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Inventor(s)

Halloran; Daniel et al.

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### QUICK-COUPPLING MECHANISM FOR TOILET AND METHOD OF USING SAME

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#### Abstract

At least one embodiment relates to a quick-coupling mechanism including a clamp spring configured to receive a valve body. The clamp spring is coupled to a release button configured to manipulate one or more arms of the clamp spring. The quick-coupling mechanism includes a base structure coupled to the toilet pedestal/bowl. The base structure is configured to hold the clamp spring in place. In a locking-state, the clamp spring seats in a groove in the valve body thus securing the valve body in place and preventing an axial movement of the valve body relative to the clamp spring. In a non-locking state, the release button bends the arms of the clamp spring outwardly to increase the diameter of the clamping portion, thus releasing valve body such that the valve body can move axially relative to the clamp spring.

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**Inventors:** Halloran; Daniel (Fredonia, WI), Pelon; Kristy (Sheboygan Falls, WI)

**Applicant:** Kohler Co. (Kohler, WI)

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## Background/Summary

[0001] This application is a continuation application of U.S. patent application Ser. No. 18/141,804 (Docket No. 010222-20139D) filed on May 1, 2023, which is hereby incorporated by reference in its entirety, and which is a divisional application of U.S. patent application Ser. No. 17/201,285 (Docket No. 010222-20139B-US) filed Mar. 15, 2021, which is hereby incorporated by reference in its entirety, and which claims priority benefit of Provisional Application No. 62/990,030 (Docket No. 010222-20139A-US) filed Mar. 16, 2020, which is hereby incorporated by reference in its entirety.

### BACKGROUND

[0002] The present application relates generally to toilet bowl and tank attachments. More specifically, the present application relates to quick-coupling toilet bowl and tank attachments and the methods of attaching toilet tanks to toilet bowls using such quick-coupling attachments/assemblies.

[0003] Current systems like this require moderate level of mechanical aptitude, which may be beyond the ability of some potential customers who would like to install the system without the assistance of a professional. Further, the attachment and/or leveling systems can be somewhat time consuming. Thus, it would be advantageous to provide a secure, leak free toilet tank-to-bowl coupling system, with significantly faster and easier installation that overcomes the foregoing challenges. These and other advantageous features will become apparent to those reviewing the present disclosure.

### SUMMARY

[0004] At least one embodiment relates to a quick-coupling mechanism. The quick-coupling mechanism includes a clamp spring configured to receive a valve body. The clamp spring is coupled to a release button configured to manipulate one or more arms of the clamp spring, such as to change a diameter of a clamping portion of the clamp spring. The quick-coupling mechanism includes a base structure coupled to the toilet pedestal/bowl. The base structure is configured to hold the clamp spring in place. In a locking-state, the clamp spring seats in a groove in the valve body thus securing the valve body in place and preventing an axial movement of the valve body relative to the clamp spring. In a non-locking state, the release button bends the arms of the clamp spring outwardly to increase the diameter of the clamping portion, thus releasing valve body such that the valve body can move axially relative to the clamp spring.

[0005] This summary is illustrative only and is not intended to be in any way limiting.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The disclosure will become more fully understood from the following detailed description, taken in conjunction with the accompanying figures, wherein like reference numerals refer to like elements, in which:

[0007] FIG. 1A includes a toilet configured with a quick-coupling mechanism.

[0008] FIG. 1B is a top view of the quick-coupling mechanism, in accordance with an exemplary embodiment of the present application.

[0009] FIGS. 2 and 3 are perspective views of the quick-coupling mechanism of FIG. 1.

[0010] FIGS. **4** and **5** are top cross-sectional views of the quick-coupling mechanism of FIG. **1** in non-locking and locking states, respectively.

[0011] FIG. **6** is a flow chart illustrating a method for using the quick-coupling mechanism of FIG. **1**.

[0012] FIG. **7** is a top view of a quick-coupling mechanism, in accordance with an exemplary embodiment of the present application.

[0013] FIG. **8** is a perspective view of the quick-coupling mechanism of FIG. **7**.

[0014] FIG. **9** is a cross-sectional view of the quick-coupling mechanism of FIG. **7**.

[0015] FIGS. **10-13** are bottom views of alternative toilet tanks for coupling with a quick-coupling mechanism, in accordance with an exemplary embodiment of the present application.

#### DETAILED DESCRIPTION

[0016] The following description focuses primarily on quick-coupling mechanisms for connecting a toilet tank and a toilet bowl, but it should be appreciated that the disclosed quick-coupling mechanism can be applied to other coupled components in the sanitation environment (e.g., bidets, urinals, etc.) to provide a quick mode of attachment. Current coupling, or gasket, systems for two piece toilets (i.e., where the tank and bowl are formed separately then coupled together) require two or three studs extend through the mounting bracket to engage holes in the top of the bowl/pedestal. Nuts are coupled to the studs to secure the system to the bowl.

[0017] Before turning to the figures, which illustrate certain exemplary embodiments in detail, it should be understood that the present disclosure is not limited to the details or methodology set forth in the description or illustrated in the figures. It should also be understood that the terminology used herein is for the purpose of description only and should not be regarded as limiting.

[0018] Referring generally to the figures, disclosed herein are quick-coupling mechanisms for connecting a toilet tank to a toilet bowl, or pedestal, for instance. According to an exemplary embodiment, the quick-coupling mechanism has a clamp spring coupled to a release tab/button, wherein the clamp spring receives a valve body and seats in a groove in the valve body. Further, a base structure, coupled to the toilet pedestal/bowl, holds the clamp spring in place. In some embodiments, the base structure may be coupled to the bottom of the toilet tank, such that a tube extends up from the bowl to engage the clamp spring and the flush valve body in the toilet tank. The release button manipulates (e.g., bends, splays, etc.) the clamp spring, thus releasing valve body. Some benefits of such a configuration include, for example, (1) reduced installation time, (2) reduces installation difficulty, and (3) a secure connection between the toilet bowl and tank that prevents leaks.

[0019] Referring now to FIG. **1A**, a toilet **1100** is illustrated according to an exemplary embodiment including a quick-coupling mechanism. The toilet **1100** includes a tank (e.g., container, reservoir, etc.), shown as a tank **1102**, and a pedestal (e.g., base, stand, support, etc.), shown as a pedestal **1104**. The tank **1102** is coupled to, and supported by, the pedestal **1104**, which is configured to be positioned on a floor. The tank **1102** is configured to receive water (e.g., via a fill valve of the toilet **1100**, etc.) and store the water in between flushes. The pedestal **1104** includes a bowl and is configured to receive the water from the tank **1102** to flush contents of bowl into a sewage line. The tank **1102** is configured to be secured to the pedestal **1104** via a quick-coupling mechanism.

[0020] The tank **1102** includes a wall (e.g., boundary, body, structure, etc.), shown as a bottom wall **1106**, and the pedestal **1104** includes a protrusion (e.g., projection, extension, etc.), shown as a lip **1108**. The bottom wall **1106** defines a surface (e.g., side, face, etc.), shown as a bottom surface **1110**. The lip **1108** extends (e.g., protrudes, projects, etc.) underneath the bottom wall **1106** and includes a surface, shown as a top surface **1112**. The tank **1102** is coupled to the pedestal **1104** such that the bottom surface **1110** of the bottom wall **1106** is adjacent to (e.g., opposite of, in confronting relation with, etc.) the top surface **1112** of the pedestal **1104**.

[0021] Referring to FIGS. 1B, 2, 3, 4, and 5, a quick-coupling mechanism **100** is shown according to an exemplary embodiment. The quick-coupling mechanism **100** may be applied to the toilet **1100**. The quick-coupling mechanism **100** includes a clamp spring **102**, which is shown as a resilient member. As shown in FIG. 1, the clamp spring **102** includes a base portion **104** with a first arm **106** and a second arm **108** extending therefrom. The base portion **104** can include a straight and/or flat portion of the clamp spring **102**. The first and second arms **106**, **108** extend from the base portion **104** parallel to each other and away from the base portion **104**, such that the first and second arms **106**, **108** each form right angles with the base portion **104**. The first and second arms **106**, **108** may form rounded angles with the base portion **104**. In some embodiments, the first and second arms **106**, **108** are obliquely angled relative to the base portion **104** (e.g., 75 degrees, 80 degrees, 100 degrees, etc.). The first and second arms **106**, **108** symmetrically extend for a length **L1** and curve toward one another, with a first end **110** of the first arm **106** and a second end **111** of the second arm **108** meeting at a point opposite from the base portion **104** such that the first and second ends **110**, **111** are separated from the base portion **104** by a valve body **101**. In other words, the base portion **104** and the length **L1** of the first and second arms **106**, **108** form three sides of a rectangular shape, or a “C” or “U” shape, for instance, and the curved portion of the first and second arms **106**, **108** form a semicircular shape with a diameter **D1**. As such, the clamp spring **102** is sized and shaped to receive the valve body **101**. The clamp spring **102** further includes a first tab **112** and a second tab **114** extending out from the first and second ends **110**, **111**, respectively. As illustrated, the first and second tabs **112**, **114** have confronting curved surfaces. In some embodiments, the first and second tabs **112**, **114** may have outwardly curved surfaces or straight surfaces (e.g., the first and second tabs **112**, **114** extend parallel to each other or away from each other at 45 degree angles).

[0022] The quick-coupling mechanism **100** includes a base structure **116**, which is configured to hold the clamp spring **102** in place. As shown in FIG. 2, the base structure **116** includes a bottom member **118**, a top member **122**, and a wall **120** extending between the bottom member **118** and the top member **122**. The wall **120** generally corresponds to the shape of the clamp spring **102** as described herein. The bottom member **118** is configured to couple to the toilet pedestal/bowl, such as using fasteners that engage the pedestal **1104** through one or more holes **121**. The fasteners may be bolts, screws, or another device. The fasteners may be formed of metal, plastic or a polymer. The fasteners may include one or more nuts, washers or seals (e.g., o-ring).

[0023] The base structure **116** includes a bore **123** that extends in a longitudinal direction relative to the valve body **101**. As shown in FIG. 2, the longitudinal direction is transverse (e.g., orthogonal) to a base of the bottom member **118**. The illustrated bore **123** has a circular cross-sectional shape to receive the valve body **101**. The base structure **116** further includes an annular channel **124**. The bottom member **118**, the wall **120**, and the top member **122** cooperate to define the annular chamber **124**. As shown in FIG. 2, the annular channel **124** receives the spring clamp **102** or at least a portion thereof (e.g., the base portion **104**, the first or second arms **106**, **108**, etc.). As shown in FIG. 2, the valve body **101** is inserted into the bore **123** and inside the clamp spring **102**, such that the first and second arms **106**, **108** of the clamp spring **102** are positioned between a portion of the valve body **101** and a portion of the wall **120** defining the annular channel **124**. The base structure **116** may further include securing features (e.g., tabs, nooks, walls, etc.) that hold parts of the clamp spring **102** in place, such as base portion **104** and/or the first and second arms **106**, **108**.

Additionally, in a locking state (FIGS. 1 and 5), the clamp spring **102** seats in a groove **125** in the valve body **101** to hold the valve body **101** in place relative to the base structure **116**. As such, the portions of the base portion **104** and the first and second arms **106**, **108** that are seated in the groove **125** define what is referred to herein as the clamping portion. The base structure **116** prevents movement of the clamp spring **102** relative to the base structure **116** along a longitudinal axis of the valve body **101**, as described in detail herein. In the locking state, the clamp spring **102** prevents movement of the valve body **101** relative to the clamp spring **102** along the longitudinal

axis of the valve body **101**.

[0024] The illustrated quick-coupling mechanism **100** includes a release button **126**. The release button **126** is a surface configured to be engaged by a user. The release button **126** may have a cuboidal shape having a flat surface, a spherical shape having a round surface, or have any suitable shape for an actuator or button. As shown in FIG. 4, the release button **126** may have a first driving feature **128** and a second driving feature **130**. The first and second driving features **128**, **130** may include a ramped or oblique (e.g., diagonal) surface. As shown, the first and second driving features **128**, **130** are on opposite ends of the release button **126** such that each of the first and second driving features **128**, **130** are associated with one tab **112**, **114** of the clamp spring and are angled (e.g., inward) toward the first and second ends **110**, **111**. The release button **126** is operatively coupled to the first and second tabs **112**, **114**. The first and second tabs **112**, **114** are coupled to the release button **126** on the outside surfaces of the first and second driving features **128**, **130**. When a user engages the release button **126** (e.g., depresses or pushes a surface of the release button **126**, such that the button **126** moves toward the valve body **101**), the first and second driving features **128**, **130** interface with the first and second tabs **112**, **114** such that the first and second tabs **112**, **114** move away from each other. An opposing movement of the first and second tabs **112**, **114** widens the diameter of the first and second arms **106**, **108** and positions the clamp spring **102** in a non-locking state, as shown in FIG. 4. In the non-locking state, a diameter  $D1'$  of the clamping portion is larger than the outer diameter of the valve body **101** so that the valve body **101** can move (e.g., slide) relative to the clamp spring **102** along the longitudinal axis. In order to facilitate this configuration, the base structure **116** further prevents the base portion **104** from any lateral movement, thus creating the force allow the first and second arms **106**, **118** to bend, or curve outwardly when the release button **126** is engaged.

[0025] Referring to FIG. 6, a method **600** for using a quick-coupling mechanism **100** is shown according to an exemplary embodiment. Not illustrated in FIG. 6, the quick-coupling mechanism couples the tank **1102** to the pedestal **1104** via a single action. That is, the tank **1102** is placed on the pedestal **1104** and snapped into place automatically through a force from gravity and/or a force from the user (e.g., technician or installer). The valve body **101**, may be inserted into the quick-connect coupling mechanism **100** (i.e., into the hollow **123** of the base structure **116** and inside the diameter of the clamp spring **102**) and aligned to attach the tank **1102** to the bowl or pedestal **1104**.

[0026] FIG. 6 illustrates the method **600** for releasing the tank **1102** from the pedestal **1104** using the quick-coupling mechanism. At step **602** (e.g., a first step), the method **600** includes depressing the release button **126** such that the release button **126** is pushed inward toward the valve body **101**. The release button **126** releases the tank **1102** from the bowl or pedestal **1104**. By pushing the release button **126** inward toward the valve body **101**, the first and second tabs **112**, **114** are pressed in toward the valve body **101**. As such, the first and second arms **106**, **108** are bent radially, increasing the diameter of the clamp spring **102**.

[0027] At step **604**, the release button **126** may be continuously depressed to retain a larger diameter of the clamp spring **102** than the diameter of the valve body **101**. As such, at step **606**, valve body **101** is removed from the base structure **116**. Once the valve body **101** is removed from the base structure **116** (e.g., allowing the tank **1102** to be removed from the bowl or pedestal **1104**), at step **608**, the release button **126** may be released (i.e., no longer depressed), and the first and second arms **106**, **108** return to the locking position. The first and second arms **106**, **108** are secured within the groove **125** of the valve body **101** under the force generated by the clamp spring **102**.

[0028] Referring to FIGS. 7-9, a quick-coupling mechanism **200** is shown according to an exemplary embodiment. The quick-coupling mechanism **200** includes a base portion **202**. The base portion **202** may include a plate, panel, or similar relatively flat surface. The base portion **202** defines a hollow portion **204** configured to receive the valve body **101**. The hollow portion **204** has a base diameter  $D2$  corresponding with the diameter of the valve body **101**. The base portion **202** is configured to be coupled to the toilet bowl. For instance, in some embodiments, the base portion

**202** may have an attachment feature **206** configured to couple with a complimentary feature on the top surface of the toilet bowl. For instance, the attachment features **206** can include slots configured to receive fasteners that clamp the base portion **202** to the toilet bowl. In some embodiments, the base portion **202** may include a dry-lock plate factory assembled to the bowl. The quick-coupling mechanism **200** includes a collar **208**. The base portion **202** and the collar **208** are separated and operatively coupled to at least one retention spring **210**. The retention spring **210** is configured to provide the force required to hold the quick-coupling mechanism **200** in place and to release it when released by the user, as explained herein. The quick-coupling mechanism **200** includes an extending feature **212**. The extending feature **212** may have a frustoconical shape such that the top end has with a top diameter and a bottom end having a bottom diameter, which is different than the top diameter. The top diameter corresponds with the diameter of the valve body **101** and the hollow portion **204** of the base portion **202** such that the valve body **101** may be inserted into the quick-coupling mechanism **200**. As shown, the bottom diameter is coupled to the collar **208** and is larger than the top diameter to provide stability.

[0029] The extending feature **212** includes a plurality of roller balls **214**. The plurality of roller balls **214** are disposed along an inner ring **216** of the extending feature **212**. The plurality of roller balls **214** may be evenly or unevenly spaced along the inner ring **216**. The plurality of roller balls **214** according to one example are stainless steel. The plurality of roller balls **214** are configured to be moved radially as the valve body **101** is inserted into the quick-coupling mechanism **200** and to snap back into place when the valve body **101** reaches a locked position with the bowl. When the plurality of roller balls **214** return to their locked position, they are secured within a groove of the valve body **101**, thus securing, or locking, the valve body **101** as coupled to the quick-coupling mechanism **200**. The quick-coupling mechanism may further include one or more O-rings to provide a seal between the coupled components (e.g., the quick-coupling mechanism **200** to the valve body **101**, the quick coupling mechanism **200** to the tank, the quick coupling mechanism **200** to the bowl, etc.). The collar **208** may be pulled downward toward the base portion **202** to release the plurality of roller balls **214** and unlock the valve body **101** from the quick-coupling mechanism **200**. In various embodiment, the bottom of the tank **300-600** may include a variety of compatible configurations dependent on the size and shape of the quick-coupling mechanism **200** (or the quick-coupling mechanism **100**), as shown in FIGS. **10-13**. The base portion **202** may include a circular shape or a rectangular shape, and may be factory assembled. As such, it is beneficial to provide tank designs to accommodate the different fit necessary to couple the tank and the bowl with the quick-coupling mechanism **200**. For instance, the bottom of the tank **300, 500** are configured circularly, and the bottom of the tank **400** can accommodate a base portion **202** with flanges.

[0030] Thus, the present disclosure describes a quick-coupling mechanism that can, advantageously, provide a secure connection between the toilet bowl and tank while reducing the installation time and difficulty.

[0031] As utilized herein, the terms “approximately,” “about,” “substantially”, and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numerical ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and claimed are considered to be within the scope of the invention as recited in the appended claims.

[0032] References herein to the positions of elements (e.g., “top,” “bottom,” “above,” “below,” etc.) are merely used to describe the orientation of various elements in the FIGURES. It should be noted that the orientation of various elements may differ according to other exemplary

embodiments, and that such variations are intended to be encompassed by the present disclosure.

[0033] The construction and arrangement of the elements as shown in the exemplary embodiments are illustrative only. Although only a few embodiments of the present disclosure have been described in detail, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited. For example, elements shown as integrally formed may be constructed of multiple parts or elements, the position of elements may be reversed or otherwise varied, and the nature or number of discrete elements or positions may be altered or varied.

[0034] Additionally, the word “exemplary” is used to mean serving as an example, instance, or illustration. Any embodiment or design described herein as “exemplary” is not necessarily to be construed as preferred or advantageous over other embodiments or designs (and such term is not intended to connote that such embodiments are necessarily extraordinary or superlative examples). Rather, use of the word “exemplary” is intended to present concepts in a concrete manner. Accordingly, all such modifications are intended to be included within the scope of the present disclosure. Other substitutions, modifications, changes, and omissions may be made in the design, operating conditions, and arrangement of the preferred and other exemplary embodiments without departing from the scope of the appended claims.

[0035] Other substitutions, modifications, changes and omissions may also be made in the design, operating conditions and arrangement of the various exemplary embodiments without departing from the scope of the present invention. For example, any element disclosed in one embodiment may be incorporated or utilized with any other embodiment disclosed herein. Also, for example, the order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. Any means-plus-function clause is intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Other substitutions, modifications, changes and omissions may be made in the design, operating configuration, and arrangement of the preferred and other exemplary embodiments without departing from the scope of the appended claims.

[0036] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular embodiments of particular inventions. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable sub-combination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a sub-combination or variation of a sub-combination.

[0037] Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the embodiments described above should not be understood as requiring such separation in all embodiments, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

[0038] Thus, particular embodiments of the subject matter have been described. In some cases, the actions recited herein can be performed in a different order and still achieve desirable results. In addition, the processes depicted in the accompanying figures do not necessarily require the

particular order shown, or sequential order, to achieve desirable results. In certain implementations, multitasking and parallel processing may be advantageous.

## Claims

1. A coupling mechanism for a toilet, the coupling mechanism comprising: a base structure configured to be coupled to a pedestal of the toilet; a collar separated from the base structure; and a retention spring coupled to the base structure and the collar, the retention spring configured to hold the coupling mechanism in place with respect to a valve body and release the coupling mechanism.
2. The coupling mechanism of claim 1, further comprising: an attachment feature of the base structure configured to receive a fastener to attach the base structure to the toilet.
3. The coupling mechanism of claim 1, wherein the base structure includes a hollow portion configured to receive the valve body, wherein the retention spring is configured to release the valve body.
4. The coupling mechanism of claim 1, further comprising: an extending feature coupled to the collar configured to lock the valve body.
5. The coupling mechanism of claim 4, wherein a top end of the extending feature has a top diameter and a bottom end of the extending feature has a bottom diameter, the bottom diameter being different than the top diameter.
6. The coupling mechanism of claim 5, wherein the top diameter corresponds to the diameter of the valve body.
7. The coupling mechanism of claim 5, wherein the bottom diameter is larger than the top diameter.
8. The coupling mechanism of claim 1, wherein the retention spring is disposed between the base structure and the collar.
9. The coupling mechanism of claim 1, wherein the valve body is unlocked from the coupling mechanism when the collar is pulled downward toward the base structure.
10. A toilet comprising: a pedestal; and a tank configured to be secured to the pedestal via a coupling mechanism for a toilet, the coupling mechanism comprising: a base structure coupled to the pedestal; a collar separated from the base structure; and a retention spring coupled to the base structure and the collar, the retention spring configured to hold the coupling mechanism in place with respect to a valve body and release the coupling mechanism.
11. The toilet of claim 10, wherein the coupling mechanism further comprises: an extending feature coupled to the collar configured to lock the valve body.
12. The toilet of claim 11, wherein a top end of the extending feature has a top diameter and a bottom end of the extending feature has a bottom diameter, the bottom diameter being different than the top diameter.
13. The toilet of claim 12, wherein the top diameter corresponds to the diameter of the valve body.
14. The toilet of claim 12, wherein the bottom diameter is larger than the top diameter.
15. The toilet of claim 10, wherein the retention spring is disposed between the base structure and the collar.
16. The toilet of claim 10, wherein the valve body is unlocked from the coupling mechanism when the collar is pulled downward toward the base structure.
17. A coupling mechanism for a toilet, the coupling mechanism comprising: a base structure configured to be coupled to a pedestal of the toilet; a collar separated from the base structure; and a retention spring disposed between and coupled to the base structure and the collar, the retention spring configured to hold the coupling mechanism in place with respect to a valve body and release the coupling mechanism.
18. The coupling mechanism of claim 17, wherein the base structure includes a hollow portion configured to receive the valve body, wherein the retention spring is configured to release the valve body.



**19.** The coupling mechanism of claim 18, further comprising: an extending feature coupled to the collar configured to lock the valve body.

**20.** The coupling mechanism of claim 19, wherein a top end of the extending feature has a top diameter corresponding to a diameter of the hollow portion and a bottom end of the extending feature has a bottom diameter, the bottom diameter being larger than the top diameter.

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