CLAIMS

1. A system comprising:

a ball launcher (18, 180, 270) including:

a hollow body (46, 182) having a plurality of ball chutes extending from an external surface to an internal bore; and

a rotatable sleeve (48, 190) disposed in the internal bore of the hollow body, the rotatable sleeve including one or more holes (70, 72, 74, 76, 102, 204) that can be sequentially aligned with the plurality of ball chutes by rotation of the sleeve with respect to the hollow body to enable balls (36, 60, 62, 64, 66, 158) within the plurality of ball chutes to pass into a well (12) through the one or more holes in sequence when the ball launcher is installed at a well.

2. The system of claim 1, comprising dispensers (184, 216, 240) installed in the plurality of ball chutes.

3. The system of claim 2, wherein the dispensers include pistons (228, 250) positioned to be extended toward the rotatable sleeve to ensure launch of balls from the ball chutes.

4. The system of claim 3, comprising visual indicator rods (234, 252) coupled to the pistons that facilitate user verification that the balls have passed from the ball chutes through the one or more holes of the rotatable sleeve.

5. The system of claim 3, wherein the dispensers include a spring dispenser (240) constructed to route wellbore fluid through a piston (250) of the spring dispenser to create a pressure differential that biases the piston toward the rotatable sleeve.

6. The system of claim 1, comprising a locking pin (188) that engages a recess (206) on the rotatable sleeve to inhibit further rotation of the sleeve when one of the one or more holes is aligned with a ball chute of the plurality of ball chutes.

7. The system of claim 1, wherein the locking pin is hydraulically actuated and includes a spring-loaded tip (198) biased toward the rotatable sleeve.

8. The system of claim 1, wherein the hollow body and the rotatable sleeve are configured to enable balls having different diameters to pass from the plurality of ball chutes through the one or more holes in sequence from smallest to largest.

9. The system of claim 1, wherein the ball chutes of the plurality of ball chutes are formed at declined angles (68) from the external surface to the internal bore.

10. The system of claim 1, wherein the rotatable sleeve is sized to provide full bore access to the wellhead through the rotatable sleeve.

11. A method comprising:

rotating a sleeve (48, 190) within a ball injector (18, 180, 270) coupled to wellhead equipment (14, 16) to align a hole (70, 72, 74, 76, 102, 204) through the sleeve with a first ball (36, 60, 62, 64, 66, 158) to cause the first ball to drop through the hole and into a well (12) through the sleeve; and

further rotating the sleeve within the ball injector to align the hole or a different hole (70, 72, 74, 76, 102, 204) through the sleeve with a second ball (36, 60, 62, 64, 66, 158) to cause the second ball to drop through the hole or the different hole and into the well through the sleeve.

12. The method of claim 11, comprising:

engaging a first recess (206) on the sleeve with a locking pin (188) to inhibit rotation of the sleeve when the hole through the sleeve is aligned with a conduit of the ball injector holding the first ball; and

retracting the locking pin to permit rotation of the sleeve after the first ball has dropped through the hole.

13. The method of claim 12, comprising:

engaging a second recess (206) on the sleeve with an additional locking pin (188) to inhibit rotation of the sleeve when the hole or the different hole through the sleeve is aligned with a conduit of the ball injector holding the second ball; and

retracting the additional locking pin to permit rotation of the sleeve after the second ball has dropped through the hole or the different hole.

14. The method of claim 11, comprising operating a dispenser (184, 216, 240) installed in a conduit of the ball injector to provide a visual confirmation that the first ball dropped through the hole.

15. The method of claim 11, comprising installing the first ball and the second ball in the ball injector, wherein installing the first ball and the second ball in the ball injector includes positioning the first ball and the second ball in different chutes of the ball injector such that the first ball and the second ball bear against the sleeve.

CLAIMS

1. A system comprising:

a ball launcher including:

a hollow body having a plurality of ball chutes extending from an external surface to an internal bore;

a rotatable sleeve disposed in the internal bore of the hollow body, the rotatable sleeve including one or more holes that can be sequentially aligned with the plurality of ball chutes by rotation of the sleeve with respect to the hollow body to enable balls within the plurality of ball chutes to pass into a well through the one or more holes in sequence when the ball launcher is installed at a well; and

dispensers installed in the plurality of ball chutes, wherein the dispensers include pistons positioned to be extended toward the rotatable sleeve to ensure launch of balls from the ball chutes, and wherein the dispensers include a spring dispenser constructed to route wellbore fluid through a piston of the spring dispenser to create a pressure differential that biases the piston toward the rotatable sleeve.

2. The system of claim 1, wherein the ball chutes of the plurality of ball chutes have different sizes to receive balls having different diameters, and the rotatable sleeve is configured to enable the balls having different diameters to pass from the plurality of ball chutes through the one or more holes in sequence from smallest to largest.

3. The system of claim 1, wherein the ball launcher includes a worm gear to enable rotation of the rotatable sleeve.

4. The system of claim 1, wherein the ball chutes of the plurality of ball chutes are formed at declined angles from the external surface to the internal bore.

5. The system of claim 1, wherein the one or more holes that can be sequentially aligned with the plurality of ball chutes by rotation of the sleeve with respect to the hollow body are equal in number to the number of ball chutes in the hollow body.

6. The system of claim 1, comprising a wellhead and a fracturing tree coupled between the wellhead and the ball launcher.

7. The system of claim 1, wherein the rotatable sleeve is sized to provide full bore access to the wellhead through the rotatable sleeve.

8. A system comprising:

a ball launcher including:

a hollow body having a plurality of ball chutes extending from an external surface to an internal bore;

a rotatable sleeve disposed in the internal bore of the hollow body, the rotatable sleeve including one or more holes that can be sequentially aligned with the plurality of ball chutes by rotation of the sleeve with respect to the hollow body to enable balls within the plurality of ball chutes to pass into a well through the one or more holes in sequence when the ball launcher is installed at a well; and

dispensers installed in the plurality of ball chutes, wherein the dispensers include pistons positioned to be extended toward the rotatable sleeve to ensure launch of balls from the ball chutes and visual indicator rods coupled to the pistons that facilitate user verification that the balls have passed from the ball chutes through the one or more holes of the rotatable sleeve.

9. A system comprising:

a ball launcher including:

a hollow body having a plurality of ball chutes extending from an external surface to an internal bore;

a rotatable sleeve disposed in the internal bore of the hollow body, the rotatable sleeve including one or more holes that can be sequentially aligned with the plurality of ball chutes by rotation of the sleeve with respect to the hollow body to enable balls within the plurality of ball chutes to pass into a well through the one or more holes in sequence when the ball launcher is installed at a well; and

a locking pin that engages a recess on the rotatable sleeve to inhibit further rotation of the sleeve when one of the one or more holes is aligned with a ball chute of the plurality of ball chutes.

10. A system comprising:

a ball launcher including:

a hollow body having a plurality of ball chutes extending from an external surface to an internal bore;

a rotatable sleeve disposed in the internal bore of the hollow body, the rotatable sleeve including one or more holes that can be sequentially aligned with the plurality of ball chutes by rotation of the sleeve with respect to the hollow body to enable balls within the plurality of ball chutes to pass into a well through the one or more holes in sequence when the ball launcher is installed at a well; and

a locking pin that is hydraulically actuated and includes a spring-loaded tip biased toward the rotatable sleeve.

11. A method comprising:

rotating a sleeve within a ball injector coupled to wellhead equipment to align a hole through the sleeve with a first ball to cause the first ball to drop through the hole and into a well through the sleeve;

engaging a first recess on the sleeve with a locking pin to inhibit rotation of the sleeve when the hole through the sleeve is aligned with a conduit of the ball injector holding the first ball;

retracting the locking pin to permit rotation of the sleeve after the first ball has dropped through the hole; and

further rotating the sleeve within the ball injector to align the hole or a different hole through the sleeve with a second ball to cause the second ball to drop through the hole or the different hole and into the well through the sleeve.

12. The method of claim 11, comprising:

engaging a second recess on the sleeve with an additional locking pin to inhibit rotation of the sleeve when the hole or the different hole through the sleeve is aligned with a conduit of the ball injector holding the second ball; and

retracting the additional locking pin to permit rotation of the sleeve after the second ball has dropped through the hole or the different hole.

13. The method of claim 11, comprising operating a dispenser installed in the conduit of the ball injector to provide a visual confirmation that the first ball dropped through the hole.

14. The method of claim 11, wherein the second ball drops into the well through the same hole as the first ball.

15. The method of claim 11, comprising:

fracturing a first portion of the well after the first ball has dropped through the hole and before the second ball has dropped through the hole or the different hole; and

fracturing a second portion of the well after the second ball has dropped through the hole or the different hole.

16. The method of claim 11, comprising installing the first ball and the second ball in the ball injector, wherein installing the first ball and the second ball in the ball injector includes positioning the first ball and the second ball in different chutes of the ball injector such that the first ball and the second ball bear against the sleeve.