in the dispense head. However, these recirculation passageways can be uncontrolled and thus can remain in an open position when the dispense head is not connected to the drum, which can create a potential for spillage.

Also, recirculated fluid can create foam that can cause problems, such as foam entry into the vent lines, potential clogging, contamination of normally dry areas of the dispense head and gas refill line, and difficulty in emptying a drum with low levels of fluid. The foam can be created when fluid is recirculated into the dispense head and further when recirculated fluid is dispensed into the drum.

When using dispense heads to draw high purity, highly corrosive, and highly caustic liquids from drums, it can be important not to connect a dispense head for equipment requiring one type of liquid to a drum containing an incorrect or incompatible different liquid. To inhibit this, coded indexing sections and recesses have been provided in the dispense head and drum insert to enable assembly of the drum insert to the dispense head only when the correct coding exists. However, connecting a coded dispense head to a coded drum insert can require a great amount of force while turning the coding and holding down the dispense head. This process can involve a two-step operation of holding down the dispense head with one hand while rotating the code key with the other.

Summary of the Invention

The fluid dispense system as per embodiments of the present invention provides a valve within the main fluid and recirculation passageways to automatically cut off the flow in the passageways when the dispense head is removed from the drum. The main fluid and recirculation passageways through the dispense head can be controlled by these valve assemblies, which can open when the dispense head is operably coupled with the drum insert and close when the dispense head is removed from the drum insert.

In addition, the fluid dispense system as per embodiments of the present invention decreases the amount of foam created during the recirculation of surfactant fluid into the dispense head and drum. The dispense head can include a recirculated fluid conduit that discharges recirculated fluid into the annular space around the drum insert down tube. A foam reduction diffuser can further reduce or eliminate foam that can be created during this recirculation process.

The fluid dispense system as per embodiments of the present invention also eases connection of a coded dispense head to a coded drum insert can by including a coupling assembly and method for quickly and easily coupling the dispense head to a drum insert.

~~In an aspect, the present invention relates to a fluid dispense system for use with a~~ drum comprising a drum insert configured to operably couple with a bung included on a drum, the drum insert having an upper portion and a drum insert down tube extending therefrom into an interior of the drum and a dispense head configured to operably couple with the drum insert, the dispense head having a first conduit comprising a first valve assembly and a second conduit comprising a second valve assembly, the first and second valve assemblies in operable communication with the drum insert when the dispense head is operably coupled with the drum insert, such that when the dispense head is operably coupled with the drum insert the first and second valve assemblies can be effected to an open position enabling fluid to flow through the conduits, and when the dispense head is not operably coupled with the drum insert the first and second valve assemblies can be ~~biased to a closed position inhibiting fluid from flowing through the conduits.~~

In a first aspect, there is provided a fluid dispense system for use with a drum containing liquid that is caustic or high purity, and for dispensing the liquid and recirculating the liquid dispensed, the system comprising: a polymer drum insert configured to operably couple with a bung included on a drum , the drum insert constructed from a fluoropolymer, the drum insert having an upper portion with a drum engaging portion, a drum insert down tube centrally positioned in the upper portion and extending therefrom into an interior of the drum, an upwardly extending nipple communicatively connected to the downtube, a support structure extending from the drum engaging portion to the nipple, the support structure having an intermediate conduit between the dispense head and drum; and a dispense head comprising a fluoropolymer configured to operably couple with the drum insert and the drum, the dispense head having a first dispense conduit for dispensing the fluid and comprising a first valve assembly and a second fluid recirculation conduit comprising a second valve assembly, each of the first and second valve assemblies being in operable engagement and communication with the drum insert when the dispense head is operably coupled with the drum insert, such that the first and second valve assemblies are effected to an open position enabling the liquid to flow through the conduits, and when the dispense head is not operably coupled with the drum insert the first and second valve assemblies are biased to a closed position inhibiting the liquid from flowing through the conduits, wherein: the first valve assembly movable along a first vertical axis of operation between the open and the closed position and the second valve assembly includes a poppet, the poppet being movable along a second vertical axis of operation between the open position and the closed position, the first vertical axis of operation and the second vertical axis of operation being parallel and non-co-axial with respect to each other; the first valve assembly of the dispense head includes a flow-inhibiting member having an engagement portion and a first biasing member that biases the flow-inhibiting member to the closed position when the dispense head is not operably coupled to the drum insert, and wherein the engagement portion is adapted to engage the nipple of the drum insert when the dispense head is operably coupled with the drum insert such that the flow-inhibiting member is forced upwardly with respect to the dispense head thereby effecting the first valve assembly to the open position; the second valve assembly of the dispense head further includes a downwardly extending stem portion engaged with the poppet, and a second biasing member that biases the poppet to the closed position when the dispense head is not operably coupled to the drum insert thereby inhibiting spillage, and wherein the stem portion is adapted to engage the drum insert at the support structure extending between the drum engagement portion of the drum insert and the nipple when the dispense head is operably coupled with the drum insert such that the stem portion is forced upwardly with respect to the dispense head to effect the second valve assembly to the open position by overcoming the second biasing member to move to the open position; and the flow-inhibiting member is located at a first distance from the drum insert along the first vertical axis when in the open position, the poppet is located at a second distance from the drum insert along the second vertical axis when in the open position, the second distance being unequal to the first distance; whereby the flow in the dispense conduit and recirculation conduit are independently and automatically cut off when the dispense head is removed from the drum inhibiting spillage resulting from said removal; the system further comprises a cap assembly selectively connectable to a cap thread portion on the upper portion of the drum insert to selectively seal the drum during transport or storage of the drum when the dispense head is not coupled with the drum insert.

The stem portion comprises an upper section and a lower section, with the lower section being offset from the upper section.

The dispense head further comprises a body portion with a plurality of ports including a port connecting to the first conduit, a port connecting to the second conduit, a port connecting to a venting conduit, and a port connecting to a seal verification conduit.

~~The second valve assembly can comprise a poppet valve including a poppet~~ member and a biasing member to bias the poppet member ~~to the~~ closed position. The drum insert can comprise ~~an actuation rib~~ effecting the poppet valve to the open position ~~when the dispense head is operably coupled with the drum insert.~~

The second conduit can comprise a recirculation fluid conduit enabling fluid to be returned to the interior of the drum through the recirculation fluid conduit. The first fluid conduit can comprise a main fluid conduit in fluid communication with a tube conduit included in the drum insert down tube and the recirculation fluid conduit can be in fluid communication with a media return conduit defined by the drum insert down tube and a diffuser down tube, the diffuser down tube further comprising a deflector proximate a lower end thereof.

A foaming reduction member can be included on the diffuser to reduce foaming of recirculated fluid prior to returning to the drum through the recirculation fluid conduit. The foaming reduction member can comprise a foam reduction chamber such that gas can be separated from the recirculated fluid and the gas can be vented from the chamber and the fluid flows out of the chamber and through the media return conduit.

The dispense head can further comprise a vent conduit enabling gas to enter and leave the drum through the vent conduit and a seal verification conduit in fluid communication with an aperture intermediate two seals at a junction between the operably coupled dispense head and drum insert.

~~In another aspect, the present invention relates to a method of using a fluid~~ dispense system for use with a drum comprising inserting a drum insert ~~into~~ an access opening of a drum such that a drum insert down tube of the drum ~~insert~~ extends into an interior of the drum, operably coupling an upper portion of the drum insert with the access opening of the drum, providing a dispense ~~head~~ having a first conduit comprising a first valve assembly and a second ~~conduit~~ comprising a second valve assembly, and operably coupling the dispense ~~head~~ to the drum insert such that the first and second valve assemblies ~~can~~ be effected into an open position enabling fluid to flow through the ~~respective first and second conduits.~~

In a second aspect, there is provided a method of using a fluid dispense system for use with a drum containing a caustic or high purity liquid and having a dispense conduit and a liquid recirculation conduit and for reducing spillage from the recirculation conduit when a dispense head is disconnected, the method comprising: inserting a drum insert into an access opening of a drum such that a drum insert down tube of the drum insert extends into an interior of the drum into said fluid and such that a nipple is outwardly exposed, the nipple supported by support structure extending from a drum engaging portion to the nipple, the support structure having an intermediate conduit between the dispense head and drum; operably coupling the drum engaging portion of an upper portion of the drum insert with the drum at the access opening of the drum; providing a dispense head comprising a fluoropolymer having a first dispense conduit comprising a first valve assembly and a second recirculation conduit comprising a second valve assembly, wherein the first valve assembly is movable along a first vertical axis of operation and the second valve assembly is movable along a second vertical axis of operation, the first vertical axis of operation and the second vertical axis of operation being parallel to each other and laterally offset with respect to each other; operably coupling the dispense head to the drum insert such that the first valve assembly engages the nipple, the second valve assembly engages the support structure extending from the drum engaging portion to the nipple, and the first and second valve assemblies are effected into an open position enabling the liquid to flow through the respective first and second conduits; directing the liquid out of the drum via the first dispense conduit when the first valve assembly is in the open position; returning the liquid to the drum via the second recirculation conduit to recirculate the liquid when the second valve assembly is in the open position; and operably decoupling the dispense head from the drum insert, the decoupling causing the first and second valve assemblies to close by way of the decoupling and thereby inhibiting the liquid in the first dispense conduit and the second recirculation conduit from exiting the dispense head when decoupled, thereby reducing spillage.

Fluid can be directed out of the drum via the first conduit when the first valve assembly is in the open position and returned to the drum via the second conduit when the second valve assembly is in the open position.

A foaming reduction member can be provided within the drum insert, the foam reduction member having a foam reduction chamber, such that gas can be separated from recirculated fluid in the foam reduction chamber. Gas can be vented from the foam reduction chamber and liquid enabled to flow out of the foam reduction chamber to an interior of the drum. A vent conduit can be provided on the on the dispense head enabling gas to enter and leave the drum through the vent conduit. A seal verification conduit can be provided on the dispense head, the seal verification conduit in fluid communication with an aperture intermediate two seals positioned at a junction between the dispense head and the drum insert, such that the seal verification conduit can be used to verify an integrity of the seals.

Disclosed herein is~~In a further aspect, the present invention relates to~~ a coupling assembly for coupling a dispense head to a drum insert for use in a fluid dispense system, the coupling assembly comprising a retaining ring having a plurality of detents disposed on an inner surface thereof and a collar having a code ring disposed thereon, the retaining ring and collar independently rotatable when the coupling assembly is not in engageable

communication with the drum insert, the collar further comprising an internal flange having a flange surface and a plurality of engagement members displaceable between a biased position below the flange surface and an engagement position above the flange surface, and wherein when the coupling assembly is placed into engageable communication with the drum insert, the engagement members can be displaced to the engagement position and engageable with the detents, such that the collar can be rotatably with retaining ring to selectively align the code ring with a coded section disposed on the drum insert.

The coupling assembly can include a first threaded portion on the inner surface of the retaining ring and a second threaded portion on an external surface of the drum insert such that the coupling assembly can be selectively coupled with the drum insert by threading the first threaded portion with the second threaded portion. The coupling assembly can further include a snap member disposed on the collar and a snap receiving notch disposed on the code ring, the code ring and collar selectively engageable by engaging the snap member and snap receiving notch. The retaining ring, collar, and code ring can be constructed of high-density polyethylene (HDPE).

Disclosed herein is~~In yet another aspect, the present invention relates to~~ a method of coupling a dispense head to a drum insert in a fluid dispense system comprising providing a coupling assembly comprising a retaining ring having a plurality of detents disposed on an inner surface thereof and a collar having a code ring operably coupled thereto, operably coupling the retaining ring to the dispense head, operably coupling the collar to the dispense head, the collar further comprising an internal flange having a flange surface and a plurality of engagement members movable between a biased position below the flange surface and an engagement position above the flange surface, such that the retaining ring and collar can be independently rotatable when the coupling assembly is not in engageable communication with the drum insert, placing at least a portion of the coupling assembly into communication with the drum insert, effecting a force on the coupling assembly such that the engagement members can be displaced to the engagement position and engage with the detents, such that the collar can be rotatable dependent of the retaining ring, rotating the retaining ring to selectively align the code ring with a coded section disposed on the upper portion of the drum insert, and operably coupling the coupling assembly with the drum insert.

First indicia can be provided on the code ring and second indicia can be included on the coded section on the drum insert, such that step of rotating the retaining ring to selectively align the code ring with the coded section can comprise matching the first indicia with the second indicia.

Disclosed herein is~~In another aspect, the present invention relates to~~ a method of reducing foaming while recirculating fluid into a drum through a dispense head, the method comprising inserting a drum insert having a down tube extending therefrom into an access opening of a drum such that the drum insert down tube of the drum insert extends into an interior of the drum, operably coupling an upper portion of the drum insert with the access opening of the drum, operably coupling the dispense head with the upper portion of the drum insert, the dispense head including a main fluid conduit and a recirculation fluid conduit in the dispense head, the main fluid conduit in fluid communication with an interior surface of the drum insert down tube and the recirculation fluid conduit in communication with a media return conduit defined by an external surface of the drum insert down tube and a diffuser down tube, the diffuser down tube comprising a deflector at a lower end thereof, and recirculating fluid into the drum through the recirculation fluid conduit into the media return conduit, such that the recirculating fluid passes over the deflector, the deflector reducing foaming of fluid returning to the drum.

The method can further include recirculating fluid through a foam reduction chamber disposed proximate an upper end of the diffuser down tube, the foam reduction chamber separating gas from fluid and discharging the gas through vents that can be connected to a venting port included on the dispense head, while the recirculating fluid flows downwardly through the media return conduit. The deflector can be positioned below the liquid level of fluid in the drum.

~~In a further aspect, the present invention relates to a fluid dispense system for use~~ with a drum comprising a drum insert configured to couple an access opening of a drum, the drum insert having an upper portion and a drum insert down tube extending therefrom into an interior of the drum and a dispense head comprising means for coupling the dispense head to the drum insert, the dispense head having a first fluid conduit comprising a first valve means and a second conduit comprising a second valve means, the first and second valve means in communication with the drum insert when the dispense head is ~~operably coupled with the drum insert, such that when the dispense head is operably~~

~~coupled with the drum insert the first and second valve means can be in an open position~~ enabling fluid to flow through the conduits, and when ~~the dispense~~ head is not operably coupled with the drum ~~insert the first~~ and second valve means can be biased to a closed ~~position inhibiting fluid from flowing through the conduits.~~

In a third aspect, there is provided a fluid dispense system for use with a drum to minimize spillage when a dispense head is removed, the system comprising: a polymer drum insert configured to couple an access opening of a drum, the drum insert having an upper portion and a drum insert down tube extending therefrom into an interior of the drum; and a dispense head comprising fluoropolymer operably coupled to the drum and the drum insert, the dispense head having a first fluid dispense conduit comprising a first valve assembly and a second fluid recirculation conduit comprising a second valve assembly, the first and second valve assemblies in communication with the drum insert when the dispense head is operably engaged and coupled with the drum insert, such that the first and second valve assemblies are in an open position enabling fluid to flow through the conduits, and when the dispense head is not operably coupled with me drum insert the first and second valve assemblies are biased to a closed position inhibiting fluid from flowing through the conduits whereby liquid from the recirculation conduit is stopped from escaping, wherein: the first valve assembly comprises a first valve member movable along a first vertical axis of operation between the open position and the closed position and centrally located over the drum insert and the second valve assembly comprises a second valve member movable along a second vertical axis of operation between the open position and the closed position, the first vertical axis of operation and the second vertical axis of operation being parallel to each other and not coaxial with respect to each other; the first valve member of the dispense head includes a first flow-inhibiting member having an engagement portion and a first biasing member that biases the first flow-inhibiting member to the closed position when the dispense head is not operably coupled to the drum insert, and wherein the engagement portion is adapted to engage the drum insert when the dispense head is operably coupled with the drum insert such that the first flow-inhibiting member is forced upwardly with respect to the dispense head to effect the first flow-inhibiting member to the open position; the second valve assembly of the dispense head includes an actuation member, a second flow-inhibiting member and a second biasing member that biases the second flow-inhibiting member to the closed position when the dispense head is not operably coupled to the drum insert whereby spillage of the fluid in the fluid dispense conduit and fluid in the return conduit is reduced, and wherein the actuation member is adapted to engage the drum insert when the dispense head is operably coupled with the drum insert such that the actuation member is forced upwardly with respect to the dispense head to effect the second valve member to the open position by overcoming the second biasing member to move the second flow-inhibiting member to the open position; and one of the first flow-inhibiting member and the second flow-inhibiting member is positioned at least partially within the dispense head when in the open position, and the other of the first flow-inhibiting member and the second flow-inhibiting member is positioned outside the dispense head when in the open position.

Disclosed herein is~~In yet another aspect, the present invention relates to~~ a fluid dispense system for use with a drum comprising a drum insert configured to couple a bung included on a drum, the drum insert having an upper portion and a drum insert down tube extending therefrom into an interior of the drum and a dispense head configured to couple the drum insert, the dispense head having a first fluid conduit comprising a first valve assembly and a seal verification port in fluid communication with a seal verification conduit and an aperture intermediate two seals at a junction between the dispense head and the drum insert, the aperture being substantially transverse the seal verification conduit, such that an integrity of a sealing between the dispense head and drum insert can be verified by forcing air into the seal verification port. The two seals can be O-rings, which can be encapsulated with polytetrafluoroethylene (PTFE).

Brief Description of the Drawings

Fig. 1 is a perspective cutaway view of a fluid dispense system of the present invention;

Fig. 2 is an exploded view of a drum insert and a cap assembly according to the present invention;

Fig. 3 is an elevational view of the drum insert of Fig. 2;

Fig. 4 is a top plan view of the drum insert of Fig. 2;

Fig. 5 is a cross sectional view of the drum insert of Fig. 4 taken along line 5-5;

Fig. 6 is an exploded view of a dispense head and coupling assembly of the present invention;

Fig. 7 is a top plan view of the dispense head of Fig. 6;