

CLAIMS

What is claimed is:

1. An apparatus comprising:
 - a cap with a capping surface and one or more sidewalls extending away from
 - 5 the capping surface along a direction having a major component that is parallel to a normal of the capping surface;
 - a plunger head, the plunger head sized to fit within an interior of a container with which the cap is to interface;
 - a retaining feature; and
 - 10 an opening in the cap, wherein:
 - the plunger head includes a shaft-receiving feature to receive a shaft that is insertable through the opening,
 - the plunger head is positioned within the cap by the retaining feature such that the opening is aligned with the shaft-receiving feature, and
 - 15 the retaining feature releases the plunger head when a force higher than a first threshold amount is applied to the plunger head in a direction facing away from, and normal to, the capping surface.
2. The apparatus of claim 1, wherein the plunger head is a circular disk.
- 20 3. The apparatus of claim 2, wherein the plunger head is made of an elastomeric material.
4. The apparatus of claim 1, wherein the retaining feature has one or more
- 25 interior-facing surfaces that compress the plunger head radially when the plunger head is inserted into the retaining feature.
5. The apparatus of claim 1, wherein:

the retaining feature has one or more interior-facing surfaces and one or more ledge surfaces that extend radially inwards from the one or more interior-facing surfaces, and

- 5 the one or more ledge surfaces have one or more innermost edges that are within a prismatic volume bounded by an outermost perimeter of the plunger head and extending along an axis that is parallel to the normal of the capping surface.

6. The apparatus of claim 5, wherein the one or more interior-facing surfaces define an inner perimeter that is larger than the plunger head, thereby allowing the
10 plunger head to translate laterally at least some amount when positioned within the retaining feature.

7. The apparatus of claim 1, wherein the one or more sidewalls is a single circular sidewall.

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8. The apparatus of claim 7, wherein an interior surface of the circular sidewall includes thread features to engage with corresponding thread features on an exterior surface of the container with which the cap is to interface.

- 20 9. The apparatus of claim 1, further comprising a perforable seal that seals the opening in the cap and that is perforable by the shaft when the shaft is inserted through the opening.

10. The apparatus of claim 1, wherein the shaft-receiving feature is a hole that is
25 sized to be smaller in diameter than a maximum dimension of the shaft in a direction that is perpendicular to the normal to the capping surface when the shaft is aligned with the normal to the capping surface.

11. The apparatus of claim 1, further comprising the container, wherein:
30 the cap is mounted to the container, and

the interior of the container is sized to allow the plunger head to be reciprocated within the interior of the container in a direction parallel to the normal of the capping surface.

- 5 12. The apparatus of claim 11, wherein the container has a portion with a substantially constant cross section along the direction parallel to the normal of the capping surface.
13. The apparatus of claim 11, further comprising the shaft, wherein:
- 10 the shaft has a center axis that is parallel to the normal of the capping surface when the shaft is inserted through the opening,
- the shaft has an insertion portion and a stop portion,
- the insertion portion extends from one end of the shaft to the stop portion,
- the stop portion is sized larger than the insertion portion in a direction
- 15 perpendicular to the center axis and is also sized larger than the shaft-receiving feature in the direction perpendicular to the center axis, and
- the stop portion engages with the plunger head when the insertion portion is fully inserted into the shaft-receiving feature.
- 20 14. The apparatus of claim 13, further comprising a shaft reciprocation mechanism, wherein the shaft reciprocation mechanism is to:
- translate the shaft through the opening along the center axis such that the insertion portion is fully inserted into the shaft-receiving feature,
- apply a force of at least the first threshold amount to the shaft, and
- 25 reciprocate the shaft one or more times within the interior of the container.
15. The apparatus of claim 13, wherein the shaft is a hollow tube.
16. A method comprising:

inserting an insertion portion of a shaft through an opening in a cap of a container and into a shaft-receiving feature in a plunger head that is positioned within the cap by a retaining feature;

- 5 applying a force greater than a first threshold amount to the shaft after the insertion portion is fully inserted into the shaft-receiving feature, thereby causing the retaining feature to release the plunger head; and

reciprocating the shaft, after the plunger head has been released from the retaining feature, such that the plunger head is reciprocated within an interior volume of the container.

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17. The method of claim 16, further comprising piercing a perforable seal in the cap with the insertion portion prior to inserting the insertion portion into the shaft-receiving feature.

- 15 18. The method of claim 16, further comprising withdrawing the insertion portion from the container, thereby causing the plunger head to engage with the cap and be pushed off the insertion portion by the cap.