It is claimed:

1. An apparatus for autonomously controlling fluid flow in a subterranean well, the fluid having a density which changes over time, the apparatus comprising:

a vortex assembly having a vortex chamber, a vortex outlet, and a first flow inlet and a second flow inlet into the vortex chamber;

a fluid control system having a first fluid passageway and a second passageway, fluid exiting the first and second passageway directed into the vortex assembly; and

a movable fluid diverter positioned in the second passageway, the fluid diverter moved by change in the fluid density, the fluid diverter movable to restrict fluid flow through the second passageway in response to change in the fluid density.

2. An apparatus as in claim 1, wherein the second passageway is for directing fluid flow as it exits the first fluid passageway.

3. An apparatus as in claim 1, the fluid control system further comprising a third passageway, and a movable fluid diverter positioned in the third passageway.

4. An apparatus as in claim 3, wherein the second and third passageways are for directing fluid flow as it exits the first fluid passageway and into the vortex assembly.

5. An apparatus as in claim 1, the fluid control system further comprising a third passageway, and the movable fluid diverter movable between the first and second control passageways.

6. An apparatus as in claim 1, wherein the movable fluid diverter rotates about a longitudinal axis of the fluid diverter.

7. An apparatus as in claim 1, wherein the movable fluid diverter pivots about a radial axis of the fluid diverter.

8. An apparatus as in claim 1, wherein the movable fluid diverter comprises a floating element unattached to the walls of the passageways.

9. An apparatus as in claim 8, wherein the movable fluid diverter comprises at least one floating ball.

10. An apparatus as in claim 1, wherein the movable fluid diverter is of a preselected effective density and is buoyant in a fluid of a preselected density.

11. An apparatus as in claim 1, wherein the fluid diverter is movable between a first and a second position, and wherein the fluid diverter is biased towards the first position by a biasing member.

10. An apparatus as in claim 11, wherein the biasing member is a counterweight.

11. An apparatus as in claim 1, wherein the fluid diverter moves between a first position in which the fluid diverter restricts fluid flow through the second passageway, and a second position in which fluid flow through the second passageway is unrestricted.

12. An apparatus as in claim 6, wherein the fluid diverter rotates to a plurality of rotational angles, and wherein restriction of the fluid flow is related to the rotational angle of the fluid diverter.

13. An apparatus as in claim 1, wherein fluid flow through the first flow inlet results in a substantially spiral flow in the vortex chamber.

14. An apparatus as in claim 13, wherein fluid flow through the second flow inlet results in a substantially radial flow in the vortex chamber.

15. An apparatus as in claim 13, wherein fluid exiting the first fluid passageway is directed into the first flow inlet of the vortex assembly when the movable fluid diverter is of a lower effective density than the fluid.

16. An apparatus as in claim 15, wherein fluid exiting the first fluid passageway is directed into the second flow inlet of the vortex assembly when the movable fluid diverter is of a higher effective density than the fluid.

17. An apparatus as in claim 15, wherein the movable fluid diverter restricts fluid flow through the second passageway when the movable fluid diverter is of a lower effective density than the fluid.

18. An apparatus as in claim 17, wherein the movable fluid diverter restricts fluid flow through the second passageway when the movable fluid diverter is of a higher effective density than the fluid.

19. An apparatus as in claim 1, further comprising a downhole tool for use in a subterranean well, the vortex assembly, fluid control system and movable fluid diverter positioned within the downhole tool.

20. A method of autonomously controlling fluid flow in a subterranean well, the fluid having a density which changes over time, the method comprising the steps of:

flowing fluid through a primary fluid passageway of a fluid control system;

flowing fluid from the primary fluid passageway into a vortex assembly having a first and second flow inlet into a vortex chamber;

flowing fluid through a control passageway of the fluid control system, the control passageway for controlling fluid flow as it exits the primary fluid passageway and into the inlets of the vortex chamber; and

moving a movable fluid diverter positioned in the control passageway in response to a change in the fluid density, the fluid diverter movable to restrict fluid flow through the control passageway.

It is claimed:

1. An apparatus for autonomously controlling fluid flow in a subterranean well, the fluid having a density which changes over time, the apparatus comprising:

a vortex assembly having a vortex chamber, a vortex outlet, and a first flow inlet and a second flow inlet into the vortex chamber;

a fluid control system having a first fluid passageway and a second passageway, fluid exiting the first and second passageway directed into the vortex assembly; and

a movable fluid diverter positioned in the second passageway, the fluid diverter moved by change in the fluid density, the fluid diverter movable to restrict fluid flow through the second passageway in response to change in the fluid density.

2. An apparatus as in claim 1, wherein the second passageway is for directing fluid flow as it exits the first fluid passageway.

3. An apparatus as in claim 1, the fluid control system further comprising a third passageway, and a movable fluid diverter positioned in the third passageway.

4. An apparatus as in claim 3, wherein the second and third passageways are for directing fluid flow as it exits the first fluid passageway and into the vortex assembly.

5. An apparatus as in claim 1, the fluid control system further comprising a third passageway, and the movable fluid diverter movable between the first and second control passageways.

6. An apparatus as in claim 1, wherein the movable fluid diverter rotates about a longitudinal axis of the fluid diverter.

7. An apparatus as in claim 1, wherein the movable fluid diverter pivots about a radial axis of the fluid diverter.

8. An apparatus as in claim 1, wherein the movable fluid diverter comprises a floating element unattached to the walls of the passageways.

9. An apparatus as in claim 8, wherein the movable fluid diverter comprises at least one floating ball.

10. An apparatus as in claim 1, wherein the movable fluid diverter is of a preselected effective density and is buoyant in a fluid of a preselected density.

11. An apparatus as in claim 1, wherein the fluid diverter is movable between a first and a second position, and wherein the fluid diverter is biased towards the first position by a biasing member.

12. An apparatus as in claim 6, wherein the fluid diverter rotates to a plurality of rotational angles, and wherein restriction of the fluid flow is related to the rotational angle of the fluid diverter.

13. An apparatus as in claim 1, wherein fluid flow through the first flow inlet results in a substantially spiral flow in the vortex chamber.

14. An apparatus as in claim 13, wherein fluid flow through the second flow inlet results in a substantially radial flow in the vortex chamber.

15. An apparatus as in claim 13, wherein fluid exiting the first fluid passageway is directed into the first flow inlet of the vortex assembly when the movable fluid diverter is of a lower effective density than the fluid.

16. An apparatus as in claim 15, wherein fluid exiting the first fluid passageway is directed into the second flow inlet of the vortex assembly when the movable fluid diverter is of a higher effective density than the fluid.

17. An apparatus as in claim 15, wherein the movable fluid diverter restricts fluid flow through the second passageway when the movable fluid diverter is of a lower effective density than the fluid.

18. An apparatus as in claim 17, wherein the movable fluid diverter restricts fluid flow through the second passageway when the movable fluid diverter is of a higher effective density than the fluid.

19. An apparatus as in claim 1, further comprising a downhole tool for use in a subterranean well, the vortex assembly, fluid control system and movable fluid diverter positioned within the downhole tool.

20. A method of autonomously controlling fluid flow in a subterranean well, the fluid having a density which changes over time, the method comprising the steps of:

flowing fluid through a primary fluid passageway of a fluid control system;

flowing fluid from the primary fluid passageway into a vortex assembly having a first and second flow inlet into a vortex chamber;

flowing fluid through a control passageway of the fluid control system, the control passageway for controlling fluid flow as it exits the primary fluid passageway and into the inlets of the vortex chamber; and

moving a movable fluid diverter positioned in the control passageway in response to a change in the fluid density, the fluid diverter movable to restrict fluid flow through the control passageway.

21. An apparatus as in claim 11, wherein the biasing member is a counterweight.

22. An apparatus as in claim 1, wherein the fluid diverter moves between a first position in which the fluid diverter restricts fluid flow through the second passageway, and a second position in which fluid flow through the second passageway is unrestricted.