# INLET ASSEMBLY FOR AN ABATEMENT APPARATUS

## FIELD OF THE INVENTION

The field of the invention relates to inlet assembly for an abatement apparatus.

## BACKGROUND

Abatement apparatus are known and are typically used for treating an effluent gas stream from a manufacturing process tool used in, for example, the semiconductor or flat panel display manufacturing industry. During such manufacturing, residual perfluorinated compounds (PFCs) and other compounds exist in the effluent gas stream pumped from the process tool. PFCs are difficult to remove from the effluent gas and their release into the environment is undesirable because they are known to have relatively high greenhouse activity.

Known abatement apparatus use combustion to remove the PFCs and other compounds from the effluent gas stream. Typically, the effluent gas stream is a nitrogen stream containing PFCs and other compounds. A fuel gas is mixed with the effluent gas stream and that gas stream mixture is conveyed using an inlet assembly into an abatement chamber such as a combustion chamber that is laterally surrounded by the exit surface of a foraminous gas burner. Fuel gas and air are simultaneously supplied to the foraminous burner to affect flameless combustion at the exit surface, with the amount of air passing through the foraminous burner being sufficient to consume not only the fuel gas supplied to the burner, but also all the combustibles in the gas stream mixture injected into the combustion chamber.

Although techniques exist for processing the effluent gas stream, they each have their own shortcomings. Accordingly, it is desired to provide an improved technique for processing an effluent gas stream.

SUMMARY

According to a first aspect, there is provided an inlet assembly for an abatement apparatus for treating an effluent stream from a semiconductor processing tool, comprising: an effluent stream inlet configured to convey the effluent stream to a nozzle conduit for delivery to an abatement chamber; a nozzle conduit scraper assembly having a nozzle conduit scraper housed within the nozzle conduit and configured to reciprocate within the nozzle conduit to reduce effluent stream deposits within the nozzle conduit; a reagent plenum configured to receive a reagent and having a wall through which at least a portion of the nozzle scraper assembly extends, the wall defining at least one reagent aperture configured to convey the reagent from the plenum and into the nozzle conduit.

The first aspect recognizes that a problem with existing arrangements is that it can be difficult to reliably introduce a reagent into the inlet assembly which typically requires a nozzle conduit scraper assembly to reduce effluent stream deposits within the nozzle conduit. Accordingly, an inlet assembly is provided. The inlet assembly may be for an abatement apparatus. The abatement apparatus may be for treating an effluent stream from a semiconductor processing tool. The inlet assembly may comprise an effluent stream inlet. The effluent stream inlet may be configured to convey or transport the effluent stream to a nozzle conduit. The nozzle conduit may deliver the effluent stream to an abatement chamber. The inlet assembly may comprise a nozzle conduit scraper assembly. The nozzle conduit scraper assembly may have a nozzle conduit scraper. The nozzle conduit scraper may be housed or retained within the nozzle conduit. The nozzle conduit scraper may be configured to reciprocate or displace within the nozzle conduit to reduce effluent stream deposits within the nozzle conduit. The inlet assembly may comprise or define a reagent plenum. The reagent plenum may be configured to receive a reagent. The reagent plenum may have a wall or cap through which at least a portion of the nozzle scraper assembly extends. The wall may define at least one reagent aperture configured to convey the reagent from the plenum and into the nozzle conduit. In this way, a

compact arrangement is provided which allows for reliable introduction of the reagent into the nozzle conduit.

The nozzle conduit may extend between a first end proximate the reagent plenum and a second end proximate the abatement chamber. Accordingly, the nozzle conduit may be elongate, with the reagent plenum at one end and the abatement chamber at the other and may typically be cylindrical.

The wall may be located at the first end of the nozzle conduit. In other words, the wall may be positioned at the end of the nozzle conduit which is away from the abatement chamber.

The wall may be shared by the nozzle conduit and the reagent plenum. Accordingly, the wall may generally separate the reagent plenum and the nozzle conduit.

The nozzle conduit scraper assembly may have an actuation rod extending from the nozzle conduit scraper to an actuator through the reagent plenum. Accordingly, the actuator rod for the nozzle conduit scraper may extend fully through the reagent plenum. Configuring the reagent plenum in this way allows the actuator rod to be fully actuated without interference from the reagent plenum.

The actuator rod may extend through the wall.

The actuator rod may terminate with a scraper carrier configured to retain the nozzle conduit scraper. In other words, the scraper carrier may be provided at that end of the actuator rod which holds the nozzle conduit scraper.

The scraper carrier may define at least one carrier aperture configured to facilitate flow of the reagent therethrough. Hence, the scraper carrier may be provided with one or more apertures through which the reagent can flow. The

apertures may be positioned to provide a desired direction of flow of the reagent within the nozzle conduit.

The scraper carrier may define a plurality of carrier apertures.

The plurality of carrier apertures may be positioned circumferentially around the scraper carrier. The carrier apertures may be positioned coaxially around the scraper carrier.

The nozzle conduit scraper may comprise a helical spring. Providing a helical spring also helps to introduce a rotational flow to the reagent in the nozzle conduit.

The nozzle conduit may define a nozzle inlet configured to receive the effluent stream and the scraper carrier may be located in a non-actuated position upstream of the nozzle inlet. Locating the scraper carrier upstream of the nozzle inlet helps to prevent the flow of the effluent stream into the nozzle conduit from being interfered with by the scraper carrier.

The nozzle conduit may comprise a baffle conduit coaxially located with the nozzle conduit, the baffle conduit being shaped and configured to redirect flow of the effluent stream from the effluent stream inlet into the nozzle conduit.

The nozzle conduit scraper assembly may extend through the reagent aperture.

The reagent aperture may be sized or dimensioned to be larger than the nozzle scraper assembly. Dimensioning the reagent aperture to be larger than the portion of the nozzle scraper assembly which extends through that reagent aperture provides a gap through which the reagent can flow.

At least one of the reagent aperture and the nozzle conduit scraper assembly may be sized to provide a gap between the wall and the nozzle conduit scraper assembly to facilitate flow of the reagent from the plenum into the nozzle conduit.

At least one of the reagent aperture and the nozzle conduit scraper assembly may be sized to provide the gap between the wall and the nozzle conduit scraper assembly to control a flow rate of the reagent from the plenum into the nozzle conduit.

At least one of the reagent aperture and the nozzle conduit scraper assembly may shaped to provide the gap between the wall and the nozzle conduit scraper assembly to control a direction of flow of the reagent from the plenum into the nozzle conduit. Accordingly, the shape or configuration of the reagent aperture and the nozzle conduit scraper assembly may be selected to direct the flow of the reagent.

At least one of the reagent aperture and the nozzle conduit scraper assembly may be shaped to provide the gap between the wall and the nozzle conduit scraper assembly to control a direction of flow of the reagent from the plenum into the nozzle conduit around the nozzle conduit scraper. Accordingly, the shape or configuration of the reagent aperture and the nozzle conduit scraper assembly may be selected to direct the flow of the reagent around the nozzle conduit scraper.

At least one of the reagent aperture and the nozzle conduit scraper assembly may be shaped to be conical.

The wall may define an aperture through which the nozzle conduit scraper assembly extends and the at least one of the reagent aperture may comprise at least one separate aperture defined by the wall. Accordingly, in addition to the aperture which receives the nozzle conduit scraper assembly, at least one further aperture may be provided through which the reagent may flow.

The inlet assembly may comprise a plurality of separate apertures define by the wall configured to facilitate flow of the reagent from the plenum into the nozzle conduit. Hence, more than one aperture may be provided to distribute reagent flow around the nozzle conduit.

The plurality of separate apertures may be positioned circumferentially, coaxially around the scraper carrier.

The plurality of separate apertures may be sized to control a flow rate of the reagent from the plenum into the nozzle conduit.

The plurality of separate apertures may be shaped to control a direction of flow of the reagent from the plenum into the nozzle conduit.

The plurality of separate apertures may be shaped to control a direction of flow of the reagent from the plenum into the nozzle conduit around the nozzle conduit scraper.

The plenum may define a plenum inlet configured to receive the reagent.

The plenum may comprise a second wall opposing the wall through which the nozzle conduit scraper assembly extends.

Further particular and preferred aspects are set out in the accompanying independent and dependent claims. Features of the dependent claims may be combined with features of the independent claims as appropriate, and in combinations other than those explicitly set out in the claims.

Where an apparatus feature is described as being operable to provide a function, it will be appreciated that this includes an apparatus feature which provides that function or which is adapted or configured to provide that function.

## BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described further, with reference to the accompanying drawings, in which:

Figure 1 illustrates schematically an inlet portion of an abatement apparatus;

Figure 2 illustrates an inlet assembly for an abatement apparatus according to one embodiment;

Figure 3 illustrates an inlet assembly for an abatement apparatus according to one embodiment; and

Figure 4 illustrates an inlet assembly for an abatement apparatus according to one embodiment.

## DESCRIPTION OF THE EMBODIMENTS

Before discussing the embodiments in any more detail, first an overview will be provided. Some embodiments provide for an arrangement which allows for the simple and effective introduction of a reagent into the effluent stream within the inlet nozzle to help optimise the destruction rate efficiency of compounds within the effluent stream without requiring a complex arrangement of an actuator required for actuation of a nozzle scraper to reduce the accumulation of particulates within the inlet nozzle. In particular, having a plenum which supplies the reagent to the inlet nozzle and through which an actuator rod which is used to actuate nozzle scraper may extend, helps to deliver the reagent to the inlet nozzle without requiring a complex arrangement of actuator required for actuation of the nozzle scraper. The plenum may supply the reagent through dedicated apertures and/or reuse the aperture through which the actuator rod extends. Those apertures may control the flow rate and/or control the direction of flow of the reagent into the inlet nozzle. The nozzle scraper may be retained by a carrier coupled with the actuator rod. The carrier may also be provided with apertures or recesses through which the reagent may flow. Those apertures or recesses may also control the flow rate and/or control the direction of flow of the reagent into the inlet nozzle.

Inlet Assembly - Overview

Figure 1 illustrates schematically an example inlet assembly 10 of an abatement apparatus. An inlet nozzle 20 is provided comprising an elongate cylindrical conduit. A concentrically located helical spring 40 is positioned against an inner surface of the inlet nozzle 20. In this example, a gas (such as fuel or oxidant) is provided to a port 65. In an upper portion of the inlet nozzle 20 there is provided a baffle 50. The baffle 50 comprises a cylindrical tube having a number of apertures 60 formed through its wall. The wall of the inlet nozzle 20 has an aperture 70 which receives an effluent stream conduit 80. In operation, an effluent stream 100 is conveyed into the effluent stream conduit 80. When activated, an inject conveys a gas (such as fuel or oxidant) into the effluent stream 100 as it passes through the effluent stream conduit 80 towards the aperture 70. The baffle 50 presents a cylindrical surface to the incident effluent stream 100 being conveyed through the aperture 70. The baffle 50 seals the upper portion of the inlet nozzle 20 and the only way for the effluent stream 100 to progress through the inlet nozzle 20 is via the apertures 60. As the effluent stream 100 travels along the elongate axis of the inlet nozzle 20, the spring disturbs the flow near the inner wall of the inlet nozzle 20. The effluent stream 100 exits the inlet nozzle 20 into the abatement chamber (not shown) surrounded concentrically by the gas delivered from the lance 55. To facilitate mixing and improve the stability of effluent stream 100, the spring 40 also imparts a rotational component to the effluent stream 100 as it passes along the inlet nozzle 20. The spring 40 therefore helps to improve the mixing of the effluent stream 100 with any reagents which helps to improve performance of the abatement apparatus. Particulates and condensates within the effluent stream 100 can accumulate on the inner surface of the inlet nozzle 20 and so the spring 40 can be displaced using an actuator coupled with an actuator rod 130 along the axial length of the inlet nozzle 20 to help remove such accumulation.

Inlet Assembly – 1st Configuration

Figure 2 illustrates an inlet assembly 10A for the abatement apparatus according to one embodiment. The inlet assembly 10A is similar in general configuration to

the arrangement shown in Figure 1. However, this arrangement provides for the compact and efficient delivery of a reagent for mixing with the effluent stream 100 within the inlet nozzle 20A. There is provided an inlet nozzle 20A housing a concentrically located baffle 50A within which is located a helical spring 40A. The helical spring 40A is carried by a carrier 120A which is retained at one end of an actuator rod 130A.

The upper portion of the inlet nozzle 20A has a structure which defines a reagent plenum 140A. In particular, the upper portion of the inlet nozzle 20A has a cylindrical structure 150A having an upper cap 160A and a lower cap 170A defining the reagent plenum 140A. The actuator rod 130A passes through an aperture 133A in the upper cap 160A and an aperture 173A the lower cap 170A. The clearance between the outer surface of the actuator rod 130A and the aperture 133A in the upper cap 160A provides for a substantial fluid seal between the actuator rod 130A and the upper cap 160A. However, the clearance between the outer surface of the actuator rod 130A and the aperture 173A through the lower cap 170A allows for fluid communication between the reagent plenum 140A and the space within the baffle 50A. The actuator rod 130A has an elongate cylindrical portion and the lower end of the actuator rod 130A has an outwardly tapering surface 135A. The aperture 173A in the lower cap 170A has a complementarily shaped tapering surface 175A. The aperture 173A in the lower cap 170A also has a parallel portion 177A through which the elongate cylindrical portion of the actuator rod 130A extends. The cylindrical structure 150A also defines a reagent inlet 180A through which a reagent is delivered into the reagent plenum 140A.

In operation, a reagent is delivered into the reagent plenum 140A via the reagent inlet 180A. The upper cap 160A, cylindrical structure 150A and lower cap 170A prevent the reagent from escaping from the reagent plenum 140A other than by flowing through the gap, opening or aperture between the outer surface of the actuator rod 130A and the aperture 173A defined by the lower cap 170A. In particular, the reagent flows through the gap between the outer surface of the

elongate cylindrical portion of the actuator rod 130A and the parallel portion 177A of the aperture defined by the lower cap 170A. The dimensioning of this gap is typically used to control the flow rate of the reagent from the reagent plenum 140A into the baffle 50A. The shape of the tapered portions helps to direct the flow of the reagent into the baffle 50. When the inlet nozzle 20A requires scraping then the actuator rod 130A can be displaced downwards without interrupting the flow of the reagent into the baffle 50A. This provides for a particularly compact and convenient way of delivering the reagent into the inlet nozzle 20A for mixing with the effluent stream 100.

Inlet Assembly – 2nd Configuration

Figure 3 illustrates an inlet assembly 10B for the abatement apparatus according to one embodiment. This arrangement also provides for the compact and efficient delivery of a reagent for mixing with the effluent stream 100 within the inlet nozzle 20B. There is provided an inlet nozzle 20B housing a concentrically located baffle 50A within which is located a helical spring 40A. The helical spring 40A is carried by a carrier 120B which is retained at one end of an actuator rod 130A.

The upper portion of the inlet nozzle 20B has a structure which defines a reagent plenum 140B. In particular, the upper portion of the inlet nozzle 20B has a cylindrical structure 150B having an upper cap 160A and a lower cap 170B defining the reagent plenum 140B. The actuator rod 130A passes through an aperture 133A in the upper cap 160A and an aperture 173B the lower cap 170B.

This arrangement is similar to the arrangement shown in Figure 2, except that the lower cap 170B and the carrier 120B have a slightly different configuration. In particular, aperture 173B in the lower cap 170B does not have a tapering portion but rather just has a parallel portion 177B through which the actuator rod 130A passes. In addition, a plurality of reagent apertures 190B are provided extending through the lower cap 170B. In this embodiment, there are provided four reagent apertures 190B positioned circumferentially around the lower cap 170B. The

carrier 120B comprises a cylindrical elongate structure which engages with a plurality of turns of the helical spring 40A. The carrier 120B is provided with a plurality of recesses 125B extending along the axial length of the carrier 120B.

The clearance between the outer surface of the actuator rod 130A and the aperture 133A in the upper cap 160A provides for a substantial fluid seal between the actuator rod 130A and the upper cap 160A. In addition, the clearance between the outer surface of the actuator rod 130A and the aperture 173B through the lower cap 170B provides for a substantial fluid seal between the actuator rod 130A and the upper cap 160A. However, in the clearance between the outer surface of the actuator rod 130A and the aperture 173B through the lower cap 170B can also be selected to allow for fluid communication between the reagent plenum 140A and the space within the baffle 50A. The plurality of reagent apertures 190B are provided extending through the lower cap 170B are sized to allow for fluid communication between the reagent plenum 140A and the space within the baffle 50A. In this example, the plurality of reagent apertures 190B extend axially, parallel to the elongate axis of the actuator rod 130A, but this need not be the case and they may extend obliquely to the to the elongate axis of the actuator rod 130A. Also in this example, the plurality of reagent apertures 190B extend axially, parallel to the elongate axis of axially, parallel to the elongate axis of the carrier 120B, but this need not be the case and they may extend obliquely to the to the elongate axis of the carrier 120B.

In operation, a reagent is delivered into the reagent plenum 140B via the reagent inlet 180A. The upper cap 160A, cylindrical structure 150A and lower cap 170B prevent the reagent from escaping from the reagent plenum 140B other than by flowing through the reagent apertures 190B defined by the lower cap 170B. The dimensioning of the reagent apertures 190B is typically used to control the flow rate of the reagent from the reagent plenum 140B towards the baffle 50A. The orientation of the reagent apertures 190B helps to direct the flow of the reagent towards the baffle 50. The provision of the carrier 120B prevents the reagent from flowing into the baffle 50 other than by flowing through the recesses 125B

defined by the carrier 120B. The orientation of the recesses 125B helps to direct the flow of the reagent into the baffle 50.

When the inlet nozzle 20B requires scraping then the actuator rod 130A can be displaced downwards without interrupting the flow of the reagent into the baffle 50A. This provides for a particularly compact and convenient way of delivering the reagent into the inlet nozzle 20B for mixing with the effluent stream 100.

Inlet Assembly – 3rd Configuration

Figure 4 illustrates an inlet assembly 10C for the abatement apparatus according to one embodiment. This arrangement also provides for the compact and efficient delivery of a reagent for mixing with the effluent stream 100 within the inlet nozzle 20C. There is provided an inlet nozzle 20C housing a concentrically located baffle 50A within which is located a helical spring 40A. The helical spring 40A is carried by a carrier 120C which is retained at one end of an actuator rod 130C.

The upper portion of the inlet nozzle 20C has a structure which defines a reagent plenum 140C. In particular, the upper portion of the inlet nozzle 20C has a cylindrical structure 150C having an upper cap 160C and a lower cap 170C defining the reagent plenum 140C. The actuator rod 130C passes through an aperture in the upper cap 160C and an aperture the lower cap 170C.

This arrangement is similar to the arrangement shown in Figure 3, except that the lower cap 170C and the carrier 120C have a slightly different configuration. In particular, aperture in the lower cap 170C is defined by an upstanding cylindrical portion 200C.

The clearance between the outer surface of the carrier 120C and the inner surface of the cylindrical portion 200C provides for a substantial fluid seal. In addition, the clearance between the outer surface of the cylindrical portion 200C and the aperture through the upper cap 160C provides for a substantial fluid seal.

A plurality of reagent apertures 190C are provided which extend through the lower cap 170C and which are sized to allow for fluid communication between the reagent plenum 140C and the space within the baffle 50A. In this example, the plurality of reagent apertures 190C extend axially, parallel to the elongate axis of the actuator rod 130C, but this need not be the case and they may extend obliquely to the to the elongate axis of the actuator rod 130C.

In operation, a reagent is delivered into the reagent plenum 140C via the reagent inlet (not shown). The upper cap 160C, cylindrical structure 150C and lower cap 170C prevent the reagent from escaping from the reagent plenum 140C other than by flowing through the reagent apertures 190C defined by the lower cap 170C. The dimensioning of the reagent apertures 190C is typically used to control the flow rate of the reagent from the reagent plenum 140C towards the baffle 50A. The orientation of the reagent apertures 190C helps to direct the flow of the reagent towards the baffle 50A.

When the inlet nozzle 20C requires scraping then the actuator rod 130C can be displaced downwards without interrupting the flow of the reagent into the baffle 50A. This provides for a particularly compact and convenient way of delivering the reagent into the inlet nozzle 20C for mixing with the effluent stream 100.

It will be appreciated that features of the 1st, 2nd and 3rd configurations can be combined or exchanged. For example, the lower cap 170A may be provided with reagent apertures 190B; 190C. Likewise, the carriers 120A; 120B; 120C may be exchanged. Similarly, gap between the aperture 173B and the actuator rod 130A or the carrier 120C may allow for fluid communication of the reagent and the aperture 173B may be provided with a tapering surface 175A.

Hence, some embodiments recognise that it can be desirable to provide a reagent (such as fuel) feed to provide an alternative injection source into a swept inlet on an abatement system. Existing etch abatement systems have a complex actuator design used to provide a fuel inject which is useful for semiconductor

gas abatement (PFCs) and uncoupling the actuator spring system and fuel feed (such as a lance) would prove beneficial. During swept inlet testing, the swept inlet was utilised in order to minimise fuel usage - the extended swept inlet was preferred – however, a design clash can arise between the actuator and bellows. By providing the inlet assemblies of the configurations set out above, a reagent can be introduced to provide for optimal destruction rate efficiencies of the effluent stream while also providing for easy actuation of the nozzle scraper, which reduces the complexity of the actuator design.

Although illustrative embodiments of the invention have been disclosed in detail herein, with reference to the accompanying drawings, it is understood that the invention is not limited to the precise embodiment and that various changes and modifications can be effected therein by one skilled in the art without departing from the scope of the invention as defined by the appended claims and their equivalents.

REFERENCE SIGNS

Inlet assembly 10; 10A; 10B; 10C
Inlet nozzle 20; 20A; 20B; 20C
Helical spring 40; 40A
Baffle 50; 50A
Lance 55
Apertures 60
Port 65
Aperture 70
Effluent stream conduit 80
Effluent stream 100
Carrier 120A; 120B; 120C
Recesses 125B
Actuator rod 130; 130A; 130C
Aperture 133A
Tapering surface 135A
Reagent plenum 140A; 140B; 140C
Cylindrical structure 150A; 150B; 150C
Upper cap 160A; 160C
Lower cap 170A; 170B; 170C
Aperture 173A; 173B
Tapering surface 175A
Parallel portion 177A
Reagent inlet 180A; 180B
Reagent apertures 190B; 190C
Cylindrical portion 200C

CLAIMS

1. An inlet assembly for an abatement apparatus for treating an effluent stream from a semiconductor processing tool, comprising:

an effluent stream inlet configured to convey said effluent stream to a nozzle conduit for delivery to an abatement chamber;

a nozzle conduit scraper assembly having a nozzle conduit scraper housed within said nozzle conduit and configured to reciprocate within said nozzle conduit to reduce effluent stream deposits within said nozzle conduit;

a reagent plenum configured to receive a reagent and having a wall through which at least a portion of said nozzle scraper assembly extends, said wall defining at least one reagent aperture configured to convey said reagent from said plenum and into said nozzle conduit.

2. The inlet assembly of claim 1, wherein said nozzle conduit extends between a first end proximate said reagent plenum and a second end proximate said abatement chamber.

3. The inlet assembly of claim 1 or 2,wherein said wall is at least one of:

located at said first end of said nozzle conduit; and

shared by said nozzle conduit and said reagent plenum.

4. The inlet assembly of any preceding claim, wherein said nozzle conduit scraper assembly has an actuator rod extending from said nozzle conduit scraper to an actuator through said reagent plenum.

5. The inlet assembly of claim 4, wherein said actuator rod at least one of:

extends through said wall; and

terminates with a scraper carrier configured to retain said nozzle conduit scraper.

6. The inlet assembly of claim 5, wherein said scraper carrier defines at least one of:

at least one carrier aperture configured to facilitate flow of said reagent therethrough;

a plurality of carrier apertures.

7. The inlet assembly of claim 6, wherein said plurality of carrier apertures are positioned circumferentially, coaxially around said scraper carrier.

8. The inlet assembly of any preceding claim, wherein said nozzle conduit at least one of:

defines a nozzle inlet configured to receive said effluent stream and said scraper carrier is located in a non-actuated position upstream of said nozzle inlet;

comprises a baffle conduit, said baffle conduit being shaped and configured to redirect flow of said effluent stream from said effluent stream inlet into said nozzle conduit; and

extends through said reagent aperture.

9. The inlet assembly of any preceding claim, wherein said reagent aperture is sized to be larger than said nozzle conduit scraper assembly.

10. The inlet assembly of any preceding claim, wherein at least one of said reagent aperture and said nozzle conduit scraper assembly is at least one of:

sized to provide a gap between said wall and said nozzle conduit scraper assembly to facilitate flow of said reagent from said plenum into said nozzle conduit;

sized to provide said gap between said wall and said nozzle conduit scraper assembly to control a flow rate of said reagent from said plenum into said nozzle conduit;

shaped to provide said gap between said wall and said nozzle conduit scraper assembly to control a direction of flow of said reagent from said plenum into said nozzle conduit;

shaped to provide said gap between said wall and said nozzle conduit scraper assembly to control a direction of flow of said reagent from said plenum into said nozzle conduit around said nozzle conduit scraper; and

shaped to be conical.

11. The inlet assembly of any preceding claim, wherein said wall defines an aperture through which said nozzle conduit scraper assembly extends and said at least one of said reagent aperture comprises at least one separate aperture defined by said wall.

12. The inlet assembly of any preceding claim, comprising a plurality of separate apertures define by said wall configured to facilitate flow of said reagent from said plenum into said nozzle conduit.

13. The inlet assembly of claim 12, wherein said plurality of separate apertures are at least one of:

positioned circumferentially, coaxially around said scraper carrier;

sized to control a flow rate of said reagent from said plenum into said nozzle conduit;

shaped to control a direction of flow of said reagent from said plenum into said nozzle conduit; and

shaped to control a direction of flow of said reagent from said plenum into said nozzle conduit around said nozzle conduit scraper.

14. The inlet assembly of any preceding claim, wherein said plenum defines a plenum inlet configured to receive said reagent.

15. The inlet assembly of any preceding claim, wherein said plenum comprises a second wall opposing said wall through which said nozzle conduit scraper assembly extends.