WHAT IS CLAIMED IS:

Claim 1: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a substantially conical tip disposed on the distal end of the barrel, the substantially conical tip having an inside surface defining a passage in fluid communication with the chamber and a locking mechanism disposed within the passage; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, an extension disposed on the plunger rod and having a tip on a distal end thereof, and a plunger head slidably disposed on the extension between the tip of the extension and the plunger rod,

wherein during an injection cycle the plunger head slides with respect to the extension and the plunger rod such that the plunger head engages the tip of the extension during aspiration and engages the plunger rod during injection,

wherein after completion of the injection cycle, the tip of the extension extends into the passage in the substantially conical tip and engages the locking mechanism so as to prevent removal of the tip of the extension from the substantially conical tip, and

wherein the locking mechanism comprises a plurality of flexible protrusions disposed about an inside surface of the substantially conical tip and extending into the passage.

Claim 2: The syringe assembly according to claim 1, wherein the flexible protrusions are adapted to flex toward the inside surface of the substantially conical tip so as to allow the tip of the extension to pass between them.

Claim 3: The syringe assembly according to claim 1, wherein the tip of the extension tapers outwardly from the distal end of the extension so as to form an abutment surface between the extension and the tip at a widest part of the tip, the tip of the extension being engaged by the locking mechanism at the abutment surface.

Claim 4: The syringe assembly according to claim 1, wherein the plunger head further comprises:

a distal wall, the distal wall having a distal sealing surface defined thereon;

a proximal wall, spaced from the distal wall; and

a central portion extending between the distal wall and the proximal wall, the central portion having a cylindrical core portion and a plurality of spaced fin portions extending radially from the cylindrical core portion,

wherein the distal wall, the proximal wall, and the cylindrical core portion of the central portion define a hole extending through the plunger head, the extension being received within the hole, and

wherein the distal wall of the plunger head perimetrically engages the inner surface of the barrel so as to seal the chamber of the barrel.

Claim 5: The syringe assembly according to claim 1, wherein a force necessary to advance the plunger rod relative to the plunger head during the injection cycle between aspiration and injection is less than a force necessary to sustain injection.

Claim 6: The syringe assembly according to claim 1, wherein the extension includes a breakable neck portion proximate to the plunger rod, the breakable neck portion being adapted to break upon application of a force to the plunger rod that is greater than a force necessary to at least partially aspirate the syringe, and less than a force necessary to withdraw the tip of the extension of the plunger assembly past the locking mechanism of the substantially conical tip.

Claim 7: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a syringe outlet disposed on the distal end of the barrel, the outlet having a cylindrical shape with an outwardly tapering distal end portion, an inside surface defining a passage in fluid communication with the chamber, and a locking mechanism disposed within the passage;

a hub comprising a cylindrical skirt portion having an open proximal end and a distal end; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, a plunger head connected to the plunger rod, the plunger head including a sealing member disposed thereon, and an extension, the extension including a tip on a distal end thereof,

wherein the cylindrical skirt portion of the hub is disposed on the outlet and forms a mating engagement with the outlet,

wherein the locking mechanism is adapted to engage and retain the tip of the extension of the plunger assembly in a locked position at least partially within the passage of the outlet, and

wherein the locking mechanism comprises a plurality of flexible protrusions disposed about the inside surface of the outlet and extending into the passage and the flexible protrusions are disposed within the outlet proximally of the distal end portion of the outlet.

Claim 8: The syringe assembly according to claim 7, wherein the plunger head is slidably disposed on the extension.

Claim 9: The syringe assembly according to claim 7, wherein the flexible protrusions are adapted to flex toward the inside surface of the outlet so as to allow the tip of the extension to pass between them.

Claim 10: The syringe assembly according to claim 7, wherein

the hub further comprises a tip extending from the distal end of the cylindrical skirt portion, the tip of the hub having an orifice extending therethrough in fluid communication with an interior of the cylindrical skirt portion such that the orifice is in fluid communication with the passage of the outlet, and a plug portion extending proximally within the cylindrical skirt portion from the distal end of the cylindrical skirt portion so as to form an annular recess between the plug portion and the cylindrical skirt portion, the annular recess being shaped to correspond to the distal end portion of the outlet and the orifice of the tip of the hub extending through the plug portion, and

the plug portion of the hub extends into the passage of the outlet of the syringe so as to close the passage and to cause the distal end portion of the outlet to engage the hub within the annular recess in a secured mating engagement.

Claim 11: The syringe assembly according to claim 7, wherein the tip of the extension tapers outwardly from the distal end of the extension so as to form an abutment surface between the extension and the tip at a widest part of the tip, the tip of the extension being engaged by the locking mechanism at the abutment surface.

Claim 12: The syringe assembly according to claim 7, wherein the plunger head further comprises:

a distal wall;

a proximal wall, spaced from the distal wall; and

a central portion extending between the distal wall and the proximal wall, the central portion having a diameter less than a diameter of the distal and proximal walls,

wherein the sealing member comprises an O-ring disposed around the central portion of the plunger head, the O-ring engaging the inside surface of the barrel so as to seal the chamber.

Claim 13: The syringe assembly according to claim 7, wherein the plunger head is connected to the plunger rod by a breakable neck portion, the breakable neck portion being adapted to break upon application of a force to the plunger rod that is greater than a force necessary to at least partially aspirate the syringe, and less than a force necessary to withdraw the tip of the extension of the plunger assembly past the locking mechanism of the outlet.

Claim 14: A syringe assembly comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a substantially conical tip disposed on the distal end of the barrel, the substantially conical tip having an inside surface defining a passage in fluid communication with the chamber and a locking clip disposed within the passage; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod and a plunger head connected to the plunger rod, the plunger head having a sealing member disposed thereon, and an extension,

wherein the locking clip is adapted to engage and retain the extension of the plunger assembly in a locked position at least partially within the passage of the substantially conical tip, and

wherein the locking clip comprises an outer cylindrical ring having an inner circumferential surface and a plurality of rigid fingers extending from the inner circumferential surface into the passage of the substantially conical tip, the fingers being adapted to engage and retain the extension of the plunger assembly via an interference fit.

Claim 15: The syringe assembly according to claim 14, wherein the plunger head is slidably disposed on the extension.

Claim 16: The syringe assembly according to claim 14, wherein the locking clip is disposed within the substantially conical tip at a proximal end of the substantially conical tip. .

Claim 17: The syringe assembly according to claim 14, wherein the plunger head further comprises:

a distal wall;

a proximal wall, spaced from the distal wall; and

a central portion extending between the distal wall and the proximal wall, the central portion having a diameter less than a diameter of the distal and proximal walls,

wherein the sealing member comprises an O-ring disposed around the central portion of the plunger head, the O-ring engaging the inside surface of the barrel so as to seal the chamber.

Claim 18: The syringe assembly according to claim 14, wherein the plunger head is connected to the plunger rod by a breakable neck portion, the breakable neck portion being adapted to break upon application of a force to the plunger rod that is greater than a force necessary to at least partially aspirate the syringe, and less than a force necessary to withdraw the extension of the plunger assembly past the locking clip of the substantially conical tip.

Claim 19: The syringe assembly according to claim 14, wherein the locking clip is made from metal.

Claim 20: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a syringe outlet disposed on the distal end of the barrel, the outlet having a cylindrical shape with an outwardly tapering distal end portion, an inside surface defining a passage in fluid communication with the chamber, and a locking mechanism disposed within the passage;

a hub comprising a cylindrical skirt portion having an open proximal end and a distal end; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, a plunger head connected to the plunger rod, the plunger head including a sealing member disposed thereon, and an extension, the extension including a tip on a distal end thereof,

wherein the cylindrical skirt portion of the hub is disposed on the outlet and forms a mating engagement with the outlet,

wherein the locking mechanism is adapted to engage and retain the tip of the extension of the plunger assembly in a locked position at least partially within the passage of the outlet,

wherein the hub further comprises a tip extending from the distal end of the cylindrical skirt portion, the tip of the hub having an orifice extending therethrough in fluid communication with an interior of the cylindrical skirt portion such that the orifice is in fluid communication with the passage of the outlet, and a plug portion extending proximally within

the interior of the cylindrical skirt portion from the distal end of the cylindrical skirt portion so as to form an annular recess defined within the interior of the cylindrical skirt portion between the plug portion and the cylindrical skirt portion, the annular recess being shaped to correspond to the distal end portion of the outlet and the orifice of the tip of the hub extending through the plug portion, and

wherein the plug portion of the hub extends into the passage of the outlet of the syringe so as to close the passage and to cause the distal end portion of the outlet to engage the hub within the annular recess in a secured mating engagement.

Claim 21: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a syringe outlet disposed on the distal end of the barrel, the outlet having a cylindrical shape with an outwardly tapering distal end portion, an inside surface defining a passage in fluid communication with the chamber, and a locking mechanism disposed within the passage;

a hub comprising a cylindrical skirt portion having an open proximal end and a distal end; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, a plunger head connected to the plunger rod, the plunger head including a sealing member disposed thereon, and an extension, the extension including a tip on a distal end thereof,

wherein the cylindrical skirt portion of the hub is disposed on the outlet and forms a mating engagement with the outlet,

wherein the locking mechanism is adapted to engage and retain the tip of the extension of the plunger assembly in a locked position at least partially within the passage of the outlet,

wherein the locking mechanism comprises a plurality of flexible protrusions disposed about the inside surface of the outlet and extending into the passage,

wherein the hub further comprises a tip extending from the distal end of the cylindrical skirt portion, the tip of the hub having an orifice extending therethrough in fluid

communication with an interior of the cylindrical skirt portion such that the orifice is in fluid communication with the passage of the outlet, and a plug portion extending proximally within the cylindrical skirt portion from the distal end of the cylindrical skirt portion so as to form an annular recess between the plug portion and the cylindrical skirt portion, the annular recess being shaped to correspond to the distal end portion of the outlet and the orifice of the tip of the hub extending through the plug portion, and

wherein the plug portion of the hub extends into the passage of the outlet of the syringe so as to close the passage and to cause the distal end portion of the outlet to engage the hub within the annular recess in a secured mating engagement.

WHAT IS CLAIMED IS

Claim 1: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a conical tip disposed on the distal end of the barrel, the conical tip having an inside surface defining a passage in fluid communication with the chamber and a locking mechanism disposed within the passage; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, an extension disposed on the plunger rod and having a tip on a distal end thereof, and a plunger head slidably disposed on the extension between the tip of the extension and the plunger rod,

wherein during an injection cycle the plunger head slides with respect to the extension and the plunger rod such that the plunger head engages the tip of the extension during aspiration and engages the plunger rod during injection,

wherein after completion of the injection cycle, the tip of the extension extends into the passage in the conical tip and engages the locking mechanism so as to prevent removal of the tip of the extension from the conical tip, and

wherein the locking mechanism comprises a plurality of flexible protrusions disposed about an inside surface of the conical tip and extending into the passage.

Claim 2: The syringe assembly according to claim 1, wherein the flexible protrusions are adapted to flex toward the inside surface of the conical tip so as to allow the tip of the extension to pass between them.

Claim 3: The syringe assembly according to claim 1, wherein the tip of the extension tapers outwardly from the distal end of the extension so as to form an abutment surface between the extension and the tip at a widest part of the tip, the tip of the extension being engaged by the locking mechanism at the abutment surface.

Claim 4: The syringe assembly according to claim 1, wherein the plunger head further comprises:

a distal wall, the distal wall having a distal sealing surface defined thereon;

a proximal wall, spaced from the distal wall; and

a central portion extending between the distal wall and the proximal wall, the central portion having a cylindrical core portion and a plurality of spaced fin portions extending radially from the cylindrical core portion,

wherein the distal wall, the proximal wall, and the cylindrical core portion of the central portion define a hole extending through the plunger head, the extension being received within the hole, and

wherein the distal wall of the plunger head perimetrically engages the inner surface of the barrel so as to seal the chamber of the barrel.

Claim 5: The syringe assembly according to claim 1, wherein a force necessary to advance the plunger rod relative to the plunger head during the injection cycle between aspiration and injection is less than a force necessary to sustain injection.

Claim 6: The syringe assembly according to claim 1, wherein the extension includes a breakable neck portion proximate to the plunger rod, the breakable neck portion being adapted to break upon application of a force to the plunger rod that is greater than a force necessary to at least partially aspirate the syringe, and less than a force necessary to withdraw the tip of the extension of the plunger assembly past the locking mechanism of the conical tip.

Claim 7: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a syringe outlet disposed on the distal end of the barrel, the outlet having a cylindrical shape with an outwardly tapering distal end portion, an inside surface defining

a passage in fluid communication with the chamber, and a locking mechanism disposed within the passage;

a hub comprising a cylindrical skirt portion having an open proximal end and a distal end; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, a plunger head connected to the plunger rod, the plunger head including a sealing member disposed thereon, and an extension, the extension including a tip on a distal end thereof,

wherein the cylindrical skirt portion of the hub is disposed on the outlet and forms a mating engagement with the outlet,

wherein the locking mechanism is adapted to engage and retain the tip of the extension of the plunger assembly in a locked position at least partially within the passage of the outlet, and

wherein the locking mechanism comprises a plurality of flexible protrusions disposed about the inside surface of the outlet and extending into the passage and the flexible protrusions are disposed within the outlet proximally of the distal end portion of the outlet.

Claim 8: The syringe assembly according to claim 7, wherein the plunger head is slidably disposed on the extension.

Claim 9: The syringe assembly according to claim 7, wherein the flexible protrusions are adapted to flex toward the inside surface of the outlet so as to allow the tip of the extension to pass between them.

Claim 10: The syringe assembly according to claim 7, wherein

the hub further comprises a tip extending from the distal end of the cylindrical skirt portion, the tip of the hub having an orifice extending therethrough in fluid communication with an interior of the cylindrical skirt portion such that the orifice is in fluid communication with the passage of the outlet, and a plug portion extending proximally within the cylindrical skirt portion from the distal end of the cylindrical skirt

portion so as to form an annular recess between the plug portion and the cylindrical skirt portion, the annular recess being shaped to correspond to the distal end portion of the outlet and the orifice of the tip of the hub extending through the plug portion, and

the plug portion of the hub extends into the passage of the outlet of the syringe so as to close the passage and to cause the distal end portion of the outlet to engage the hub within the annular recess in a secured mating engagement.

Claim 11: The syringe assembly according to claim 7, wherein the tip of the extension tapers outwardly from the distal end of the extension so as to form an abutment surface between the extension and the tip at a widest part of the tip, the tip of the extension being engaged by the locking mechanism at the abutment surface.

Claim 12: The syringe assembly according to claim 7, wherein the plunger head further comprises:

a distal wall;

a proximal wall, spaced from the distal wall; and

a central portion extending between the distal wall and the proximal wall, the central portion having a diameter less than a diameter of the distal and proximal walls,

wherein the sealing member comprises an O-ring disposed around the central portion of the plunger head, the O-ring engaging the inside surface of the barrel so as to seal the chamber.

Claim 13: The syringe assembly according to claim 7, wherein the plunger head is connected to the plunger rod by a breakable neck portion, the breakable neck portion being adapted to break upon application of a force to the plunger rod that is greater than a force necessary to at least partially aspirate the syringe, and less than a force necessary to withdraw the tip of the extension of the plunger assembly past the locking mechanism of the outlet.

Claim 14: A syringe assembly comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a conical tip disposed on the distal end of the barrel, the conical tip having an inside surface defining a passage in fluid communication with the chamber and a locking clip disposed within the passage; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod and a plunger head connected to the plunger rod, the plunger head having a sealing member disposed thereon, and an extension,

wherein the locking clip is adapted to engage and retain the extension of the plunger assembly in a locked position at least partially within the passage of the conical tip, and

wherein the locking clip comprises an outer cylindrical ring having an inner circumferential surface and a plurality of rigid fingers extending from the inner circumferential surface into the passage of the conical tip, the fingers being adapted to engage and retain the extension of the plunger assembly via an interference fit.

Claim 15: The syringe assembly according to claim 14, wherein the plunger head is slidably disposed on the extension.

Claim 16: The syringe assembly according to claim 14, wherein the locking clip is disposed within the conical tip at a proximal end of the conical tip.

Claim 17: The syringe assembly according to claim 14, wherein the plunger head further comprises:

a distal wall;

a proximal wall, spaced from the distal wall; and

a central portion extending between the distal wall and the proximal wall, the central portion having a diameter less than a diameter of the distal and proximal walls,

wherein the sealing member comprises an O-ring disposed around the central portion of the plunger head, the O-ring engaging the inside surface of the barrel so as to seal the chamber.

Claim 18: The syringe assembly according to claim 14, wherein the plunger head is connected to the plunger rod by a breakable neck portion, the breakable neck portion being adapted to break upon application of a force to the plunger rod that is greater than a force necessary to at least partially aspirate the syringe, and less than a force necessary to withdraw the extension of the plunger assembly past the locking clip of the conical tip.

Claim 19: The syringe assembly according to claim 14, wherein the locking clip is made from metal.

Claim 20: A syringe assembly, comprising:

a syringe barrel having an inside surface defining a chamber, an open proximal end, and a distal end;

a syringe outlet disposed on the distal end of the barrel, the outlet having a cylindrical shape with an outwardly tapering distal end portion, an inside surface defining a passage in fluid communication with the chamber, and a locking mechanism disposed within the passage;

a hub comprising a cylindrical skirt portion having an open proximal end and a distal end; and

a plunger assembly disposed at least partially within the syringe barrel, the plunger assembly comprising an elongate plunger rod, a plunger head connected to the plunger rod, the plunger head including a sealing member disposed thereon, and an extension, the extension including a tip on a distal end thereof,

wherein the cylindrical skirt portion of the hub is disposed on the outlet and forms a mating engagement with the outlet,

wherein the locking mechanism is adapted to engage and retain the tip of the extension of the plunger assembly in a locked position at least partially within the passage of the outlet,

wherein the hub further comprises a tip extending from the distal end of the cylindrical skirt portion, the tip of the hub having an orifice extending therethrough in fluid communication with an interior of the cylindrical skirt portion such that the orifice is in fluid communication with the passage of the outlet, and a plug portion extending proximally within the interior of the cylindrical skirt portion from the distal end of the cylindrical skirt portion so as to form an annular recess defined within the interior of the cylindrical skirt portion between the plug portion and the cylindrical skirt portion, the annular recess being shaped to correspond to the distal end portion of the outlet and the orifice of the tip of the hub extending through the plug portion, and

wherein the plug portion of the hub extends into the passage of the outlet of the syringe so as to close the passage and to cause the distal end portion of the outlet to engage the hub within the annular recess in a secured mating engagement.