

CHAMBER CLEANING MECHANISM

BACKGROUND OF THE INVENTION

The invention relates to a method and apparatus for cleaning a chamber.

5 The manufacturing or fabrication processes in certain industries produce toxic gaseous effluent. For example, chemical vapor deposition processes associated with semiconductor fabrication produces highly toxic gaseous effluent. Also, combustion processes involving the partial combustion of solid fuels discharge hot gaseous effluent. These gaseous effluent are usually heavily laden with particulate matter and must be cleaned or "scrubbed" before they can be treated and released into the environment. Typically, particulate laden gaseous effluent are introduced into a scrubbing chamber through an inlet. The particulate matter tends to adhere to the inner surface of the chamber. Various methods and apparatus have been devised to prevent, or at least slow down, the buildup of particulate matter on the inner surfaces of scrubbing chambers.

15 Referring to prior art Fig. 1a, a chamber cleaning mechanism is shown. The scrubbing chamber (not shown) has an inlet 1, which houses a plurality of scraping blades 2 parallel to a longitudinal axis of inlet 1. The scraping blades 2 are rigidly interconnected by three rings 3, as shown. An actuating arm 4 extends through a slit 5 in the inlet 1 and is attached to the middle one of rings 3.

20 Referring now to prior art Fig. 1b, actuating arm 4 is attached to a piston rod 6, which is driven by a pneumatically operated piston 7. The pneumatically operated piston 7 drives actuating arm 4 back and forth, causing the scraping blades 2 to scrape in a reciprocating motion along the inner surface of inlet 1.

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SUMMARY OF THE INVENTION

30 In one embodiment, the invention relates to a method for cleaning a chamber having at least one scraping blade mounted to an annular member. The method comprises the step of applying a force to the annular member in a direction tangential to a circumference of the annular member so as to cause the annular member to

circumferentially rotate, thereby causing the scraping blade to circumferentially rotate, whereby an inner surface of the chamber is scraped by the scraping blade.

In another embodiment, the invention relates to a chamber cleaning mechanism comprising an annular mounting means for mounting at least one scraping blade within the chamber parallel to a longitudinal axis of the chamber, and a rotating means for rotating the scraping blade circumferentially within the chamber.

In another embodiment, the invention relates to a chamber cleaning mechanism comprising at least one scraping blade rotatably mounted within the chamber parallel to a longitudinal axis of the chamber. An annular gear assembly supports the scraping blade within the chamber, and a pushrod assembly rotates the scraping blade circumferentially within the chamber.

Advantages and features of the invention include one or more of the following: rotatably mounted scraping blades for cleaning the inner surface of a chamber, and a method and apparatus for mounting and rotating the scraping blades circumferentially in such a way as to allow a direct and unobstructed path through the chamber. Other advantages and features of the invention will become apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1a illustrates a prior art chamber cleaning mechanism.

Fig. 1b illustrates a view along line II--II of the chamber cleaning mechanism in Fig. 1a.

Fig. 2 illustrates a gaseous effluent scrubbing chamber and an apparatus for cleaning the chamber.

Fig. 3 illustrates scraping blades and a gear assembly for mounting the scraping blades according to the embodiment of Fig. 2.

Fig. 4a illustrates a side view of a pushrod assembly for rotating the scraping blades according to the embodiment of Fig. 2.

Fig. 4b illustrates a top view of the pushrod assembly shown in Fig. 4a.

Fig. 4c illustrates a side view of the pushrod assembly shown in Fig. 4a after full assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Fig. 2, a gaseous effluent scrubbing chamber is shown generally at 10. The scrubbing chamber 10 has an inlet 15 for introducing gaseous effluent into scrubbing chamber 10. An oxygenator section 20 mixes the gaseous effluent with oxygen. A thermal reaction section 25 having an inner surface 26 and heating element 30 housed within thermal reaction section 25 decomposes and oxidizes the gaseous effluent. Gaseous effluent leaves thermal reaction chamber 25 through a direct and unobstructed distal opening in thermal reaction chamber 25 and enter a scrubbing section 35 wherein water sprays 40 spray water on the gaseous effluent. A first water intake 41 supplies water sprays 40 with water. A drain 45 carries away water from water spray 40 for treating and recycling. Gaseous effluent pass through scrubbing section 35 and up a cooling and scrubbing section 50 for cooling and further scrubbing. Water sprays 55 spray additional water on the gaseous effluent, providing further scrubbing. A second water intake 56 supplies water sprays 55 with water. The water is then carried away by drain 45. Gaseous effluent exits scrubbing chamber 10 through outlet 60. Scraping blades 65, which may be at least one scraping blade, scrape inner surface 26 of thermal reaction section circumferentially to prevent buildup of particulate matter. Scraping blades 65 are preferable thin and narrow so as to expose a minimum surface area of scraping blades 65 to the gaseous effluent.

Referring now to Fig. 3, an annular gear assembly for rotatably mounting scraping blades 65 is shown. Annular bracket 66, bolts 67, and washers 68 connect scraping blades 65 together to keep them stiff and spaced apart. The blades 65 may alternatively be welded to brackets 66. A distal annular flange plate 71 is fastened to an annular housing 70 at a bottom of annular housing 70 by bolts 72. Distal annular flange plate 71 supports a distal annular bearing 73 which is disposed on top of distal annular flange plate 71. Distal annular bearing 73 supports an annular gear 75 which is rotatably mounted on distal annular bearing 73. Annular gear 75 has tabs 76 which are adapted to receive scraping blades 65. Bolts 77 and washers 78 securely fasten scraping blades 65 to annular gear 75. A proximal annular bearing 79 is mounted on annular gear 75 to stabilize and support annular gear 75 during rotation. A proximal

annular flange plate 80 is fastened to annular housing 70 by bolts 81 to cover and enclose the apparatus. Tubular extension 82 extends tangentially from housing 70 for housing a pushrod 90 and lever 95.

5 An advantage of annular gear assembly described above is that, in addition to supporting scraping blades 65, its annular shape allows a direct and unobstructed path for gaseous effluent to pass through thermal reaction section 25 and into scrubbing section 35.

Referring now to Fig. 4a, a pushrod assembly for rotating scraping blades 65 is shown. An air cylinder 85 pneumatically drives a piston 86. Pneumatically driven
10 piston 86 is threaded to engage a pushrod 90 and to drive pushrod 90 back and forth in a reciprocating motion. Pushrod 90 has a pushrod tip 91 extending from a distal end which is adapted to receive a lever 95 for engaging annular gear 75.

Referring now to Fig. 4b, pushrod tip 91 has a hole 92 for receiving a lynch
pin 97. Lever 95 likewise has a hole 98 at a proximal end for receiving lynch pin 97.
15 Thus, by aligning pushrod hole 92 with lever hole 98 and inserting lynch pin 97 therethrough, pushrod 90 and lever 95 may be attached in a hinge of manner. Lever 95 also has a cavity 96 which is adapted to receive a spring 93 extending from pushrod tip 91.

As can be seen in Fig. 4c, spring 93 serves to bias lever 95 towards annular
20 gear 75 such that lever 95 is always in contact with annular gear 75, thereby facilitating engagement of lever 95 to annular gear 75.

In operation, gaseous effluent, such as AsH_3 , CCl_4 , C_2F_6 , CF_4 , GeH_4 , H_2 , PH_3 , NF_3 , SiH_4 , and TEOS, enters scrubbing chamber 10 through outlet 15. The gaseous effluent is not water soluble and will pass through water sprays essentially unreacted.
25 The most effective way of disposing of the gaseous effluent is by burning by controlled thermal decomposition and oxidation. Thus, as gaseous effluent enters scrubbing chamber 10, it is mixed with an oxygen source, for example compressed air. This mixture of gaseous effluent and oxygen then enters thermal reaction section 25 wherein heating element 30 heats up the mixture and thermally decomposes and oxidizes it. The decomposed and oxidized mixture is then scrubbed in scrubbing
30 section 35, cooled and further scrubbed in cooling/scrubbing section 50, and released

through outlet 60. However, as the gaseous effluent is decomposed and oxidized in thermal reaction section 25, particulate matter formed in the gaseous effluent tends to cling and adhere to inner surface 26 of thermal reaction section 25.

5 To prevent buildup of particulate matter, scraping blades 65 are rotatably mounted parallel to a longitudinal axis of thermal reaction section 25 and scrape inner surface 26 of thermal reaction section 25 circumferentially. As described above, scraping blades 65 are securely fastened to annular gear 75, which is rotatably mounted and supported by distal and proximal annular bearings 73 and 79.

10 Annular gear 75 is rotated (thus rotating scraping blades 65) by the reciprocating motion of pushrod 90 and lever 95. Lever 95 is biased by spring 93 to engage a gear tooth of annular gear 75. Pneumatically driven piston 86 then drives pushrod 90 forward. The forward motion of pushrod 90 is transferred through lever 95 to the gear tooth of annular gear 75, pushing the gear tooth in a direction tangential to a circumference of annular gear 75, and causing annular gear 75 to rotate an angular
15 distance equal to the distance traveled by the gear tooth.

As pneumatically driven piston 86 is pulled back, pushrod 90 and lever 95 are also pulled back, causing lever 95 to disengage from the current gear tooth of annular gear 75. When piston 86 subsequently drives forward, spring 93 causes lever 95 to engage the next gear tooth of annular gear 75. The gear tooth is then pushed in a
20 direction tangential to the circumference of the annular gear 75 by the forward motion of pushrod 90, causing annular gear 75 to rotate again. The cycle is repeated with each back and forth motion of pneumatically operated piston 86 such that annular gear 75 is consequently circumferentially rotated, thereby causing scraping blades 65 to also circumferentially rotate.

25 An advantage of the invention is that the tangential pushing motion of the pushrod assembly, along with the annular shape of the gear assembly, allow for a direct and unobstructed path through thermal reaction section 25 and scrubbing section 35.

30 It is to be understood that the embodiment described above is merely illustrative of some of the many specific embodiments of the present invention, and

that other arrangements can be devised by one of ordinary skill in the art at the time the invention was made without departing from the scope of the invention.

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WHAT IS CLAIMED IS:

1. A method for cleaning a chamber having at least one scraping blade mounted to an annular member, comprising the step of applying a force to said annular member in a direction tangential to said annular member so as to cause said annular member to circumferentially rotate, thereby causing said scraping blade to circumferentially rotate, whereby an inner surface of said chamber is scraped by said scraping blade.
2. The method of claim 1, wherein said annular member is an annular gear, further comprising:
- serially engaging each gear tooth of said annular gear; and
 - serially disengaging each gear tooth of said annular gear in a direction tangential to a circumference of said annular gear.
3. A chamber cleaning mechanism, comprising:
- an annular mounting means for mounting at least one scraping blade within a chamber parallel to a longitudinal axis of said chamber; and
 - a rotating means for rotating said scraping blade circumferentially within said chamber.
4. The chamber cleaning mechanism of claim 3, wherein said annular mounting means comprises:
- a distal annular flange plate fastened to an annular housing;
 - a distal annular bearing disposed within said annular housing on said distal annular flange plate;
 - an annular gear disposed within said annular housing on said distal annular bearing;
 - said at least one scraping blade coupled to said annular gear;
 - a proximal annular bearing disposed within said annular housing on said annular gear; and



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a proximal annular flange plate fastened to said annular housing.

5. The chamber cleaning mechanism of claim 3, wherein said rotating means comprises a lever biased towards an annular gear such that a distal end of said lever is in contact with said annular gear.

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6. The chamber cleaning mechanism of claim 5, wherein said rotating means further comprises:

a pushrod having a proximal pushrod end connected to a pneumatically operated piston, said piston driving said pushrod in a reciprocating motion; and

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a pushrod tip extending from a distal pushrod end and adapted to hingedly engage a distal end of said lever.

7. The chamber cleaning mechanism of claim 5, wherein said lever is springloaded.

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8. A chamber cleaning mechanism, comprising:

at least one scraping blade rotatably mounted within a chamber parallel to a longitudinal axis of said chamber;

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an annular gear assembly supporting said scraping blade within said chamber; and

a pushrod assembly rotating said scraping blade circumferentially within said chamber.

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9. The chamber cleaning mechanism of claim 8, wherein said gear assembly comprises:

a distal annular flange plate fastened to an annular housing;

a distal annular bearing disposed within said annular housing on said distal annular flange plate;

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an annular gear disposed within said annular housing on said distal annular bearing;

said at least one scraping blade coupled to said annular gear;



a proximal annular bearing disposed within said annular housing on said annular gear; and

a proximal annular flange plate fastened to said annular housing.

5 10. The chamber cleaning mechanism of claim 8, wherein said pushrod assembly comprises a lever biased towards said annular gear such that a distal end of said lever is in contact with said annular gear.

10 11. The chamber cleaning mechanism of claim 10, wherein said pushrod assembly further comprises:

a pushrod having a proximal pushrod end connected to a pneumatically operated piston, said piston driving said pushrod in a reciprocating motion; and

a pushrod tip extending from a distal pushrod end and adapted to hingedly engage a proximal end of said lever.

15 12. The chamber cleaning mechanism of claim 10, wherein said lever is springloaded.



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