

CLAIMS

What is claimed is:

1. A spray nozzle, comprising:
 - a first conduit that provides a first flow path for a first fluid, the first flow path including a first inlet and a first outlet;
 - a second conduit that provides a second flow path for a second fluid that is different from the first fluid, the second flow path including a second inlet and a second outlet;
 - a first head including the first outlet and second outlet that ejects therefrom a spray in a first direction, wherein the spray includes at least one of the first fluid and the second fluid; and
 - at least one balancing outlet in fluid communication with the second conduit, the at least one balancing outlet configured to eject the second fluid as a balancing jet in a second direction, wherein the second direction is different from the first direction such that a spray force of ejection of the spray is at least partially offset by a balancing force of ejection of the balancing jet.
2. The spray nozzle of claim 1, wherein the balancing force is generally opposite to the spray force.
3. The spray nozzle of claim 1, wherein the at least one balancing outlet is not in fluid communication with the first flow path.
4. The spray nozzle of claim 1, wherein the at least one balancing outlet includes a first pair of balancing outlets located on a first side of the spray nozzle and a second pair of balancing outlets located on a second side of the spray nozzle, and wherein the second conduit is in communication with the first pair of the balancing outlets and the second pair of the balancing outlets opposite to the first side.
5. The spray nozzle of claim 1, further comprising:
 - a third conduit that provides a third flow path for the first fluid; and
 - a second head that ejects therefrom the spray that includes the first fluid and the second fluid.

6. The spray nozzle of claim 5, wherein:
 - the first conduit is in fluid communication with the first head;
 - the second conduit is in fluid communication with the first head, the second head, and the at least one balancing outlet; and
 - the third conduit is in fluid communication with the second head.
7. The spray nozzle of claim 1, wherein:
 - the first fluid is a slurry and the second fluid is a at least one gas.
8. The spray nozzle of claim 1, further comprising a plenum chamber configured to receive the second fluid from the second conduit, the plenum chamber being in fluid communication with the first head and the at least one balancing outlet.
9. The spray nozzle of claim 1, further comprising at least one sensor configured to:
 - measure flow within at least one of the first conduit and the second conduit; and
 - transmit a signal to a control unit that controls at least one of a gas source, a valve, a fluid source, and a slurry source.
10. The spray nozzle of claim 1, further comprising at least one sensor configured to:
 - detect a physical location, velocity, or acceleration of the spray nozzle; and
 - transmit a signal to a control unit that controls at least one of a gas source, a valve, a fluid source, and a slurry source.
11. A spray nozzle assembly comprising:
 - a spray nozzle, the spray nozzle including:
 - a first conduit that provides a first flow path for a first fluid, the first flow path including a first inlet and a first outlet;
 - a second conduit that provides a second flow path for a second fluid that is different from the first fluid, the second flow path including a second inlet and a second outlet;
 - a first head including the first outlet and second outlet that ejects therefrom a spray in a first direction, wherein the spray includes at least one of the first fluid and the second fluid; and
 - at least one balancing outlet in fluid communication with the second conduit, the at least one balancing outlet configured to eject the second fluid as a balancing jet in a second

direction, wherein the second direction is different from the first direction such that a spray force of ejection of the spray is at least partially offset by a balancing force of ejection of the balancing jet;

a fluid or slurry source configured to deliver the first fluid into the first inlet of the first conduit;

a first gas source configured to deliver the second fluid into the second inlet of the second conduit; and

a robotic arm having the spray nozzle coupled to an end thereof.

12. The spray nozzle assembly of claim 11, wherein the spray nozzle is coupled to the end of the robotic arm such that the spray nozzle is permitted to swivel in at least two directions relative to the end of the robotic arm.

13. The spray nozzle assembly of claim 11, wherein the spray nozzle further comprises at least one sensor configured to at least one of:

measure flow within at least one of the first conduit and the second conduit; and

detect a physical location, velocity, or acceleration of the spray nozzle or of the robotic arm.

14. The spray nozzle assembly of claim 13, further comprising a control unit that controls at least the first gas source, and wherein the at least one sensor is further configured to transmit a signal indicative of the physical location, velocity, or acceleration of the spray nozzle or of the robotic arm or the flow speed within the at least one of the first conduit and the second conduit to the control unit.

15. The spray nozzle assembly of claim 14, wherein the control unit is configured to increase or decrease an output of the first gas source in response to receipt of the signal from the at least one sensor.

16. The spray nozzle assembly of claim 14, wherein the spray nozzle comprises a third conduit that provides a third flow path for the second fluid or a third fluid different from the second fluid, and wherein the spray nozzle assembly further includes a second gas source configured to deliver the second fluid or the third fluid into the third conduit.

17. The spray nozzle assembly of claim 16, wherein the control unit is configured to increase or decrease an output of the second gas source in response to receipt of the signal from the at least one sensor.

18. The spray nozzle assembly of claim 11, wherein the robotic arm comprises multiple interconnected segments that permit the robotic arm to curve relative to a longitudinal axis of the robotic arm.

19. The spray nozzle assembly of claim 11, wherein the robotic arm has a hollow interior that permits both a first main line coupled to the fluid or slurry source and to the first inlet of the first conduit, and a second main line coupled to the first gas source and to the second inlet of the second conduit to pass therethrough.

20. A nozzle comprising:

- a first conduit that provides a first flow path for a first fluid, the first flow path including a first inlet and a first outlet;

- a second conduit that provides a second flow path for a second fluid that is different from the first fluid, the second flow path including a second inlet and a second outlet;

- a third conduit that provides a third flow path for a third fluid that is different from the first fluid and from the second fluid, the third flow path including a third inlet and a third outlet;

- a first head including the first outlet and the second outlet that ejects therefrom a spray in a first direction that includes at least one of the first fluid and the second fluid; and

- at least one balancing outlet in fluid communication with at least the third conduit, the at least one balancing outlet configured to eject the third fluid therefrom as a balancing jet in a second direction, wherein the second direction is different from the first direction such that a spray force of ejection of the spray is at least partially offset by a balancing force of ejection of the balancing jet.