Claims

1. A breather outlet comprising:

a fluid conduit for the passage of a dispersion containing particulate matter;

a laser arranged to provide laser light inside the fluid conduit; wherein, in use, the laser light heats the particulate matter sufficiently to generate incandescence;

one or more sensors for detecting the incandescence of the particulate matter so as to determine a characteristic of the dispersion; and

an electromagnetic wave generator operable to provide electromagnetic waves inside the fluid conduit wherein the output of the electromagnetic wave generator is split and directed upstream of the laser light so as to perform a scattering measurement and downstream of the laser light so as to vaporise at least a portion of the dispersion.

2. A breather outlet as claimed in claim 1, wherein a single electromagnetic generator provides the electromagnetic waves both upstream and downstream of the laser light.

3. A breather outlet as claimed in claim 1 or 2, wherein the output is split by a waveguide splitter.

4. A breather outlet as claimed in any of claims 1 to 3, wherein the intensity of the electromagnetic waves is lower at the upstream position than at the downstream position.

5. A breather outlet as claimed in claim 4, further comprising an attenuator for attenuating the electromagnetic waves directed towards the upstream position.

6. A breather outlet as claimed in any preceding claim, wherein the electromagnetic wave generator is a microwave generator.

7. A breather outlet as claimed in any preceding claim, wherein the one or more sensors are coupled to the fluid conduit by optical fibres.

8. A breather outlet as claimed in any preceding claim, wherein the sensors are electronically or optically multiplexed.

9. A breather outlet as claimed in any preceding claim, wherein the laser is configured to provide a first relatively low power pulse and a second relatively high power pulse to the particulate matter.

10. A breather outlet as claimed in claim 9, wherein the first pulse is a preheat pulse and the second pulse induces incandescence in the particulate matter.

11. A breather outlet as claimed in claim 9 or 10, wherein the same laser provides both the first and second pulses.

12. A breather outlet as claimed in any of claims 1 to 8, wherein the laser is a continuous wave laser.

13. A breather outlet as claimed in any preceding claim, further comprising a second laser, wherein the lasers intersect one another inside the fluid conduit.

14. A breather outlet as claimed in claim 13, wherein the lasers are diametrically opposed.

15. A breather outlet as claimed in any preceding claim, wherein the characteristic of the dispersion include one or more of:

(i) composition;
(ii) size of the particulate matter;
(iii) volume fraction of particulate matter;
(iv) flow rate of the dispersion;
(v) flight time of the particulate matter;
(vi) increase in temperature of the particulate matter; and
(vii) fluid conduit discharge pressure.

16. A breather outlet as claimed in any preceding claim, further comprising a safety interlock which prevents the laser and/or electromagnetic wave generator from operating if the breather outlet is not assembled or is misassembled.

17. A breather outlet substantially as described herein with reference to and as shown in the accompanying drawing.

18. A gas turbine engine comprising a breather outlet as claimed in any preceding claim.

19. A method of using a breather outlet comprising:

passing a dispersion containing particulate matter through a fluid conduit;

passing electromagnetic waves through the dispersion to perform a scattering measurement;

heating the particulate matter with laser light to generate incandescence;

detecting the incandescence of the particulate matter to determine a characteristic of the dispersion; and

vaporising at least a portion of the dispersion using electromagnetic waves.

20. A fluid management method as claimed in claim 19, wherein a single electromagnetic wave generator provides the electromagnetic waves both upstream and downstream of the laser light.

21. A fluid management method as claimed in claim 19 or 20, wherein the particulate matter is heated with a first relatively low power pulse of laser light and a second relatively high power pulse of laser light.

22. A fluid management method as claimed in claim 21, wherein the first pulse is a preheat pulse and the second pulse induces incandescence in the particulate matter.

23. A fluid management method substantially as described herein with reference to the accompanying drawing.

Claims

1. A breather outlet comprising:

a fluid conduit for the passage of a dispersion containing particulate matter;

a laser arranged to provide laser light inside the fluid conduit; wherein, in use, the laser light heats the particulate matter sufficiently to generate incandescence;

one or more sensors for detecting the incandescence of the particulate matter so as to determine a characteristic of the dispersion; and

an electromagnetic wave generator operable to provide electromagnetic waves inside the fluid conduit wherein the output of the electromagnetic wave generator is split and directed upstream of the laser light so as to perform a scattering measurement and downstream of the laser light so as to vaporise at least a portion of the dispersion.

2. A breather outlet as claimed in claim 1, wherein a single electromagnetic generator provides the electromagnetic waves both upstream and downstream of the laser light.

3. A breather outlet as claimed in claim 1 or 2, wherein the output is split by a waveguide splitter.

4. A breather outlet as claimed in any of claims 1 to 3, wherein the intensity of the electromagnetic waves is lower at the upstream position than at the downstream position.

5. A breather outlet as claimed in claim 4, further comprising an attenuator for attenuating the electromagnetic waves directed towards the upstream position.

6. A breather outlet as claimed in any preceding claim, wherein the electromagnetic wave generator is a microwave generator.

7. A breather outlet as claimed in any preceding claim, wherein the one or more sensors are coupled to the fluid conduit by optical fibres.

8. A breather outlet as claimed in any preceding claim, wherein the sensors are electronically or optically multiplexed.

9. A breather outlet as claimed in any preceding claim, wherein the laser is configured to provide a first relatively low power pulse and a second relatively high power pulse to the particulate matter.

10. A breather outlet as claimed in claim 9, wherein the first pulse is a preheat pulse and the second pulse induces incandescence in the particulate matter.

11. A breather outlet as claimed in claim 9 or 10, wherein the same laser provides both the first and second pulses.

12. A breather outlet as claimed in any of claims 1 to 8, wherein the laser is a continuous wave laser.

13. A breather outlet as claimed in any preceding claim, further comprising a second laser, wherein the lasers intersect one another inside the fluid conduit.

14. A breather outlet as claimed in claim 13, wherein the lasers are diametrically opposed.

15. A breather outlet as claimed in any preceding claim, wherein the characteristic of the dispersion include one or more of:

(i) composition;
(ii) size of the particulate matter;
(iii) volume fraction of particulate matter;
(iv) flow rate of the dispersion;
(v) flight time of the particulate matter;
(vi) increase in temperature of the particulate matter; and
(vii) fluid conduit discharge pressure.

16. A breather outlet as claimed in any preceding claim, further comprising a safety interlock which prevents the laser and/or electromagnetic wave generator from operating if the breather outlet is not assembled or is misassembled.

17. A gas turbine engine comprising a breather outlet as claimed in any preceding claim.

18. A method of using a breather outlet comprising:

passing a dispersion containing particulate matter through a fluid conduit;

passing electromagnetic waves through the dispersion to perform a scattering measurement;

heating the particulate matter with laser light to generate incandescence;

detecting the incandescence of the particulate matter to determine a characteristic of the dispersion; and

vaporising at least a portion of the dispersion using electromagnetic waves.

19. A fluid management method as claimed in claim 18, wherein a single electromagnetic wave generator provides the electromagnetic waves both upstream and downstream of the laser light.

20. A fluid management method as claimed in claim 18 or 19, wherein the particulate matter is heated with a first relatively low power pulse of laser light and a second relatively high power pulse of laser light.

21. A fluid management method as claimed in claim 20, wherein the first pulse is a preheat pulse and the second pulse induces incandescence in the particulate matter.