CLAIMS

The invention claimed is:

1. A variable flow resistance system comprising:

a chamber configured to induce rotational motion of a fluid flowing therethrough;

a fluid inlet coupled to the chamber; and

a fluid outlet coupled to the chamber that allows the fluid to exit through at least a sidewall of the chamber.

2. The variable flow resistance system of claim 1, wherein the fluid outlet comprises a channel within the chamber that extends from the top or bottom interior surface of the chamber through at least a sidewall of the chamber.

3. The variable flow resistance system of claim 2, wherein the channel exits through the sidewall of the chamber at more than one point.

4. The variable flow resistance system of claim 1, wherein the fluid outlet comprises at least one hole in the sidewall of the chamber.

5. The variable flow resistance system of claim 1, wherein at least a portion of the sidewall of the chamber has at least some degree of curvature.

6. The variable flow resistance system of claim 1, wherein the chamber is configured such that the rotational motion occurs, at least in part, in the same direction as the fluid flow.

7. The variable flow resistance system of claim 1, wherein the fluid inlet comprises a main flow pathway and a branch flow pathway;

wherein the branch flow pathway is configured such that fluid entering the branch flow pathway does not undergo rotational motion or undergoes less rotational motion than fluid entering the main flow pathway.

8. The variable flow resistance system of claim 7, wherein the branch flow pathway is structurally connected to the fluid outlet.

9. The variable flow resistance system of claim 1, wherein the chamber is configured to induce increasing rotational motion of the fluid with decreasing fluid viscosity.

10. A variable flow resistance system comprising:

a plurality of chambers that are connected in series fluid

communication with one another, each chamber having a fluid inlet and a fluid outlet coupled thereto;

wherein at least some of the chambers are configured to induce rotational motion of a fluid flowing therethrough; and

wherein the fluid outlets of at least some of the chambers are configured to allow the fluid to exit through at least a sidewall of the chamber.

11. The variable flow resistance system of claim 10, wherein at least some of the chambers are configured such that the rotational motion occurs, at least in part, in the same direction as the fluid flow.

12. The variable flow resistance system of claim 10, wherein at least some of the chambers are configured to induce increasing rotational motion of the fluid with decreasing fluid viscosity.

13. The variable flow resistance system of claim 10, wherein at least some of the chambers have at least some degree of curvature in at least a portion of the sidewall of the chamber.

14. The variable flow resistance system of claim 10, wherein the fluid outlet of at least some of the chambers comprises a channel within the chamber that extends from the top or bottom interior surface of the chamber through at least a sidewall of the chamber.

15. The variable flow resistance system of claim 10, wherein the fluid outlet of at least some of the chambers comprises at least one hole in the sidewall of the chamber.

16. The variable flow resistance system of claim 10, wherein the fluid inlets of at least some of the chambers comprise a main flow pathway and a branch flow pathway;

wherein the branch flow pathway is configured such that fluid entering the branch flow pathway does not undergo rotational motion or undergoes less rotational motion than fluid entering the main flow pathway.

17. The variable flow resistance system of claim 16, wherein the branch flow pathway is structurally connected to the fluid outlet in at least some of the chambers.

18. A method comprising:

installing a wellbore pipe in an uncompleted wellbore;

wherein the wellbore pipe comprises at least one variable flow resistance system in fluid communication with the interior of the wellbore pipe, each variable flow resistance system comprising:

a plurality of chambers that are connected in series fluid communication with one another, each chamber having a fluid inlet and a fluid outlet coupled thereto;

wherein at least some of the chambers are configured to induce rotational motion of a fluid flowing therethrough; and

wherein the fluid outlets of at least some of the chambers are configured to allow the fluid to exit through at least a sidewall of the chamber.

19. The method of claim 18, further comprising:

allowing a formation fluid to flow through at least some of the variable flow resistance systems and into the interior of the wellbore pipe; and

producing the formation fluid from the wellbore pipe.

20. The method of claim 18, wherein the uncompleted wellbore comprises a horizontal wellbore.

21. The method of claim 18, wherein the uncompleted wellbore penetrates a subterranean formation comprising a plurality of intervals; and

wherein there is at least one variable flow resistance system within each interval.

CLAIMS

1. A variable flow resistance system comprising:

a chamber configured to induce rotational motion of a fluid flowing therethrough, the chamber having a top interior surface and a bottom interior surface and a sidewall extending therebetween;

a fluid inlet coupled to the chamber;

a channel defined in the bottom interior surface and extending through the sidewall; and

a fluid outlet coupled to the chamber at the channel, the fluid outlet being configured to allow the fluid to exit through the sidewall of the chamber via the channel.

2. The variable flow resistance system of claim 1, wherein the channel exits through the sidewall of the chamber at more than one point.

3. The variable flow resistance system of claim 1, wherein the fluid outlet comprises at least one hole in the sidewall of the chamber.

4. The variable flow resistance system of claim 1, wherein at least a portion of the sidewall of the chamber is arcuate.

5. The variable flow resistance system of claim 1, wherein the chamber is configured such that the rotational motion occurs, at least in part, in the same direction as the fluid flow.

6. The variable flow resistance system of claim 1, wherein the fluid inlet comprises a main flow pathway and a branch flow pathway; wherein the branch flow pathway is configured such that fluid entering the branch flow pathway does not undergo rotational motion or undergoes less rotational motion than fluid entering the main flow pathway.

7. The variable flow resistance system of claim 1, wherein the chamber is configured to induce increasing rotational motion of the fluid with decreasing fluid viscosity.

8. A variable flow resistance system comprising:

a plurality of chambers that are connected in series fluid communication with one another, each chamber having a fluid inlet and a fluid outlet coupled thereto;

wherein at least some of the chambers are configured to induce rotational motion of a fluid flowing therethrough; and

wherein the fluid outlet of at least one of the chambers is coupled to the chamber at a channel defined in a bottom interior surface of the chamber, the channel extending through a sidewall of the chamber and the fluid outlet being configured to allow the fluid to exit through the sidewall of the chamber via the channel.

9. The variable flow resistance system of claim 1, wherein at least some of the chambers are configured such that the rotational motion occurs, at least in part, in the same direction as the fluid flow.

10. The variable flow resistance system of claim 8, wherein at least some of the chambers are configured to induce increasing rotational motion of the fluid with decreasing fluid viscosity.

11. The variable flow resistance system of claim 8, wherein at least some of the chambers have at least some degree of curvature in at least a portion of a respective sidewall of each chamber.

12. The variable flow resistance system of claim 8, wherein the fluid outlet of at least some of the chambers comprises at least one hole in a respective sidewall of each chamber.

13. The variable flow resistance system of claim 8, wherein the fluid inlets of at least some of the chambers comprise a main flow pathway and a branch flow pathway;

wherein the branch flow pathway is configured such that fluid entering the branch flow pathway does not undergo rotational motion or undergoes less rotational motion than fluid entering the main flow pathway.

14. A method comprising:

installing a wellbore pipe in an uncompleted wellbore, the wellbore pipe comprising at least one variable flow resistance system in fluid communication with an interior of the wellbore pipe, the at least one variable flow resistance system comprising:

a plurality of chambers that are connected in series fluid communication with one another, each chamber having a fluid inlet and a fluid outlet coupled thereto;

wherein at least some of the chambers are configured to induce rotational motion of a fluid flowing therethrough; and

wherein the fluid outlet of at least one of the chambers is coupled to the chamber at a channel defined in a bottom interior surface of the chamber, the channel extending through a sidewall of the chamber and the fluid outlet being configured to allow the fluid to exit through the sidewall of the chamber via the channel.

15. The method of claim 14, further comprising:
allowing a formation fluid to flow through the at least one variable flow resistance system and into the interior of the wellbore pipe; and producing the formation fluid from the wellbore pipe.

16. The method of claim 14, wherein the uncompleted wellbore comprises a horizontal wellbore.

17. The method of claim 14, wherein the uncompleted wellbore penetrates a subterranean formation comprising a plurality of intervals; and
wherein there is at least one variable flow resistance system within each interval.