

carriage, the first plunger rod including a distal rod end and a proximal rod end and wherein the distal rod end is disposed above the proximal end of the first syringe assembly and is axially aligned with the plunger. Further, the method may include activating the actuating device coupled to the first carriage to move the first cradle from a first position to a second position, thereby applying a force to the first plunger rod causing the first plunger rod to become coupled to the first syringe assembly.

[0007] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a carriage having a movable cradle including a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod. An actuating device may be operatively coupled to the carriage and adapted to move the cradle from a first position to a second position to couple the plunger rod to the syringe assembly. The machine may further include an elongated pressure plate positioned adjacent to the carriage and defining an inlet and an outlet, the inlet being sized to receive a proximal end of the plunger rod and apply a downward force on the proximal end of the plunger rod as the plunger rod moves from the inlet to the outlet. A constant tension spring may be coupled to the pressure plate, the constant tension spring providing a downward force to the pressure plate such that the downward force is transferred to the plunger rod via the pressure plate as the cradle moves between the first position and the second position.

[0008] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a carriage having a movable cradle including a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod. The machine may include an actuating device operatively coupled to the carriage and adapted to move the cradle from a first position to a second position to couple the plunger rod to the syringe assembly. A pressure plate may be positioned adjacent to the carriage so that the cradle moves beneath the pressure plate when the cradle moves from the first position to the second position, the pressure plate adapted to apply a downward force to the plunger rod disposed in the aperture portion of the cradle when the cradle moves from the first position to the second position. The actuating device may include a lever operatively coupled to the carriage and adapted to be manipulated to index the cradle from the first position to the second position.

[0009] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a carriage having a movable cradle including a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod. An actuating device may be operatively coupled to the carriage and adapted to index the cradle from a first position to a second position only once upon an activation event for coupling the plunger rod to the syringe assembly.

[0010] There is disclosed method of using a machine to couple a plunger rod to a syringe assembly may include positioning a syringe assembly onto a movable cradle of a carriage, wherein the syringe assembly includes a distal end and a proximal end, a syringe barrel, and a plunger disposed within the syringe barrel at the proximal end of the syringe assembly. Next, the method may include positioning a plunger rod onto the cradle where the plunger rod may include a distal rod end and a proximal rod end and wherein the distal rod end of the plunger rod is disposed above the proximal end of the syringe assembly and is axially aligned with the plunger. The method may include activating an actuating device operatively connected to the carriage. Further, the method may include indexing the cradle from the first position to the second position only once in response to activating the actuating device, wherein a force may be applied to either or both of the syringe assembly and the plunger rod as the cradle indexes from the first position to the second position to couple the plunger rod to a plunger of the syringe assembly.

[0011] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a carriage having a movable cradle including a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod. An actuating device may be operatively coupled to the carriage and adapted to move the cradle from a first position to a second position to couple the plunger rod to the syringe assembly. Further, a friction element may be disposed adjacent to the carriage and below the pressure plate where the friction element may be adapted to engage a syringe barrel of the syringe assembly carried by the cradle as the cradle moves from the first position to the second position, thereby applying a rotational force to the syringe assembly and spin the syringe assembly relative to the plunger rod when the cradle moves from the first position to the second position

[0012] There is disclosed a method of using a machine to couple a plunger rod to a syringe assembly may include positioning a syringe assembly onto a movable cradle of a carriage, wherein the syringe assembly includes a distal end and a proximal end, a syringe barrel, and a plunger disposed within the syringe barrel at the proximal end of the syringe assembly. The method may include positioning a plunger rod onto the cradle, the plunger rod including a distal rod end and a proximal rod end and wherein the distal rod end of the plunger rod is disposed above the proximal end of the syringe assembly and is axially aligned with the plunger. Then, the method may include activating an actuating device operatively connected to the carriage to move the cradle from a first position to a second position, and rotating the syringe assembly relative to the plunger rod when the cradle moves between the first position and the second position, thereby causing a first threaded portion on the distal rod end of the plunger rod to become threadably coupled to a second threaded portion of the plunger of the syringe assembly.

[0013] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a carriage having a movable cradle including a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod. The machine may include an actuating device operatively coupled to the carriage and adapted to index the cradle from a first position to a second position only once upon an activation event to couple the plunger rod to the syringe assembly. A pressure plate may be positioned adjacent to the carriage so that the cradle moves beneath the pressure plate when the cradle moves from the first position to the second position, the pressure plate adapted to apply a downward force to the plunger rod disposed in the aperture portion of the cradle when the cradle moves from the first position to the second position. The actuating device may include a servomotor and an operation switch for operatively controlling the servomotor, the servomotor coupled to the carriage to index the cradle via the carriage.

[0014] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a base and a carriage attached to the base and movable relative to the base, the carriage including a movable cradle having a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod. An actuating device may be coupled to the carriage and adapted to index the cradle from a first

position to a second position. The machine may include a pressure plate supported by the base and positioned adjacent to the carriage so that the cradle moves beneath the pressure plate when the cradle moves from the first position to the second position, the pressure plate adapted to apply a downward force to the plunger rod disposed in the aperture portion of the cradle. The cradle may include a cradle axis that is coaxial with longitudinal axes of the syringe assembly and plunger rod when the syringe assembly and plunger rod are disposed in the cradle, the cradle axis being disposed at an angle greater than zero degrees relative to vertical.

[0015] There is disclosed a machine for coupling a plunger rod to a syringe assembly may include a carriage having a movable cradle including a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion sized to receive a plunger rod, an actuating device operatively coupled to the carriage and adapted to move the cradle from a first position to a second position to couple the plunger rod to the syringe assembly, and a pressure plate positioned adjacent to the carriage so that the cradle moves beneath the pressure plate when the cradle moves from the first position to the second position, the pressure plate adapted to apply a downward force to the plunger rod disposed in the aperture portion of the cradle when the cradle moves from the first position to the second position. The machine may include at least one of the following (a) through (e) aspects. In aspect (a), a constant tension spring may be operatively coupled to the pressure plate and the pressure plate may define an inlet portion adapted to receive a proximal end of the plunger rod when the cradle moves from the first position to the second position. The constant tension spring may provide the downward force to the plunger rod, applied via the pressure plate, when the cradle moves between the first position and the second position. In aspect (b), a friction element may be disposed adjacent to the carriage and below the pressure plate. The friction element may be adapted to engage a syringe barrel of the syringe assembly carried by the cradle as the cradle moves from the first position to the second position. The friction element may be adapted to apply a rotational force to the syringe barrel to spin the syringe assembly relative to the plunger rod when the cradle moves from the first position to the second position. In aspect(c), the actuating device may be operatively connected to the carriage and adapted to index the cradle between the first position and the second position in response to an activation event. In aspect (d), the cradle may include a cradle axis that is coaxial with longitudinal axes of the syringe

assembly and plunger rod when the syringe assembly and plunger rod are disposed in the cradle. The cradle axis may be disposed at an angle greater than zero degrees relative to vertical. Finally in aspect (e), the carriage may be selected from separate and interchangeable first and second carriages. The first carriage may include a cradle having a seat portion sized to receive a syringe assembly of a first size and the second carriage may include a cradle having a seat portion sized to receive a syringe assembly of a second size.

[0016] There is disclosed a method of using a machine to couple a plunger rod to a syringe assembly may include positioning a syringe assembly onto a movable cradle of a carriage, wherein the syringe assembly includes a distal end and a proximal end, a syringe barrel, and a plunger disposed within the syringe barrel at the proximal end of the syringe assembly. Next, the method may include positioning a plunger rod onto the cradle where the plunger rod may include a distal rod end and a proximal rod end and wherein the distal rod end of the plunger rod is disposed above the proximal end of the syringe assembly and is axially aligned with the plunger. The method may include activating an actuating device operatively connected to the carriage. Further, the method may include indexing the cradle from the first position to the second position more than once in response to activating the actuating device, wherein a force may be applied to either or both of the syringe assembly and the plunger rod as the cradle indexes from the first position to the second position to couple the plunger rod to a plunger of the syringe assembly.

[0017] There is disclosed the machine for coupling a plunger rod and syringe assembly and method for using the machine may include any one or more of the following forms or method steps.

[0018] In a preferred form, the machine may include a selected pressure plate positioned above the cradle so that the cradle moves beneath the selected pressure plate when the cradle moves from the first position to the second position. The selected pressure plate may be adapted to apply a downward force to the plunger rod disposed in the aperture portion of the cradle when the cradle moves from the first position to the second position.

What is Claimed:

1. A machine for coupling a plunger rod to a syringe assembly, the machine comprising:

a selected carriage including a cradle having a seat portion sized to receive a syringe assembly and an aperture portion disposed above the seat portion and sized to receive a plunger rod;

an actuating device operatively coupled to the selected carriage and adapted to move the cradle from a first position to a second position to couple the plunger rod to the syringe assembly; and

wherein the selected carriage is selected from separate and interchangeable first and second carriages, wherein the first carriage includes a cradle adapted to receive a syringe assembly of a first size and the second carriage including a cradle sized to receive a syringe assembly of a second size that is different from the first size.

2. The machine of claim 1, further comprising a selected pressure plate positioned above the cradle so that the cradle moves beneath the selected pressure plate when the cradle moves from the first position to the second position, the selected pressure plate adapted to apply a downward force to the plunger rod disposed in the aperture portion of the cradle when the cradle moves from the first position to the second position.

3. The machine of claim 2, further comprising a selected constant tension spring operatively coupled to the selected pressure plate, the selected pressure plate defining an inlet portion adapted to receive a proximal end of the plunger rod when the cradle moves from the first position to the second position, the selected constant tension spring providing the downward force to the plunger rod, applied via the selected pressure plate, when the cradle moves between the first position and the second position.

4. The machine of any one of claims 1 through 3, wherein the first carriage includes a first pressure plate coupled to the first carriage, and the second carriage includes a second pressure plate coupled to the second carriage, such that the selected pressure plate is coupled to the selected carriage.

5. The machine of any one of claims 1 through 4, further comprising a quick-change fastener and a table, the selected carriage removably coupled to the table by the quick-change fastener.

6. The machine of any one of claims 1 through 5, wherein the first carriage includes a first base and the second carriage includes a second base, and the actuating device includes a servomotor adapted to be operatively connected to the first and second bases.

7. The machine of any one of claims 1 through 6, further comprising a selected friction element disposed adjacent to the selected carriage, the selected friction element adapted to engage a syringe barrel of the syringe assembly carried by the cradle as the cradle moves from the first position to the second position, the friction element adapted to apply a rotational force to the syringe barrel to spin the syringe assembly relative to the plunger rod when the cradle moves from the first position to the second position.

8. The machine of claim 7, wherein the first carriage includes a first guide plate coupled to the first carriage and carrying a first friction element and the second carriage includes a second guide plate coupled to the second carriage and carrying a second friction element such that the selected friction element is carried by a selected guide plate coupled to the selected carriage.

9. The machine of any one of claims 1 through 8, further comprising a selected movable plunger rod base coupled to the selected carriage, the selected plunger rod base disposed above the cradle and including an orifice sized to receive a flanged proximal end of the plunger rod, the orifice coaxially aligned with the aperture portion of the cradle, the plunger rod base being movable with the cradle from the first position to the second position;

a selected holding cap having an outwardly extending tab arranged to extend into the orifice of the selected plunger rod base, the selected holding cap removably attached to the selected plunger rod base; and

wherein the selected holding cap is fixed relative to the selected carriage and is disposed in the orifice when the cradle is in the first position.

10. The machine of claim 9, wherein the selected plunger rod base is selected from separate and interchangeable first and second plunger rod base, wherein the first plunger rod base includes an orifice adapted to receive a plunger rod of a first size and the second plunger rod base includes an orifice sized to receive a plunger rod of a second size that is different from the first size.

11. The machine of any one of claims 1 through 10, wherein the cradle includes a cradle axis that is coaxial with longitudinal axes of the syringe assembly and plunger rod when the syringe assembly and plunger rod are disposed in the cradle, the cradle axis being disposed at an angle greater than zero degrees relative to vertical.

12. The machine of claim 11, wherein the selected carriage comprises a rotational carousel with a rotational axis that is parallel to the cradle axis such that the rotational axis of the selected carriage is disposed at an angle greater than zero degrees relative to vertical.

13. The machine of any one of claims 1 through 12, wherein the actuating device is adapted to index the cradle between the first position and the second position in response to an activation event.

14. The machine of claim 13, wherein the actuating device indexes the cradle only once upon the activation event.

15. The machine of any one of claims 1 through 14, wherein the actuating device includes a servomotor and an operation switch for operatively controlling the servomotor, the servomotor coupled to the selected carriage to move the cradle via the selected carriage.

16. The machine of any one of claims 1 through 15, wherein the actuating device includes a lever for a user to manually index the cradle from the first position to the second position.

17. The machine of claim 16, wherein the actuating device includes a slidable bracket arranged to move the lever.

18. The machine of any one of claims 2 through 17, wherein the selected carriage is rotationally disposed relative to the selective pressure plate.

19. The machine of any one of claims 1 through 18, wherein the seat portion of the cradle comprises a first roller and a second roller separated by a gap, the first and second rollers of the seat portion adapted to engage the syringe barrel of the syringe assembly and retain the syringe barrel in the gap when carried by the cradle, the first and second rollers allowing for the syringe assembly to spin as the cradle indexes from the first position to the second position.

20. The machine of any one of claims 1 through 19, wherein the selected carriage includes a plurality of cradles carried by the selected carriage.

21. The machine of any one of claims 1 through 20, further comprising a selected exit chute disposed adjacent to the selected carriage at the second position of the cradle, the selected exit chute adapted to receive the plunger rod and syringe assembly from the cradle after the plunger rod is coupled to the syringe assembly;

wherein the first carriage includes a first exit chute coupled to the first carriage and the second carriage includes a second exit chute coupled to the second carriage such that the selected exit chute is coupled to the selected carriage.

22. The machine of claim 21, wherein the selected exit chute includes a ramp, the ramp including a slot sized to receive the plunger rod and syringe assembly after the cradle moves to the second position.

23. A method of using a machine to couple a plunger rod to a syringe assembly, the method comprising:

decoupling a second carriage from an actuating device;

coupling a first carriage to the actuating device after decoupling the second carriage from actuating device, the first carriage including a movable first cradle adapted to receive a syringe assembly of a first size;

positioning a first syringe assembly onto the movable first cradle of the first carriage, the first syringe assembly including a distal end and a proximal end, a syringe barrel, and a plunger disposed within the syringe barrel;

positioning a first plunger rod onto the first cradle of the first carriage, the first plunger rod including a distal rod end and a proximal rod end and wherein the distal rod end is disposed above the proximal end of the first syringe assembly and is axially aligned with the plunger; and

activating the actuating device coupled to the first carriage to move the first cradle from a first position to a second position, thereby applying a force to the first plunger rod causing the first plunger rod to become coupled to the first syringe assembly.

24. The method of claim 23, further including applying a downward force to the proximal rod end of the first plunger rod when the first cradle moves from the first position toward the second position.

25. The method of claim 23 or 24, further including fastening the first carriage to a table by a quick-change fastener, wherein the table is connected to the actuating device.

26. The method of claim 25, wherein decoupling the second carriage from the actuating device includes decoupling the quick-change fastener securing the second carriage to the table.

27. The method of any one of claims 23 through 26, wherein decoupling the second carriage from the actuating device includes decoupling a servomotor of the actuating device from a receiving member of the second carriage.

28. The method of any one of claims 23 through 27, wherein coupling the first carriage to the actuating device includes coupling a servomotor of the actuating device to a receiving member of the first carriage.

29. The method of any one of claims 23 through 28, further including, prior to decoupling the second carriage from the actuating device, positioning a second syringe assembly onto a second cradle of the second carriage, the second cradle adapted to receive the second syringe assembly of a second size, the second syringe assembly including a distal end and a proximal end, a syringe barrel, and a plunger disposed within the syringe barrel, wherein the second cradle of the second carriage is sized to receive a second syringe barrel of a second size;

positioning a second plunger rod onto the second cradle of the second carriage, the second plunger rod including a distal rod end and a proximal rod end and wherein the distal rod

end is disposed above the proximal end of the second syringe assembly and is axially aligned with the plunger; and

activating the actuating device coupled to the second carriage to move the second cradle from a first position to a second position, thereby applying a force to the second plunger rod causing the second plunger rod to become coupled to the second syringe assembly.