to keep the additive in suspension.

[0019] In operation, the additive can be introduced at one or more different points along the emissions pathway in the system 100. These various additive introduction points are illustrated in broken line in Figure 1. In further embodiments, the additive can be introduced at multiple locations in the emissions pathway, either simultaneously or selectively. In some embodiments, the additive is introduced at point 122 in conjunction with a treatment substance such as lime slurry 120. As discussed above, the lime slurry 120 can be introduced to the emissions (for example, via an atomizer, throat, or nozzle) to remove sulfur dioxide from the emissions. In further embodiments, the additive can be introduced to the emissions pathway separately from the lime slurry injection (either upstream or downstream, such as at introduction point 124). In still further embodiments, the additive can be introduced via a supply line at point 126 in conjunction with a dilution material, such as dilution water 128. In yet another embodiment, the additive is added

directly into the contact zone 104. While Figure 1 illustrates that the additive introduced at introduction points 122, 124 and 126 is PAC conditioned on-site (e.g., hydrated at or proximate to the introduction point), in further embodiments the additive comprises other suitable materials and/or can be preconditioned (e.g., pre-hydrated and dried).

[0020] In still further embodiments, the additive is introduced downstream of the contact zone 104 at introduction point 130. In yet another embodiment, the additive is introduced in the bag house 106 at introduction point 132 (e.g., the additive can be introduced at an inlet, an outlet, or into one or more individual bag house cells). In some embodiments, the additive is introduced after a cyclone or electrostatic precipitator proximate to the bag house 106 inlet. In several embodiments where the additive is introduced in or adjacent to the bag house 106, the additive is dried or partially dried so as to not introduce excess fluid to the filtration bags in the bag house 106. In other embodiments, the additive is conditioned in situ in the bag house 106 (e.g., moisture/steam and additive are added to the bag house 106), and the moisture can be preferentially absorbed by the additive. While Figure 1 illustrates that the additive introduced at introduction points 130 and 132 is preconditioned PAC (e.g., pre-hydrated and dried), in further embodiments the additive comprises other suitable materials and/or can be conditioned in situ. Further, the additive can be introduced in response to a sensed condition (e.g., an additive introduction mechanism can be in communication with a sensor). In some embodiments, the additive is introduced in response to a sensed mercury level. In other embodiments, the additive is introduced continuously, dynamically, or at a pre-set timing interval. In various embodiments, the additive introduction can be pressurized or non-pressurized (e.g. gravity-fed).

[0021] Figure 2 is schematic illustration of an additive slurry system 200 configured in accordance with embodiments of the technology. The slurry system 200 can be used to supply a conditioned additive to the emissions handling system 100 illustrated in Figure 1. For example, in some embodiments, the slurry system 200 can be used to condition an additive for introduction to the emissions handling system 100 at points such as 122, 124, or 126, or other location shown in Figure 1.

[0022] The slurry system 200 comprises an additive silo 202 configured to accept raw additive such as PAC. As will be described in further detail below with reference to Figure 3, the

additive silo 202 contains or is coupled to a silo feed system 204 configured to break up and/or meter additive for admixture with a conditioning agent (e.g., water or other fluid). The conditioning agent can be contained in one or more conditioner (e.g., hydration) silos or wetting cones 206. After the additive from the additive silo meets the conditioner from the wetting cones 206, the additive becomes conditioned and can be stored in a conditioned additive silo 208. In one embodiment, the conditioned additive silo 208 is configured to store hydrated PAC slurry. The conditioned additive can be metered for delivery to the emissions pathway discussed above with reference to Figure 1 via one or more conditioned additive delivery lines 210.

[0023] Figure 3 is an isometric, partially cut-away view of the silo feed system 204 of Figure 2, configured in accordance with embodiments of the technology. The silo feed system 204 includes an arch breaker 302 configured to break up and/or meter the additive. The additive can be redirected at region 306 toward conditioner silos (e.g., wetting cones 206 in Figure 2) via one or more screw feeders 304. In some embodiments, the screw feeders 304 compact or meter the additive. The screw feeders 304 can operate simultaneously or redundantly during system repairs. The additive can processed by the silo feed system 204 at a selected rate to achieve the desired degree of mercury removal. For example, in some embodiments, PAC can be passed through the silo feed system 204 at a rate of about 10 to 250 pounds per hour. In a particular embodiment, the PAC is processed at a rate of about 90 pounds per hour.

[0024] Figure 4 is a schematic illustration of the conditioner silo 206 configured in accordance with embodiments of the technology. The conditioner silo 206 includes an inlet 402 configured to receive additive from the silo feed system 204 (e.g., from the screw feeder 304 shown in Figure 3). Metered quantities of conditioning agent (e.g., water) are introduced to the additive from a conditioning agent supply line 404. The additive and conditioning agent are admixed in a hopper or wetting cone 406 and passed to a conditioned additive silo (e.g., the conditioned additive silo 208 shown in Figure 2). The additive and conditioning agent can be selected in respective quantities to achieve a desired level of dilution. For example, in one embodiment, water and PAC are combined to form an approximately 1%-10% solution of hydrated PAC. In a particular embodiment, water and PAC are combined to form an approximately 1%-7% solution. The

conditioned additive is ready for introduction to the emissions pathway of the emissions handling system 100 shown in Figure 1 via one or more dedicated or shared supply lines.

[0025] While Figures 2 through 4 illustrate a particular set of devices for conditioning (i.e., hydrating) an additive, in further embodiments numerous other conditioning devices and methods can be used. For example, heaters, coolers, steam generators, dryers, nozzles, atomizers, throat nozzles, converging and/or diverging nozzles, metering devices, compactors, or other devices can be used individually or in combination to condition, initialize, or otherwise prepare one or more additives for introduction to the emissions handling system 100. Further in some embodiments, one or more conditioned or non-conditioned additives can be added in combination at the same or multiple spots in the system 100.

[0026] Figure 5 is a block diagram illustrating a method 500 of removing mercury from exhaust gas in a flue gas desulfurization system in accordance with embodiments of the technology. In some embodiments, the method 500 includes inletting the gas into a flue gas desulfurization system housing 510. The method 500 further includes conditioning an additive 520. The conditioning can comprise hydrating, drying, heating, etc. In particular embodiments, conditioning the additive comprises hydrating PAC with water. In another particular embodiment, the conditioning comprises drying previously-hydrated PAC. The drying can comprise removing free water, physisorbed water, or chemisorbed water.

[0027] The method 500 further includes introducing the conditioned additive into the housing 530. The introduction can be done by a gravity feed, pump, drip mechanism, nozzle, throat, atomizer, or other delivery device. In some embodiments, the introduction comprises automatically controlling or modifying a dilution percentage of the hydrated PAC. In further embodiments, the introduction comprises automatically modifying a timing of introduction. In some embodiments, the automatic modification of introduction can be in response to a sensed temperature, mercury level, dew point, approach to saturation temperature, water partial pressure, humidity, or other condition. In still further embodiments, the conditioned additive can be introduced at a pre-set timing interval. The method 500 additionally includes capturing mercury from the gas with the conditioned additive 540.

[0028] Figure 6 is a block diagram illustrating a method 600 of controlling a moisture content of fly ash in a bag house in accordance with embodiments of the technology. The method 600 includes conditioning an additive 610 (e.g., PAC) in any of the manners described above. The additive is introduced to emissions within a housing 620. In various embodiments, the additive can be conditioned in situ (e.g., by combining the additive with liquid water or steam in the housing with the emissions) or prior to introduction to the emissions in the housing (e.g., by pre-hydrating and drying the additive). In some embodiments, the introduction comprises pumping the additive into a flue-gas desulfurization system.

[0029] The emissions are passed to a bag house having flay ash therein 630. The method 600 further includes controlling a moisture content of the fly ash in the bag house in response to the introducing 640. For example, in some embodiments, the type of additive, the method of additive conditioning, and/or the means of additive introduction to the emissions can allow a user to control the moisture content in the fly ash and/or operate the system to achieve a desired level of moisture.

Examples

1. A method of removing mercury from exhaust gas in a flue gas desulfurization system, the method comprising:

inletting the gas into a housing;

conditioning an additive;

introducing the conditioned additive into the housing; and

capturing mercury from the gas.

2. The method of example 1 wherein conditioning the additive comprises conditioning powder activated carbon.

3. The method of example 2 wherein conditioning powder activated carbon comprises hydrating the powder activated carbon with water.

4. The method of example 3 wherein hydrating the powder activated carbon comprises forming an approximately 1%-7% solution of hydrated powder activated carbon.

5. The method of example 3, further comprising drying previously-hydrated powder activated carbon, wherein introducing the conditioned additive comprises introducing the dried, previously-hydrated powder-activated carbon.

6. The method of example 1 wherein introducing the conditioned additive comprises introducing the conditioned additive via an atomizer, throat, or nozzle.

7. The method of example 1 wherein introducing the conditioned additive into the housing comprises automatically modifying a dilution percentage of the conditioned additive.

8. The method of example 1, further comprising sensing at least one of a mercury level, temperature or humidity condition.

9. The method of example 8 wherein introducing the conditioned additive comprises automatically introducing the conditioned additive in response to the sensed mercury level.

10. The method of example 1 wherein introducing the conditioned additive comprises introducing the conditioned additive continuously or at a pre-set timing interval.

11. A method, comprising:
conditioning an additive;
introducing the conditioned additive to emissions within a housing;
passing the emissions to a baghouse, the baghouse having fly ash therein; and
controlling a moisture content of the fly ash in the baghouse in response to the introducing.

12. The method of example 11, further comprising hydrating the fly ash.

13. The method of example 11 wherein conditioning the additive comprises hydrating and at least partially drying the additive.

14. The method of example 11 wherein conditioning the additive comprises hydrating the additive within the housing.

15. The method of example 11 wherein conditioning the additive comprises hydrating the additive prior to introducing the additive into the housing.

16. The method of example 11 wherein conditioning the additive comprises introducing steam or water to the additive.

17. The method of example 11 wherein introducing the conditioned additive to emissions comprises pumping the conditioned additive into a flue-gas desulfurization system.

18. A flue gas desulfurization system, comprising:
a source of emissions, the emissions including mercury;
a housing comprising an inlet in communication with the source, and an outlet in communication with a baghouse;
a source of conditioned additive; and
an introducer configured to introduce the conditioned additive to the housing.

19. The system of example 18 wherein the introducer comprises an atomizer, throat, or nozzle configured to inject the conditioned additive to the housing.

20. The system of example 18, further comprising a sensor configured to sense at least one of a mercury level, temperature, dew point, or pressure, wherein the sensor is in communication with the introducer.

21. The system of example 18 wherein the source of the emissions comprises at least one of a coke processing system, a power plant, a trash to steam plant, a carbon alloy processing system, a dry sulfur removal system, or a hot ash circulator.

22. The system of example 18 wherein the source of the conditioned additive comprises:
an additive silo;
a hydration silo; and
a slurry silo coupled to the introducer and configured to receive material from the additive silo and the hydration silo.

23. The system of example 22, further comprising a breaker positioned in the additive silo and configured to break up the additive.

24. The system of example 22 wherein the hydration silo comprises a generally-conical shape and is configured to meter fluid introduction to the slurry silo.

25. The system of example 18 wherein the introducer comprises a supply line in fluid connection with the source of conditioned additive and a source of dilution water.

26. The system of example 18 wherein the introducer comprises a supply line in fluid connection with the source of conditioned additive and a source of lime slurry.

27. A method, comprising:
introducing an additive to emissions within a bag house; the bag house having fly ash therein;
conditioning one or both of the additive or the fly ash; and
controlling a moisture content of the fly ash in the bag house.

28. The method of example 27 wherein conditioning one or both of the additive or the fly ash comprises hydrating one or both of the additive or the fly ash.

29. The method of example 27 wherein introducing an additive to emissions within a bag house comprises introducing dry powder-activated carbon to the emissions within a bag house.

[0030] From the foregoing it will be appreciated that, although specific embodiments of the technology have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the technology. For example, while the conditioned additive is illustrated as being introduced into various locations in the emissions pathway, in further embodiments, the conditioned additive can be introduced further upstream, further downstream, at multiple locations, or by different means than shown. Further, certain aspects of the new technology described in the context of particular embodiments may be combined or eliminated in other embodiments. For example, while the conditioned additive is described in several embodiments as being hydrated PAC, in further embodiments the conditioned additive can comprise any substance having suitable material properties for use in the systems described herein. Moreover, while advantages associated with certain embodiments of the technology have been described in the context of those embodiments, other embodiments may also exhibit such advantages, and not all embodiments need necessarily exhibit such advantages to fall within the scope of the technology. Accordingly, the disclosure and associated technology can encompass other embodiments not expressly shown or described herein. Thus, the disclosure is not limited except as by the appended claims.

CLAIMS

I/We claim:

1. A method of removing mercury from exhaust gas in a flue gas desulfurization system, the method comprising:

inletting the gas into a housing;

conditioning an additive;

introducing the conditioned additive into the housing; and

capturing mercury from the gas.

2. The method of claim 1 wherein conditioning the additive comprises conditioning powder activated carbon.

3. The method of claim 2 wherein conditioning powder activated carbon comprises hydrating the powder activated carbon with water.

4. The method of claim 3 wherein hydrating the powder activated carbon comprises forming an approximately 1%-7% solution of hydrated powder activated carbon.

5. The method of claim 3, further comprising drying previously-hydrated powder activated carbon, wherein introducing the conditioned additive comprises introducing the dried, previously-hydrated powder-activated carbon.

6. The method of claim 1 wherein introducing the conditioned additive comprises introducing the conditioned additive via an atomizer, throat, or nozzle.

7. The method of claim 1 wherein introducing the conditioned additive into the housing comprises automatically modifying a dilution percentage of the conditioned additive.

8. The method of claim 1, further comprising sensing at least one of a mercury level, temperature or humidity condition.

9. The method of claim 8 wherein introducing the conditioned additive comprises automatically introducing the conditioned additive in response to the sensed mercury level.

10. The method of claim 1 wherein introducing the conditioned additive comprises introducing the conditioned additive continuously or at a pre-set timing interval.

11. A method, comprising:
conditioning an additive;
introducing the conditioned additive to emissions within a housing;
passing the emissions to a baghouse, the baghouse having fly ash therein; and
controlling a moisture content of the fly ash in the baghouse in response to the introducing.

12. The method of claim 11, further comprising hydrating the fly ash.

13. The method of claim 11 wherein conditioning the additive comprises hydrating and at least partially drying the additive.

14. The method of claim 11 wherein conditioning the additive comprises hydrating the additive within the housing.

15. The method of claim 11 wherein conditioning the additive comprises hydrating the additive prior to introducing the additive into the housing.

16. The method of claim 11 wherein conditioning the additive comprises introducing steam or water to the additive.

17. The method of claim 11 wherein introducing the conditioned additive to emissions comprises pumping the conditioned additive into a flue-gas desulfurization system.

18. A flue gas desulfurization system, comprising:

a source of emissions, the emissions including mercury;

a housing comprising an inlet in communication with the source, and an outlet in communication with a baghouse;

a source of conditioned additive; and

an introducer configured to introduce the conditioned additive to the housing.

19. The system of claim 18 wherein the introducer comprises an atomizer, throat, or nozzle configured to inject the conditioned additive to the housing.

20. The system of claim 18, further comprising a sensor configured to sense at least one of a mercury level, temperature, dew point, or pressure, wherein the sensor is in communication with the introducer.

21. The system of claim 18 wherein the source of the emissions comprises at least one of a coke processing system, a power plant, a trash to steam plant, a carbon alloy processing system, a dry sulfur removal system, or a hot ash circulator.

22. A method, comprising:

introducing an additive to emissions within a bag house; the bag house having fly ash therein;

conditioning one or both of the additive or the fly ash; and

controlling a moisture content of the fly ash in the bag house.

23. The method of claim 22 wherein conditioning one or both of the additive or the fly ash comprises hydrating one or both of the additive or the fly ash.

24. The method of claim 22 wherein introducing an additive to emissions within a bag house comprises introducing dry powder-activated carbon to the emissions within a bag house.

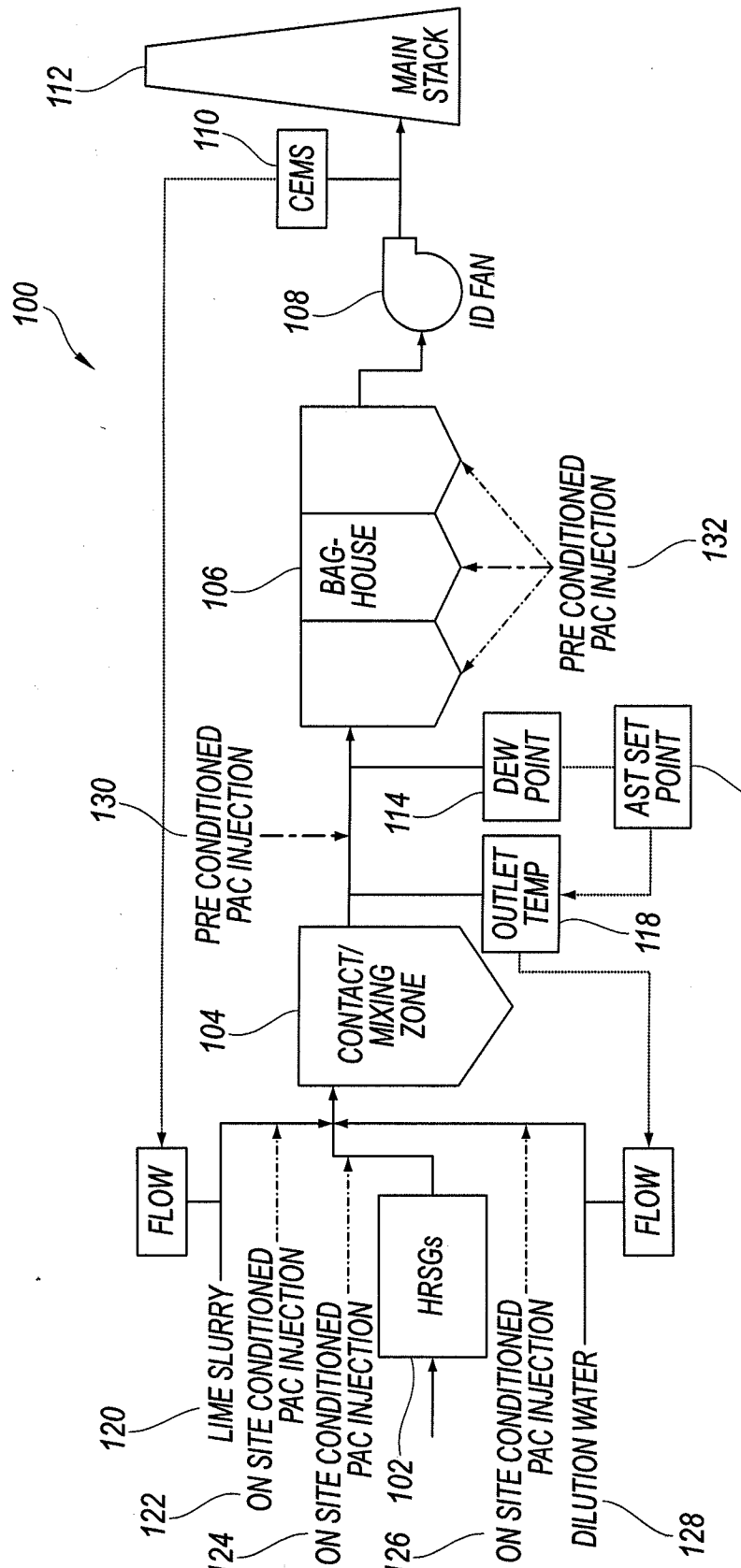

100
112
MAIN STACK
110
CEMS
108
ID FAN
106
BAG-HOUSE
132
PRE CONDITIONED PAC INJECTION
130
PRE CONDITIONED PAC INJECTION
114
DEW POINT
116
AST SET POINT
118
OUTLET TEMP
104
CONTACT/ MIXING ZONE
FLOW
FLOW
120
LIME SLURRY
122
ON SITE CONDITIONED PAC INJECTION
124
ON SITE CONDITIONED PAC INJECTION
102
HRSGs
126
ON SITE CONDITIONED PAC INJECTION
DILUTION WATER
128

Fig. 1

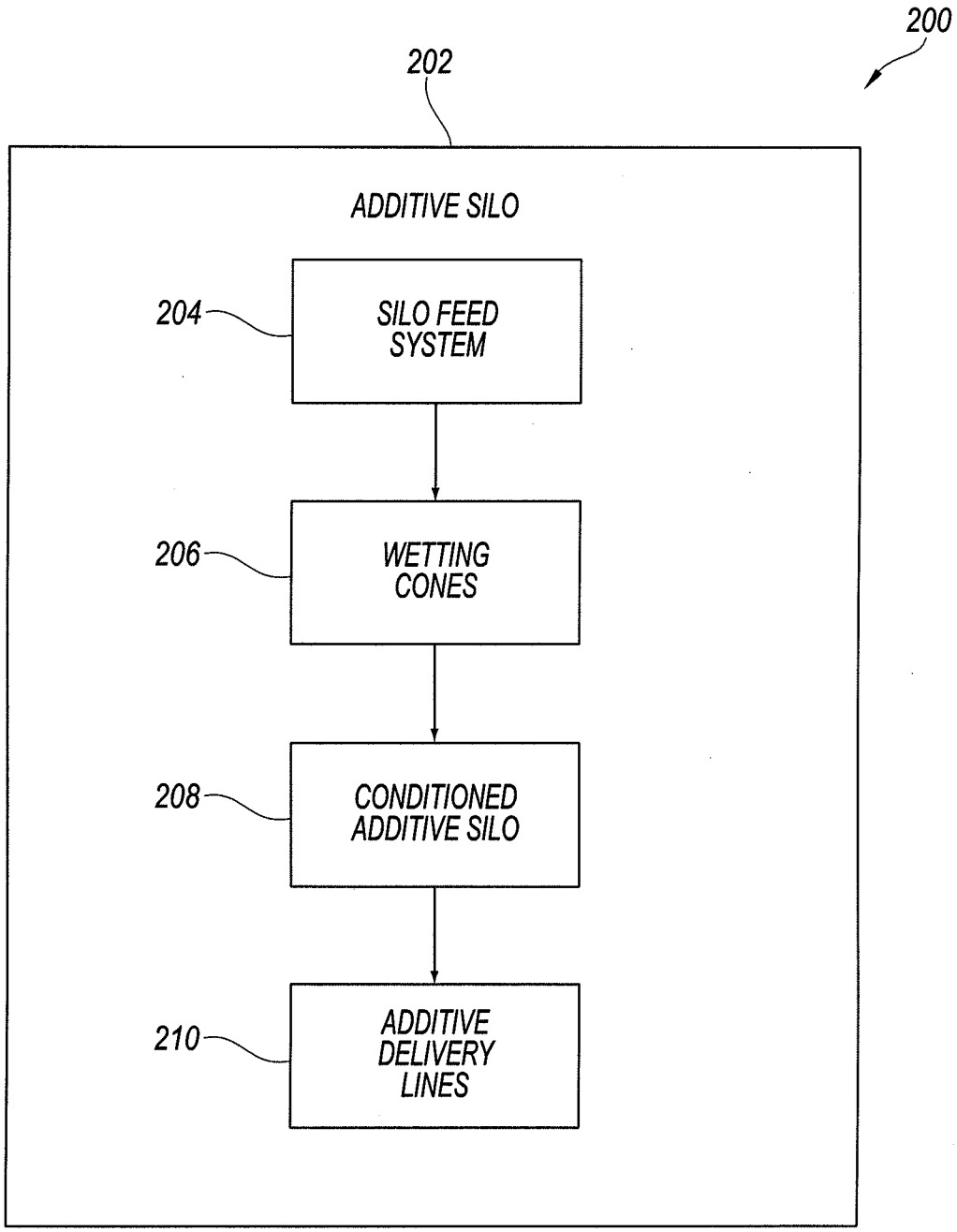

200
202
ADDITIVE SILO
204
SILO FEED SYSTEM
206
WETTING CONES
208
CONDITIONED ADDITIVE SILO
210
ADDITIVE DELIVERY LINES

Fig. 2

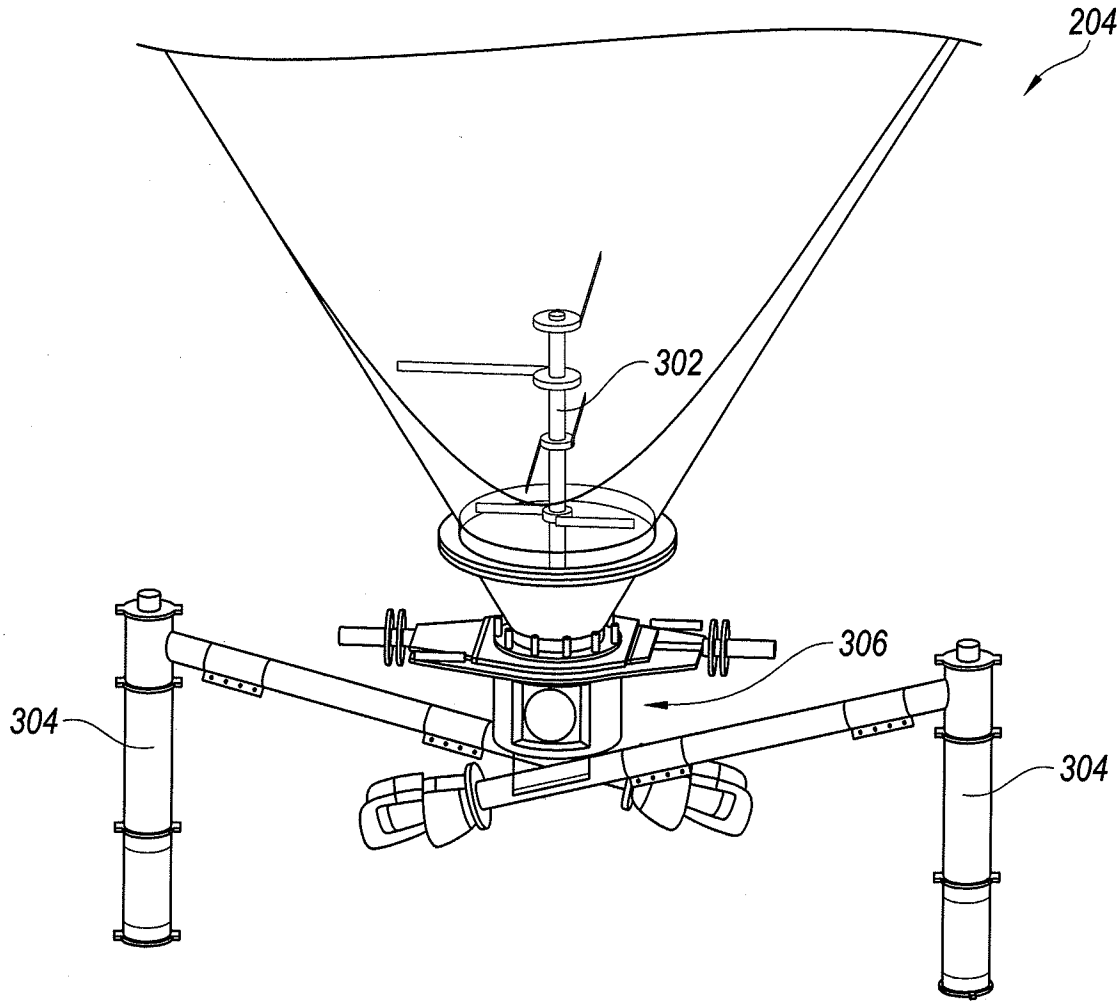


Fig. 3

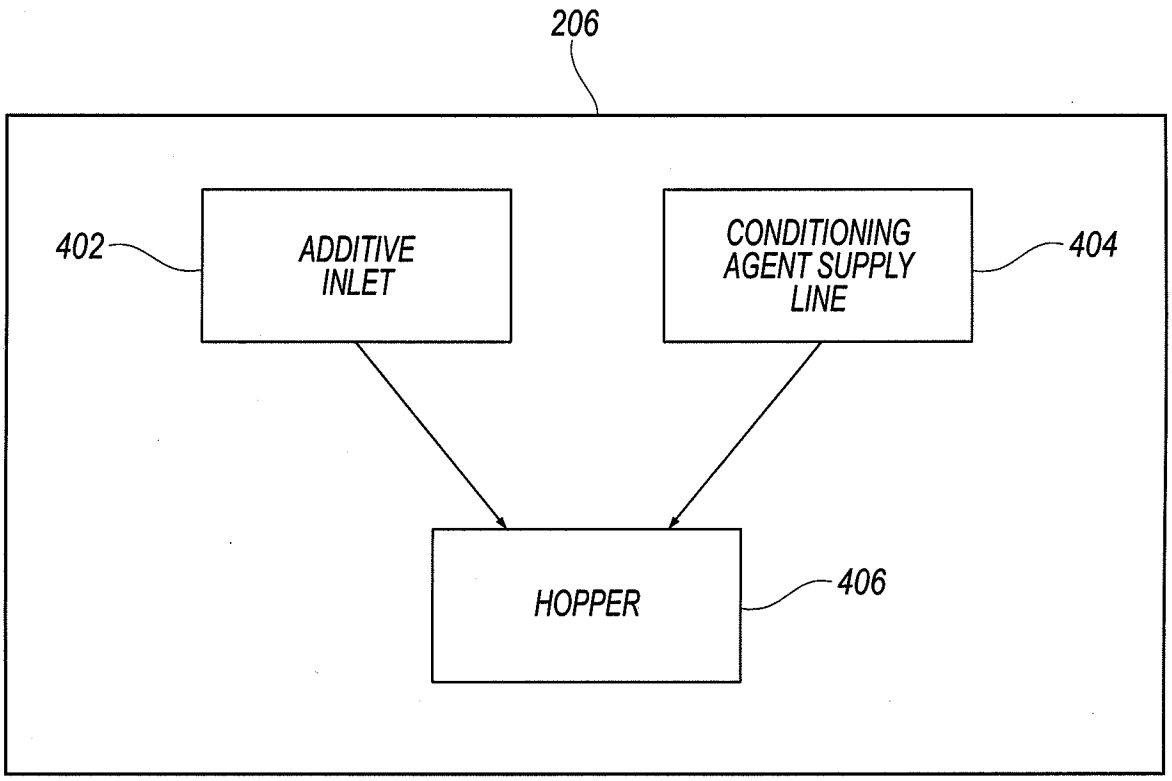

206
402
ADDITIVE INLET
CONDITIONING AGENT SUPPLY LINE
404
HOPPER
406

Fig. 4

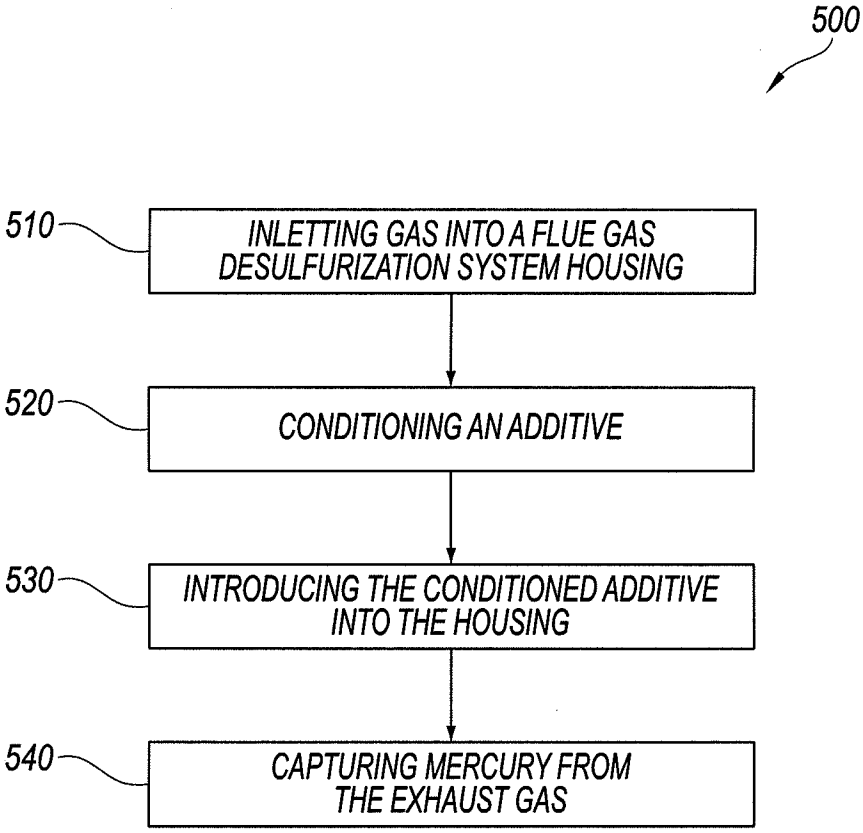

500
510
INLETTING GAS INTO A FLUE GAS DESULFURIZATION SYSTEM HOUSING
520
CONDITIONING AN ADDITIVE
530
INTRODUCING THE CONDITIONED ADDITIVE INTO THE HOUSING
540
CAPTURING MERCURY FROM THE EXHAUST GAS

Fig. 5

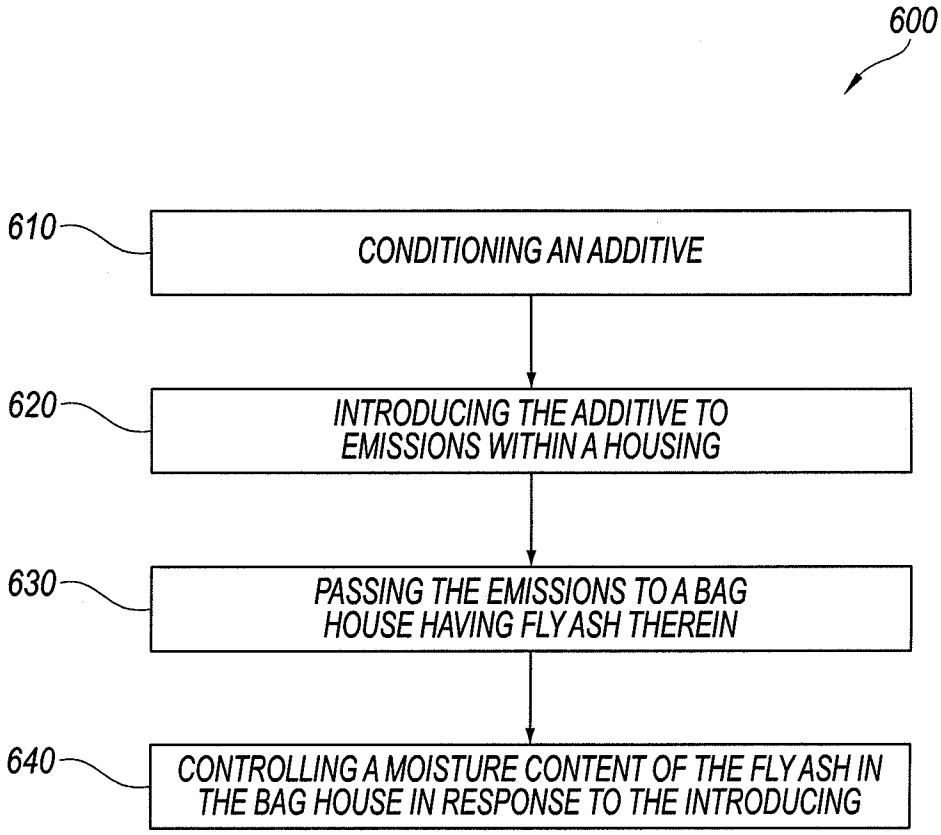

600
610
CONDITIONING AN ADDITIVE
620
INTRODUCING THE ADDITIVE TO EMISSIONS WITHIN A HOUSING
630
PASSING THE EMISSIONS TO A BAG HOUSE HAVING FLY ASH THEREIN
640
CONTROLLING A MOISTURE CONTENT OF THE FLY ASH IN THE BAG HOUSE IN RESPONSE TO THE INTRODUCING

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/072167

A. CLASSIFICATION OF SUBJECT MATTER

B01D 53/64(2006.01)i, B01D 53/02(2006.01)i, B01D 53/48(2006.01)i

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)
B01D 53/64; B01D 53/50; B01D 53/02; B01D 46/02; B01D 53/56; B01D 53/34; B01D 53/46; B01D 53/48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: mercury, quick silver, flue gas, emmission gas, exhaust gas, waste gas, PAC, activated carbon, hydrated, hydrating, remove, capture

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0223088 A1 (CHANG, R. et al.) 15 September 2011. See abstract; paragraphs [0002], [0007]-[0009], [0013], and [0053]-[0056].	1-2,7-11
Y		6,17-21
A		3-5,12-16,22-24
Y	US 2011-0044872 A1 (UKAI, N. et al.) 24 February 2011. See abstract; claims 1,2; paragraphs [0001], [0010]-[0014], [0020], [0044], [0047], [0051]-[0053], [0077]; and figure 1.	6,18-21
A		1-5,7-17,22-24
Y	US 2009-0056543 A1 (WINKLER, H.) 5 March 2009. See abstract; claims 1,6,10; paragraphs [0002], [0006]-[0007] and [0011].	17
A		1-16,18-24
A	JP 07-204432 A (MITSUBISHI HEAVY IND LTD.) 8 August 1995. See abstract; claim 1; paragraphs [0008]-[0009], [0021]; and figure 1.	1-24
A	US 4889698 A (MOLLER, J. T. et al.) 26 December 1989. See abstract; claim 1; column 4, lines 35-49, lines 55-59; column 5, lines 5-25, lines 40-52; and column 6, lines 22-37, lines 49-58.	1-24

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

☒ See patent family annex.

* 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 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	Date of mailing of the international search report
23 September 2013 (23.09.2013)	**24 September 2013 (24.09.2013)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2012/072167

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