CLAIMS

1. A tool for handling a plug in a subsea wellhead assembly comprising:

a tool main body having a cylinder in selective fluid communication with a fluid source;

an end effector having a latch in selective engagement with the plug and a coupling assembly in selective mechanical cooperation with a latch assembly in the plug;

a piston moveably disposed within the cylinder;

a stem connected between the piston and the end effector, so that when fluid is introduced into the cylinder the end effector is axially moveable with movement of the piston; and

a pressure controlled sequence valve in the piston that is in selective fluid communication with the latch and the coupling assembly.

2. The tool of claim 1, wherein the pressure controlled sequence valve comprises,

a bore in the piston having,

an inlet in fluid communication with a fluid source,

a latch outlet in fluid communication with the latch, and

a coupling assembly outlet in fluid communication with the latch assembly, and

a spool element slidable in the bore that is selectively sequenced to a position where there is fluid communication between the inlet and the latch outlet and that extends along a flow path that is transverse to the spool element, and selectively sequenced to a position where there is fluid communication between the inlet and coupling assembly outlet and that extends along a flow path that is transverse to the spool element, and wherein when the inlet and latch outlet are in fluid communication, fluid communication between the inlet and coupling assembly outlet is blocked by the spool element.

3. The tool of claim 2, wherein the spool element is in fluid communication with the fluid source, wherein the position of the spool element corresponds to a pressure of the fluid in the fluid source, and wherein flow paths extend transverse through the spool element, so that by selectively pressurizing an end of the spool element with a designated pressure the spool element is strategically disposed so that the flow paths register with flow lines that are in fluid communication with the fluid source and with flow lines that are in communication with one of the latch or the coupling assembly, so that strategic positioning of the spool element selectively provides fluid communication between the fluid source and a one of the latch or the coupling

assembly and selectively blocks fluid communication between the fluid source and a one of the latch or the coupling assembly.

4. The tool of claim 1, wherein the fluid source comprises a remotely operated vehicle.

5. The tool of claim 1, wherein the fluid source supplies fluid at selective pressures.

6. The tool of claim 2, wherein the bore comprises a first bore, and the spool element comprises a first spool element, and wherein the first bore and the first spool element define a power supply valve, the pressure controlled sequence valve further comprising,

a second bore in the piston having,

a latch inlet in fluid communication with the latch,

a coupling assembly inlet in fluid communication with the coupling assembly,

an outlet in fluid communication with a storage tank, and

a second spool element slidable in the second bore that is selectively sequenced to a position where there is fluid communication between the outlet and the latch inlet and to a position where there is fluid communication between the outlet and coupling assembly inlet.

7. The tool of claim 6, wherein when fluid flows from the second bore, fluid is urged from a chamber in the end effector and routed to an inlet of the second bore that is in fluid communication with the outlet of the second bore.

8. The tool of claim 2, wherein the latch outlet comprises an actuating latch outlet, the tool further comprising a deactuating latch outlet in the bore that is in fluid communication with the latch, so that when the spool element is positioned in the bore so that the inlet in fluid communication with the actuating latch outlet, fluid flows to the latch to couple the plug to the end effector, and so that when the spool element is positioned in the bore so the inlet is in fluid communication with the deactuating latch outlet, fluid flows to the latch to decouple the plug from the end effector.

9. The tool of claim 2, wherein the coupling assembly outlet comprises a locking actuator outlet, the tool further comprising an unlocking actuator outlet in the bore that is in fluid communication with the coupling assembly, so that when the spool element is positioned in the bore so the inlet is in fluid communication with the locking actuator outlet, fluid flows to the

coupling assembly to anchor the plug to a tubing hanger, and so that when the spool element is positioned in the bore so the inlet is in fluid communication with the unlocking actuator outlet, fluid flows to the coupling assembly to disengage the plug from the tubing hanger.

10. A method of handling a plug in a subsea wellhead assembly comprising:

a. providing a plug handling tool having a tool body having a chamber, a piston in the chamber, and a stem connecting the piston to an end effector that couples to the plug, the plug handling tool further having a plug latch, a plug anchor system, and a pressure actuated power supply valve located in the piston that has an inlet, and has an outlet in communication with a plug latch actuator, and an outlet in communication with the plug anchor system;

b. coupling the plug to the plug handling tool by supplying fluid to the power supply valve at a pressure that sequences the power supply valve to a position so the inlet is in communication with the outlet in communication with the plug latch actuator;

c. inserting the plug into the subsea wellhead assembly; and

d. anchoring the plug in the subsea wellhead assembly by supplying fluid to the power supply valve at a pressure that sequences the power supply valve to a position so the inlet is in communication with the outlet in communication with the plug anchor system.

11. The method of claim 10, further comprising providing a vent valve having an inlet in communication with the plug latch actuator, an inlet in communication with the plug anchor, and an outlet in communication with a storage tank, and that is sequenced in response to the supply of fluid of step (b).

12. The method of claim 11, further comprising selectively venting fluid through the vent valve to storage, wherein the fluid is evacuated from the plug latch actuator in response to fluid flowing from the power supply valve.

13. The method of claim 10, wherein the fluid is supplied by a remotely operated vehicle disposed subsea.

14. The method of claim 10, wherein the tool further comprises, the method further comprising supplying fluid in the chamber to selectively move the piston, stem, and end effector in an axial direction.

15. The method of claim 10, wherein the pressure that sequences the power supply valve to a position comprises a first pressure and the position comprises a first position, the method further comprising supplying a second pressure to the power supply valve that is greater than the first pressure, and wherein the step of supplying the second pressure to the power supply valve sequences the power supply valve so that the inlet is in communication with a sleeve for unlatching the plug from the plug handling tool.

16. A tool for handling a plug in a subsea wellhead assembly comprising:

a tool body having a cavity that is in fluid communication with a remotely operated vehicle (ROV);

an end effector coupled with the tool body having a plug latch system and a plug anchoring system;

a piston axially moveable within the cavity; and

a sequence valve system in the piston comprising:

a power supply valve having an inlet, a first outlet and a second outlet respectively in fluid communication with the plug latch system and the plug anchoring system, and a pilot member selectively sequenced in response to a pressure of fluid supplied by the ROV to a first position where the inlet is in communication with the first outlet and to a second position where the inlet is in communication with the second outlet, and

a vent valve having an outlet, a first inlet and a second inlet respectively in fluid communication with the plug latch system and the plug anchoring system, and a pilot member selectively sequenced in response to a pressure of fluid supplied by the ROV to a first position where the outlet is in communication with the first inlet and to a second position where the outlet is in communication with the second inlet.

17. The tool of claim 16, further comprising a stem mounted on an end of the piston that attaches to the end effector, so that when fluid is supplied to a side of the piston, the stem and the end effector are axially moved.

18. The tool of claim 16, wherein the plug latch system comprises elongated latching fingers that attach to the plug when fluid flows from the first outlet.

19. The tool of claim 16, wherein the plug anchoring system comprises members that selectively extend radially outward when fluid flows from the second outlet.