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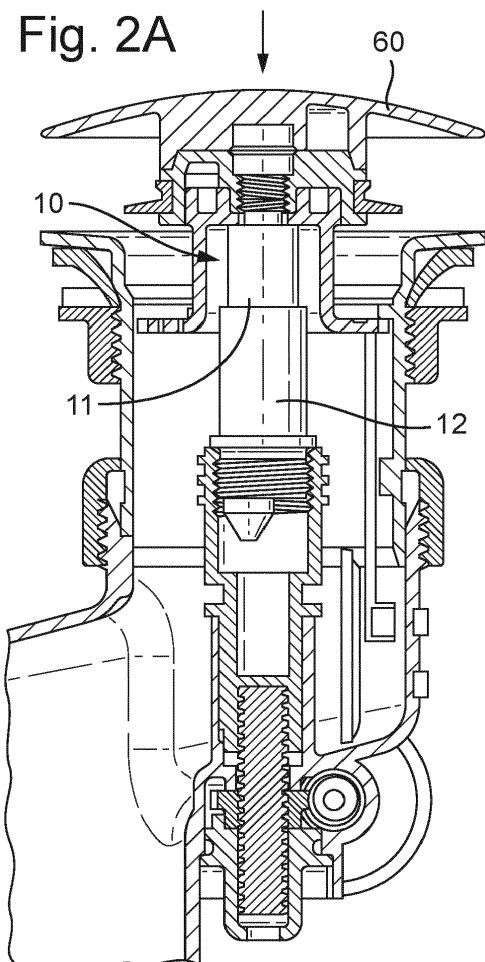
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(54) **ASSEMBLY AND DRAIN COVER**

(57) In the present invention, an assembly for sealing a drain is provided. The assembly is configured to be operated manually and automatically. The assembly comprising a mechanism comprising a first member and a second member, a sealing module comprising a seal for sealing an aperture, and an automated device. In the present invention, a further assembly for sealing a drain is provided. The assembly comprising a sealing module comprising a seal for sealing an aperture, and a cover for covering a drain.



Description

[0001] The present invention relates to an assembly and a cover for a drain.

[0002] Manual drain covers are known in the prior art in which a user can close a bath plug in order to provide a seal (e.g. to fill the bath with water), and to manually open the bath plug (e.g. to drain the water from the bath).

[0003] Various types of manual drain cover are known. For example, a simple plug (e.g. on a chain) can be provided which fits within an aperture of a drain to seal the drain and can be removed from the aperture to open the drain. In order to provide a reliable seal, the plug must be pushed into the drain at the correct angle, otherwise leaks can occur. When not being used, such a simple plug may take up space around the bath (which can be limited) and a plug provided by itself may be moved away from the drain which may mean it is not available for use when needed.

[0004] Other types of manual drain assembly may be provided, for example, including a click clack mechanism. Click clack plugs allow a user to manually operate the plug to move it down to seal a drain aperture and to move the plug up to open the drain aperture. Click clack plugs are advantageous in that they control the movement of the plug and provide reliable positioning of the plug in the drain aperture. Additionally, click clack plugs are generally positioned in the drain aperture in a fixed manner which means that plug is available for use. Other types of manual bath plug may comprise lever mechanisms to move the bath plug up and down to open and close the drain.

[0005] There are benefits to providing an automated bath drain assembly which can be operated by a user remotely. Various known automated assemblies are limited in that they do not allow for manual operation in addition to automated operation. Some known automated assemblies provide a safety mechanism to open the drain, for example when the amount of water in a bath reaches a predetermined level, but do not provide a way for the bath plug to be operated both manually and automatically based on user input.

[0006] Thus, it would be advantageous to provide an assembly which can be used by a user in person or remotely which can reliably seal a drain in both manual and automatic modes of operation.

[0007] It has also been identified that if a drain assembly is operated automatically, an issue may occur is there is an object obstructing movement of the drain assembly, and particularly a top cover of the drain which tends to protrude over the drain. Thus, it would be advantageous to provide an assembly which can reduce damage caused to such an obstructing object and/or the drain assembly if such a situation occurs. In other words, it would be beneficial to provide an assembly with a safety mechanism.

[0008] According to an aspect of the present invention, an assembly for sealing a drain is provided, wherein the

assembly is configured to be operated manually and automatically, the assembly comprising: a mechanism comprising a first member and a second member, the first member being configured to move a linear direction relative to the second member to move the mechanism between a first configuration, in which the mechanism is in a stable extended state, and a second configuration, in which the mechanism is in a stable compressed state; a sealing module comprising a seal for sealing an aperture, the sealing module being connected to the first member so as to move with the first member in the linear direction; an automated device connected to the second member; wherein during manual operation, the second member is stationary and the first member is moved by a user between a first position, in which the mechanism is in the first configuration, and a second position, in which the mechanism is in the second configuration, and wherein during automatic operation, the automated device is configured to move the second member so as to move the first member from the first position to the second position or from the second position to the first position.

[0009] The assembly of the present invention can be operated manually and automatically which beneficially allows a user to operate the assembly remotely, whilst still providing the option for the user to easily operate the assembly in person when desired. Typically, the automatic operation will be used when the user is away from the room in which the assembly is provided, e.g. away from the bathroom. The user is more likely to use the manual operation when they are in close proximity, e.g. in the bath.

[0010] Having such automatic operation means that, when used in a bath for example, the bath could be run from anywhere remotely (e.g. outside the bathroom) without having to check if the plug is down first. Additional benefits of automatic operation include that a bath could have smart control, e.g. to maintain water temperature if a user does not go to the bathroom straight away, for example, by opening the drain to drain some water and topping up the bath with hot water. The assembly may also be configured to open the seal if the amount of water in the bath reaches a predetermined amount or level.

[0011] When the first member is in the first position, the aperture may be open, and when the first member is in the second position, the seal may be configured to seal the aperture.

[0012] The automated device may comprise a lead-screw and a motor.

[0013] The assembly may further comprise:

a first gear attached to a rotating part of the motor; and

a second gear configured to interact with the first gear and the leadscrew,

wherein the motor is configured to rotate and, via the first gear and the second gear, move the leadscrew

in a linear direction.

[0014] The leadscrew may be connected to a rotating part of the motor, and rotation of the leadscrew may be configured to move the second member in a linear direction.

[0015] The automated device may comprise a solenoid comprising an electromagnet configured to move the second member in a linear direction.

[0016] The assembly may further comprise a protrusion configured to limit movement of the first member.

[0017] The assembly may further comprise a drain body configured to be positioned within a drain, wherein the drain body is configured to house the mechanism.

[0018] The assembly may further comprise a hair trap connected to the first member and/or the sealing module.

[0019] The assembly may further comprise at least one sensor configured to determine the position of the first member and/or the sealing module.

[0020] The at least one sensor may be positioned on the drain body.

[0021] The sensor may be connected to the first member and/or the sealing module.

[0022] The assembly may further comprise a magnet, wherein the at least one sensor is a hall sensor.

[0023] There may be two sensors, comprising a first sensor configured to determine when the first member is in the first position and a second sensor configured to determine when the first member is in the second position.

[0024] The automated device may receive user input wirelessly from a remote control or app.

[0025] The seal may form a radially outermost part of the sealing component.

[0026] The seal may be an elastic member.

[0027] The sealing member may comprise a body which is connected to the seal, optionally wherein the body is integral with the seal.

[0028] The seal may be a ring.

[0029] The assembly may further comprise:

a cover for covering a drain, the cover and sealing module being releasably connected to each other, wherein the cover is configured to automatically detach from the sealing component.

[0030] According to an aspect of the present invention, an assembly for sealing a drain is provided, the assembly comprising: a sealing module comprising a seal for sealing an aperture, the sealing module being configured to connect to a mechanism configured to control movement of the sealing module in a linear direction; and a cover for covering a drain, the cover and sealing module being releasably connected to each other, wherein the cover is configured to automatically detach from the sealing component.

[0031] Providing a cover and sealing module which are releasably attachable means that the cover and the seal-

ing module can be easily separated from one another. This is beneficial in that the cover may detach from the assembly if there is an object which prevents the assembly from moving into a position in which a drain needs to be sealed. This may be a particularly useful safety feature which reduces or avoids the risk of someone's fingers from being trapped if they are in the way of the cover when the automatic mechanism is operated. This allows the seal to still be moved to seal a drain aperture, whilst preventing the cover from damaging the object obstructing the movement of the assembly. Having such a bath cover means that the drain could be sealed from anywhere remotely (e.g. outside the bathroom) without having to check whether the plug is obstructed first. Additionally, this assembly allows easy interchangeability of drain cover aesthetics. For example, the cover can be swapped for another cover with a different finish and/or shape. For example, the user could change a chrome circular drain cover for a matte black square drain cover without replacing the whole assembly.

[0032] The assembly may be configured to promote reattachment of the cover and sealing module when detached

[0033] The assembly may comprise an attachment portion configured to releasably attach the cover and the sealing module, preferably wherein the attachment portion comprises:

a) a first magnet attached to the cover and a second magnet attached to the sealing component;

b) a spring connected to the cover and the sealing portion;

c) an elastic connector connected to the cover and the sealing portion; and/or

d) corresponding mating portions on the cover and sealing module, preferably wherein at least one of the mating portions comprises a clip.

[0034] The cover may be larger in plan than the drain, preferably wherein the cover is larger in plan than the seal.

[0035] The present invention will now be described by way of example only, with references to the following drawings in which:

Fig 1A is a schematic cross section of an assembly according to the present invention, Fig 1B shows a mechanism which may be used in the present invention in a closed state and Fig 1C shows a mechanism which may be used in the present invention in an open state;

Fig 2A shows the schematic cross section of the assembly of Fig 1A in an open state during manual operation and Fig 2B shows the schematic cross

section of the assembly of Fig 1A in a closed state;

Fig 3A shows a schematic cross section of an assembly according to the present invention. Figs 3B and 3C shows a part of the assembly of Fig 3A in different positions;

Figs 4A to 4F show the schematic cross section of the assembly of Fig 1A in different positions during automatic operation;

Fig 5A shows a schematic cross section of an assembly according to the present invention. Figs 5B and 5C shows a part of the assembly of Fig 5A in different positions.

Fig 6 shows a schematic cross section of an assembly according to the present invention;

Figs 7A, 7B, 7C show the schematic cross section of the assembly of Fig 6 in different positions; and

[0036] The figures show the components described below. The components depicted in the figures are not to scale. In the figures, like parts are indicated with like reference numerals.

[0037] As described above, there are known drain plug assemblies which can be operated manually and/or automatically to seal and/or open a drain. However, there is room for an improved assembly which provides reliable operation, in both manual and automatic modes, for sealing a drain.

[0038] The present invention provides an assembly which may be used to seal a drain. The assembly is suitable for sealing a drain. More specifically, the assembly can be used to open and close an aperture forming part of the drain. The assembly can be used, when in place, to seal the drain to prevent liquid (e.g. water) passing into the drain. Sealing the drain means that the drain is closed and the aperture is sealed. The assembly may also be used to open the drain (i.e. the drain aperture) to allow waste liquid to pass into the drain. The drain could be part of a sink or bathtub or any other suitable appliance, e.g. one which requires drainage of waste liquid. The drain is the part of the appliance through which the liquid is drained from the appliance, which is normally on a base surface of the appliance.

[0039] The assembly is configured to be operated manually and automatically. Manual operation of the assembly means that a user can directly operate the assembly in person. This will generally be done by pressing on a part of the assembly to move the assembly between different configurations. At least a part of the assembly may be exposed when in situ, and the exposed part may be contacted by the user during manual operation. Additionally, the assembly can be operated automatically. In other words, the assembly may be electronically operated. Thus, the assembly may comprise an automated

device which can move the assembly between different configurations. The automated device may be used to operate the assembly without any physical user input. Thus, the automated device may be used to change the configuration of the assembly without the user applying a force to the assembly. Preferably, the automated device is concealed. The automated device may be positioned within part of the drain, as described further below.

[0040] As the assembly can be operated automatically, it can be part of a smart system used for automatic/remote operation of a bath. This may be part of a smart bath system which can be operated by a user using a remote control, app, or other control device. For example, a smart system may be voice activated, e.g. using Amazon® Alexa®. Providing such a smart bath system with the assembly allows a user to fill up the bath remotely. The assembly can be used to check the drain is sealed prior to activating filling of the bath, e.g. using sensors as described below. If the drain is open, the assembly can be used to seal the drain. This prevents water being wasted by going down an open drain.

[0041] In an embodiment, the assembly 1 comprises a mechanism 10, a sealing module 20 and an automated device 40, for example, as shown in figure 1A. The components of the assembly can be provided in a relatively small space whilst still providing manual and automatic operation. This is particularly advantageous given the limited space often provided for a drain used for a sink or bath.

[0042] Generally, both the manual and automatic operation engage the mechanism 10 to move the mechanism 10 between an extended or compressed state, which allows the drain to be opened or sealed respectively. When the mechanism 10 is in the compressed state, the length of the mechanism 10 is smaller than when the mechanism 10 is in the extended state. The way in which the mechanism 10 is engaged differs between manual and automatic operation. The mechanism 10 will be described in further detail below, followed by a description of manual operation and automatic operation.

[0043] The mechanism 10 is configured to allow, or control, manual operation of the assembly 1. Thus, the user interaction with the assembly 1 moves components of the mechanism 10, which moves the seal 21 to an open and closed position. The mechanism 10 is also configured to keep the seal in the open or closed position (until further input from the user and/or automated device 40).

[0044] As described in further detail below, the mechanism 10 comprises a first member 11 and a second member 12. The first member 11 and second member 12 may be cylindrically shaped components which fit together. The first member 11 and second member 12 are configured to move relative to each in a linear direction. As shown in figure 1A, the first member 11 sits within the second member 12. Although, the second member 12 could instead be provided within the first member 11.

[0045] The mechanism 10 may otherwise be referred to as a click-clack, or a push button, or a sprung plug etc.. Use of such a mechanism 10 is beneficial because they are easily obtainable and relatively cheap. Furthermore, they provide reliable movement between component parts.

[0046] Briefly, the mechanism 10 controls movement of the first member 11 relative to the second member 12 and comprises two stable configurations as shown in figures 1B and 1C. Thus, when no external force is applied, the mechanism 10 will move to and/or maintain the position of the first member 11 relative to the second member 12 in one of the stable configurations. Thus, the components of the mechanism 10 when not experiencing any external force, may be in the first configuration or the second configuration. The stable configurations may otherwise be referred to as neutral configurations or equilibrium states. The mechanism 10 may only have two stable configurations. Thus, the mechanism 10 may be bi-stable.

[0047] The first member 11 can move relative to the second member 12. The mechanism 10 is configured to allow movement of the first member 11 in a linear direction. The mechanism 10 is configured to allow movement of the first member 11 in a linear direction relative to the second member 12. The mechanism 10 may prevent relative movement between the first member 11 and the second member 12 in other directions, e.g. by rotation. Thus, the mechanism 10 may only allow movement between the first member 11 and the second member 12 in a single direction, i.e. the linear direction above. The linear direction may be along a linear path which is parallel to and aligned with a longitudinal axis 90 of the mechanism. The mechanism may comprise mating parts to prevent relative rotation between the first and second member and guides to restrict movement of the first and second members along a direction of movement. For example, the first member 11 may comprise a channel 94 in which a part of a screw 95 is positioned. The screw 95 may be fixed to the second member 12 and may prevent rotation of the first member 11 relative to the second member 12. Of course, other mating parts may be used instead to prevent rotation between the first member 22 and the second member 12.

[0048] In a first configuration, the mechanism 10 is in a stable extended state as shown in figure 1C. In a second configuration, the mechanism 10 is in a stable compressed state as shown in figure 1B. Without external input, the mechanism 10 should be in either the first or second configuration. Thus, the mechanism 10 should not move of its own accord when in one of the first or second configurations. This may be due to a spring 93 within the mechanism 10 which pushes the first and second members away from each other. The spring 93 pushes the first and second members towards the first configuration, i.e. when the mechanism 10 is extended, as shown in figure 1C. When the mechanism 10 is in the extended state, the overlap between the first member 11

and the second member 12 is decreased and may be near a minimum overlap. The mechanism 10 may further comprise a component such as a fixed length pin 91 which links the first and second members and keeps them in place relative to each other, despite the spring, when the mechanism is in the second configuration. The screw 95 may also restrict the second member 12 from moving further away from the first member to restrict the relative movement of the first and second members.

[0049] The pin 91 is linked to the second member 12, e.g. by an end of the pin 91 being positioned in a hole 96 of the second member and the pin being kept in place by a fastener 97. The pin 91 follows a path 92 inside the mechanism 10 which holds the first and second members in place relative to each other despite the force applied by the spring. The path 92 may be defined on a surface of the first member 11. The path 92 may be shaped so as to restrict the pin 91 to move in one direction around the path 92, e.g. clockwise or anticlockwise. As the pin 91 follows the path 92, the position of the pin 91 in the second configuration as in figure 1B can maintain the mechanism 10 in the compressed state despite the spring 93. The pin 91 is configured to restrict rather than prevent movement, so that the mechanism 10 can be moved between the first and second configurations. When the mechanism 10 is in the compressed state, the overlap between the first member 11 and the second member 12 is increased and may be near a maximum overlap, as shown in figure 1B.

[0050] The assembly 1 is configured such that the mechanism 10 is in the first configuration when the first member 10 is in a first position. The assembly is configured such that the mechanism 10 is in the second configuration when the first member 10 is in a second position. The first and second positions indicate the overall position of the first member relative to the drain aperture. The first position is an uppermost position of the first member 11, for example, as shown in figure 1A. Thus, the drain aperture is open. The second position is a lowermost position of the first member relative to the drain aperture, for example, as shown in figure 4C. Thus, the aperture is closed (i.e. sealed).

[0051] The assembly 1 can be operated manually by applying a force to the assembly 1 which moves the first member 11 relative to the second member 12. In the context of figure 1A, the assembly 1 is operated manually from above by a user. The first member can be moved by a user from a first position in which the mechanism is in the first configuration to a second position in which the mechanism is in the second configuration. The first member can be moved by a user from the second position in which the mechanism is in the second configuration to the first position in which the mechanism is in the first configuration. The secondary member is stationary during manual operation.

[0052] The assembly 1 can be operated automatically by using the automated device 40 to move the second member 12. Thus, the automatic operation differs from

the manual operation in that the second member 12 moves in automatic operation, but is stationary in the manual operation. Movement of the second member may move the first member 11. In the context of figure 1A, the assembly 1 is operated automatically from below by the automated device 40 (e.g. based on user input).

[0053] When a user applies a force downwards on the assembly, the first member 11 is pushed towards the second member 12 and the mechanism 10 is compressed. Thus, starting from the configuration shown in figure 2A, the first member 11 moves in a linear direction (which is down in figure 2A) until it reaches an end point of the available movement. At this point, the force is removed and the mechanism 10 moves to the second configuration, which is shown in figure 2B. In the second configuration, the spring within the mechanism 10 is compressed. However, the guides and mating parts of the mechanism 10 function to keep the first member 11 in place relative to the second member 12 such that the mechanism 10 is maintained in the second configuration.

[0054] If a force is applied to the mechanism 10 when in the second configuration as shown in figure 2B, the force moves the first member 11 further into the second member 12 and based on the mating parts and guides, the first member 11 is released and the spring applies a force to move the first member 11 away from the second member 12 back to the first configuration as shown in figure 2A. Components other than a spring may be used, e.g. anything which can be compressed and returned to a neutral state when a force is removed. The mechanism may 10 correspond to any appropriate click-clack type device, otherwise referred to as a click clack plug bolt spring, which controls movement of the first and second members relative to each other as described.

[0055] The assembly 1 further comprises the sealing module 20 which comprises seal 21. The sealing module 20 is connected to a part of the mechanism 10, and more specifically, the first member 11. The automated device 40 is connected to a part of the mechanism 10, and more specifically, a second member 12. During manual operation, the user applies a force to move the first member 11 so that the seal 21 can be moved to a desired location to open or close a drain aperture. During automatic operation, the automated device 40 applies a force to move the second member 12 which moves the first member 11 so that the seal 21 can be moved to a desired location.

[0056] The sealing module 20 may be directly connected to the first member 11 such that they are in contact. The sealing module 20 may have a sealing module thread 23 in the body 22, and the first member 11 may have a corresponding first member thread 13. The sealing module thread 23 and the first member thread 13 may be configured to fit together, i.e. in direct connection with each other. Thus, the sealing module 20 may be connected to the first member 11 by screwing the sealing module 20 onto an end of the first member 11. The sealing module 20 may be indirectly connected to the first member 11, i.e. another component may be provided between

the sealing module 20 and the first member 11. Either way, the sealing module 20 is configured to move with the first member in the linear direction. Therefore, the sealing module 20 may be fixed relative to the first member 11. Thus, as the first member 11 moves relative to the second member 12, so too does the sealing module 20.

[0057] The seal 21 of the sealing module 20 is for sealing the aperture of the drain. The seal 21 is configured to close the aperture and is intended to provide a liquid tight seal with another component (e.g. the drain body described below). The seal 21 may be a gasket seal. The seal 21 may be a ring, i.e. annular shaped. The seal 21 may be made of any appropriate material which allows the seal 21 to form a liquid tight seal with a surrounding body, i.e. the appliance or drain body. The seal 21 may be elastic or rubber. The seal 21 is attached to a moving part of the assembly 1.

[0058] The sealing module may comprise body 22. The body 22 may be formed of any appropriate material. Preferably the body 22 is metal or hard plastic. The body 22 may be connected to the first member 11. Any appropriate form of connection may be used depending on the material of the body 22 and the first member 11. As described above, the body 22 and first member 11 may be screwed together, although other forms of connection may be used additionally or alternatively, e.g. adhesive and/or welding may be used.

[0059] The body 22 and the seal 21 may be in direct contact. The seal 21 may be positioned on the body 22. More specifically, the seal 21 may surround the body 22. The body 22 may have a groove 29 which holds the seal 21 in position. The seal 21 may be fitted to the body 22 without any additional connection, for example, the seal 21 and body 22 may be shaped so that the seal 21 fits securely on the body 22, e.g. within the groove 29. Additionally or alternatively, the seal may be connected to the body with adhesive and/or welding. Other connecting options are also available. Although the body 22 and seal 21 may preferably be formed of different materials, the body 22 and the seal 21 could be the same material. Furthermore, the seal 21 could be integral with the body 22. For example, the an integral version of the body 22 and seal 21 may be formed by 3-D printing.

[0060] It may be preferable for the seal 21 and body 22 to be provided as separate parts so that the seal 21 can be replaced, e.g. if worn down over time. It may be beneficial to position the seal 21 in a groove of the body 22, without any additional connection means so that the seal 21 can be more easily replaced.

[0061] The seal 21 may form a radially outermost part of the sealing module 20. Thus, the seal 21 may extend radially outwards from the body 22. This is beneficial because it allows the seal 21 to contact an edge of an aperture to seal the drain when the body 22 is within the aperture as shown in figure 2B.

[0062] The seal 21 is connected (directly or indirectly) to the first member 11 in a fixed manner which means

that during normal use, the seal 21 and the first member 11 do not move relative to each other. This means that movement of the first member 11 corresponds to movement of the seal 21. Throughout the description it will thus be understood that discussion of the movement of the first member 11, relative or otherwise, will correspond to the same movement of the seal 21, relative or otherwise.

[0063] The assembly may further comprise a hair trap 26. The hair trap 26 effectively acts as a filter to collect solid objects in the liquid passing through the drain. In particular, the hair trap 26 is configured to catch hair. The hair trap 26 could be provided at various locations within the assembly 1. As shown in figure 1A, the hair trap 26 is preferably connected to the sealing module 20, and specifically to the sealing body 22. The hair trap 26 could additionally or alternatively be connected to the first member 11. The hair trap may be provided as a separate member which is attached to the sealing module 20 and/or the first member 11. Alternatively, the hair trap 26 could be integral with the sealing body 22 and/or the first member 11.

[0064] In general, if the assembly is provided in a bath drain, it is likely that waste liquid passing through the drain will include hair. The hair may build up within the drain and can block the drain. Thus, the provision of the hair trap 26 is beneficial in that the as liquid passes through the trap, hair (and other debris) may be collected by the trap which reduces build up and blockades in the drain and allows. This prevents hair from blocking the drain and the hair and other debris to be more easily be cleared out by a user. The hair trap 26 may be easily detached from other parts of the assembly so that it can be removed and the hair (and/or any other debris caught by the hair trap) can be removed from the assembly and the hair trap 26 can be cleaned.

[0065] The assembly 1 may comprise the drain body 70 configured to be positioned within the drain aperture. In this case, the drain body may 70 form the drain aperture. The seal 21 may form a seal with the drain body 70. The drain body 70 may house various parts of the assembly 1. For example, the drain body 70 may house the mechanism 1. Thus, the drain body 70 may otherwise be referred to as a housing. The drain body 70 provides a passage for the drainage of liquid from the bath. The drain body 70 may comprise several parts which fit together to form the drain body 70. This may make it easier to fit the drain body to the bath. The drain body may comprise a waste pipe portion 76 configured to connect an upper part of the drain body 70.

[0066] The drain body 70 may include at least one thread 72, and preferably several threads 72 to interact with other threaded portions. For example, a nut 101 with threading 102 may screw onto an outer thread 72 on the drain body. The nut 101 may be useful for keeping the drain body in position as the nut 101 can be positioned just below the base 110 of the bath surrounding the drain aperture. The nut 101 may be particularly useful in that

different baths generally have different thicknesses, and so the nut 101 can be tightened (or loosened) to clamp around the bath for a range of bath styles/thicknesses. The drain body 70 may include a lip 75 which sits on a surface of the bath surrounding the aperture. The drain body 70 may comprise a portion 77 configured to support the automated device 40. The drain body 70 may comprise a sensor supporting portion 78. A further nut 103 may be provided with threaded portion 104 in order to connect an upper and lower part of the drain body which may include threading 74. The drain body may comprise protrusion 71 which is configured to interact with other parts of the assembly 1 as described below.

[0067] The drain body 70 may be formed of any appropriate material. The drain body 70 may be impervious to water, i.e. waterproof. The drain body may be formed of plastic, e.g. a thermoplastic.

[0068] During manual operation, the mechanism 10 is configured to allow a user to manually move the first member 11 from the first position to the second position or from the second position to the first position. Specifically, as described above, the mechanism 10 allows relative movement between the first member 11 and the second member 12. In general, manual operation involves the user pressing on an uppermost part of the assembly 1 (e.g. the cover 60 as described below, or the sealing module 20 if the cover 60 is not present).

[0069] When the assembly 1 is in the orientation as shown in figure 2A and 2B, the user may press downwards on the cover 60 (as indicated by the arrow). More generally, during manual operation, the user presses the sealing module 20 (optionally via the cover 60) towards the second member 12. During manual operation, the position of the second member 12 is fixed. Thus, the second member 12 is prevented from substantial movement. This means that movement of the first member 11 changes position of the first member 11 relative to the second member 12. The position of the second member 12 may be fixed in a number of different ways. For example, the assembly 1 may comprise at least one mating part and/or protrusion which prevents rotation of the second member 12. The automated device 40 may prevent movement of the second member 12 when the automated device 40 is not in operation (i.e. during manual operation). The automated device 40 may restrict movement of the second member 12 to a linear direction parallel to and optionally aligned with the direction of movement of the first member 11.

[0070] As the position of the second member 12 is fixed, the force applied (directly or indirectly) to the sealing module 20 moves the sealing module 20 and the first member 11 relative to the second member 12. As the user presses on the cover 60, the cover 60, sealing module 20 and first member 11 are moved in the same direction as the force applied by the user (i.e. in the direction of the arrow in figure 2A. When the first member 11 is pushed as far as it will go and the user removes the applied force, the first member 11 will remain in the second

position, as shown in figure 2B. The mechanism is in the second configuration when the first member is in the second position as shown in figure 2B. If the user applies a manual downward force again to the assembly 1 in the second configuration shown in figure 4B, the first member 11 will move from the second position back of figure 2B to the first position of figure 2A. In further detail, the first member 11 will move a small distance in the direction of the applied force, i.e. towards the second member 12, such that the mechanism releases the first member 11 so that it can move upwards, away from the second member 12 back to the first configuration shown in figure 2A.

[0071] In another operation mode, the automated device 40 may be configured to operate the assembly 1. Specifically, the automated device 40 may be configured to provide a force to move the second member 12. As described below, movement of the second member 12 can be used to open and close the seal 21.

[0072] The automated device 40 may comprise a leadscrew 43 and a motor 46, for example as shown in figures 3A, 3B and 3C. The motor 46 may be a low voltage DC motor. The motor 46 is configured to rotate to move the leadscrew 43. The leadscrew 43 is configured to move in a linear direction as indicated by the arrow in figure 3B. The leadscrew 43 may be configured to move in the same direction as the first member 11 (or at least parallel to the linear direction of movement of the first member 11). The leadscrew 43 is preferably configured to move along the same axis as the direction of movement of the first member 11.

[0073] The automated device 40 may further comprise gears configured to translate rotational motion of the motor 46 to linear motion of the leadscrew 43. The linear movement of the leadscrew 43 is orthogonal to an axis about which the motor 46 rotates. For example, the automated device 40 may comprise a worm gear 44 (which may be referred to as a first gear) attached to a rotating part of the motor 46. Thus the worm gear 44 rotates in the same direction as the rotating part of the motor.

[0074] The automated device 40 may comprise a worm wheel 45 (which may be referred to as a second gear) configured to interact with the worm gear 44 and the leadscrew 43. Rotation of the motor is configured, via the worm gear 44 and the worm wheel 45, to move the leadscrew 43 in the linear direction. Rotation of the motor in a first direction (e.g. clockwise) may lead to the leadscrew 43 moving in an upwards direction, i.e. towards the first member 11. Rotation of the motor in a second direction opposite to the first direction (e.g. anti-clockwise) may lead to the leadscrew 43 moving in a downwards direction, i.e. away from the first member 11. Of course, the relative movement of the motor and the leadscrew 43 could be set up as desired, for example such that clockwise rotation of the motor leads to downwards movement of the leadscrew 43.

[0075] In further detail, when the rotating part of the motor 46 rotates, the worm gear 44 rotates as indicated by the arrow shown in figure 3C. Teeth of the worm gear

45 interact with teeth of the worm wheel 44. Thus, the worm gear 44 and the worm wheel 45 interact and rotation of the worm gear 44 rotates the worm wheel 45. The worm wheel 45 has an inner thread which interacts with the thread 48 of the leadscrew. The leadscrew is prevented from rotating, for example, due to the connection with the connector portion. Thus, rotation of the worm wheel 45 moves the leadscrew 43 in a linear direction (i.e. up or down as shown in the figures) depending on the direction of rotation of the worm wheel 45. The direction of movement of the leadscrew 43 is along the same axis as the axis of rotation of the worm wheel 45.

[0076] The automated device 40 is connected to the second member 12. The automated device 40 may be connected directly or indirectly to the second member 12. Specifically, the leadscrew 43 may be connected to the second member 12 such that the second member 12 and the leadscrew 43 move together.

[0077] The leadscrew 43 may be indirectly connected to the second member 12, i.e. another component may be provided between the leadscrew 43 and the second member 12. The automated device may be connected to the second member via a connector portion 41, for example, as shown in figure 1A. Even so, the second member 12 and the leadscrew 43 are configured to move together. In other words, the leadscrew 43 and the second member 12 are fixed relative to each other during normal use.

[0078] A connector portion 41 may be provided to connect the leadscrew 43 and the second member 12. The connector portion 41 may be directly connected to the second member 12 such that they are in contact. For example, the connector portion 41 may have a first connector thread 42 and the second member 12 may have a second member thread 14. The first connector thread 42 and the second member thread 14 may be configured to fit together, i.e. in direct connection with each other. Thus, the first connector portion 41 may be connected to the second member 12 by screwing the first connector portion 41 onto an end of the second member 12.

[0079] The connector portion 41 may be directly connected to the leadscrew 43 such that they are in contact. For example, the connector portion 41 may have a second connector thread 47 which may interact with the leadscrew thread 48. The second connector thread 47 and the leadscrew thread 48 may be configured to fit together, i.e. in direct connection with each other. Thus, the connector portion 41 may be connected to the leadscrew 43 by screwing the connector portion 41 onto an end of the leadscrew 43.

[0080] It will be noted that the leadscrew thread 48 may be uniform along the length of the leadscrew 43, for example as shown in the figures. However, this is not a necessity and different portions of threading could be provided along the length of the leadscrew 43. For example, a top portion of the leadscrew thread 48 configured to connect to the connector portion 41 may differ from a lower portion of the leadscrew thread 48 configured to

interact with the worm wheel 45. The different portions may have different shape and/or sizes of thread.

[0081] Although the connector portion 41 is shown in the figures, the automated device 40 could be provided without the connector portion 41. The leadscrew 43 could be directly connected to the second member 12. For example, the leadscrew 43 could be directly connected to the second member 12. Thus, the leadscrew 43 and the second member 12 could be in contact with each other and may be attached in any appropriate way, e.g. using corresponding threads and/or adhesive and/or welding. The second member 12 and the leadscrew 43 could be formed as an integral component. In other words, part of the mechanism 10 could be integrated into the leadscrew 43.

[0082] The automated device 40 is configured to receive user input. The automated device may receive user input wirelessly. The automated device may comprise a receiver configured to receive signals corresponding to the user input. For example, the user input may be received from a remote control or app or control device, such as those which recognise voice commands (e.g. Google or Amazon Alexa). The automated device may comprise a controller (not shown), e.g. comprising some form of computer processor, configured to operate the assembly based on the received signals. The controller may be used to provide input signals to the motor 46 which rotates based on the controller input.

[0083] The automated device 40 is configured to operate the assembly 1 to open or close the drain depending on the user input. The automated device 40 opens the drain by moving the first member 11 from the second position to the first position. The automated device closes the drain by moving the first member from the first position to the second position. More specifically, the automated device 40 moves the second member 12 so as to move the first member from the first position to the second position or from the second position to the first position. As the automated device 40 is connected to the second member 12, movement of the automated device moves the second member 12 as described above.

[0084] The automated opening and closing of the seal will be described in relation to figures 4A to 4F.

[0085] In figure 4A, the first member 11 is in the first position and the drain is open. As can be seen, there is a gap between the seal 21 and the top of the drain body 70 which allows liquid to pass through the drain aperture. In this position, the mechanism 10 is in the first configuration. If there is no user input and no input from the automated device 40, the assembly 1 will stay in the position as shown in figure 4A. It is noted that the configuration shown in figure 4A is the same as in figure 2A and the assembly 1 could be operated manually (as described above) and/or automatically (as described below).

[0086] When the drain is open (as shown in figure 4A), if a signal is received by the automated device 40 from the user that the drain should be closed, the automated

device can be used to close the drain. Starting from figure 4A, the motor 46 moves the leadscrew 43 upwards (in the direction of the arrow in figure 4A). As discussed above, the upwards movement of the leadscrew 43 also means upwards movement of the second member 12, which can be seen in figure 4B.

[0087] The upwards movement of the first member 11 is limited in the configuration shown in figures 4A and 4B. This represents an uppermost position of the first member 11 (and thus, the seal 21). As the second member 12 is moved upwards, the position of the first member 11 is maintained. As shown in figures 4A and 4B, the second member 12 is moved upwards, but the position of the first member 11 is the same. Therefore, the second member is pushed towards the first member, and the mechanism is pushed out of the first configuration in figure 4A.

[0088] The first member may be connected to a part which limits the upwards movement of the first member to define the uppermost position. As shown in figure 2B, a hair trap 26 is provided which is connected to the seal body 22 and/or first member 11. An end 25 of the hair trap 26 interacts with protrusion 71 of the drain body 70. The end 25 of the hair trap 26 may be a radially outermost portion of the hair trap 26. The protrusion 71 limits movement of the first member 11. In particular, the protrusion 71 limits the first member 11 from moving upwards, i.e. away from the second member 12 in the linear direction and/or along the axis. Using the hair trap to limit movement of the first member 11 is beneficial in that the hair trap can provide multiple functions. However, the sealing module 20 and/or first member 11 may have any appropriate portion configured to interact with the protrusion 71 of the drain body 70 to limit movement of the first member 11. Either way, the protrusion 71 prevents the first member 11 from moving away from the second member 12 when the automated device 40 is operating to push the second member 12 upwards.

[0089] Thus, as the automated device 40 works to move the second member 12 upwards, the position of the first member is maintained and the second member 12 is moved to increase overlap with the first member 11. This means that the first member 11 is pushed within the second member 12 (although the first member 11 could alternatively be on the outside of the second member 12). The second member 12 can be pushed upwards to reach the end of the available movement. Thus, the protrusion allows the automated device to engage the mechanism 10 so that it is in the second configuration.

[0090] At this point, the direction of movement of the motor 46 is swapped. In other words, once the mechanism 10 is engaged, the direction of the motor 46 is reversed. Thus, the motor rotates in the opposite direction to lower the leadscrew 43 as indicated by the arrow in figure 4C. As the second member 12 is connected to the leadscrew 43, the second member 12 moves downwards due to the movement of the automated device 40. At this point, the mechanism is in the second configuration (i.e.

it is compressed as shown in figure 4C). As the mechanism is in the second configuration, the relative position between the first member 11 and the second member 12 is maintained as the second member 12 is moved downwards. Thus, the first member 11 is also moved downwards at the same rate as the second member 12 (and the leadscrew 43). The first member 11 is therefore moved to the second position. As the seal 21 is connected to the first member 11, the seal 21 moves downwards also into the aperture of the drain, thus closing the drain as shown in figure 4C.

[0091] The automated device may continue moving the leadscrew downwards until the leadscrew reaches a bottom casing 49. This may prevent the leadscrew 43 from moving further in the downwards direction. This corresponds to when the first member 11 is in the second position and the drain is closed, as shown in figure 2C. The bottom casing 49 may be a part of the drain body configured to house the automated device 40 or it may be a part of the automated device 40 configured to prevent further movement of the leadscrew 43. Instead of bottom casing 49, a protrusion could be used to stop the leadscrew 43. Alternatively or additionally, the drain body 70 could provide a protrusion which could interact with the second member and/or the connector portion to establish an end of available motion for the second member 12. The positioning of any such protrusion should be selected such that the seal 21 can be within the aperture to seal the drain when the second member 12 is at the lowest available position.

[0092] When the drain is closed (as shown in figure 4D), if a signal is received by the automated device 40 from the user that the drain should be opened, the automated device 40 can be used to open the drain. As will be noted, the position of the components of the assembly is the same in figure 4D and in figure 4C. Starting from figure 4D, the mechanism 10 is in the second configuration. The motor 46 moves the leadscrew 43 upwards (in the direction of the arrow in figure 4D). As discussed above, the upwards movement of the leadscrew 43 also means upwards movement of the second member 12, which can be seen in by figures 4D and 4E.

[0093] As the mechanism is in the second configuration, the position of the first member 11 and the second member 12 is maintained relative to each other as the second member 12 is moved upwards, i.e. there is no relative movement between the first member 11 and the second member 12. This is shown by figures 4D and 4E in which the first member 11 remains in the same position relative to the second member 12. Thus, as the second member 12 is moved upwards, the first member 11 is moved upwards with the second member 12 (and the leadscrew 43). The first member 11 is therefore moved to the first position as shown in figure 4E. As the seal 21 is connected to the first member 11, the seal 21 also moves upwards out of the drain aperture, thus opening the drain as shown in figure 4E.

[0094] When the first member 11 reaches the upper-

most position of the first member (as shown in figure 2E), further movement upwards of the first member 11 is restricted. Specifically, the end 25 of the hair trap 26 interacts with protrusion 71 to limit further upwards movement of the first member 11, i.e. in the first direction, with the second member 12. As described above, the protrusion could additionally or alternatively interact directly with the first member 11 and/or the sealing module 22. Either way, the protrusion 71 prevents the first member 11 from moving further upwards.

[0095] Thus, as the automated device 40 works to move the second member 12 further up, the position of the first member 11 is maintained. The second member 12 can be pushed upwards to reach the end of the available movement. This results in relative movement between the second member 12 and the first member 11 to further compress the mechanism 10 by increasing the overlap between the first member 11 and the second member 12. This releases the position of the first member 11 relative to the second member 12 such that the mechanism is released from the second configuration.

[0096] At this point, the automated device 40 could stop as the drain has been opened. However, if the assembly 1 is manually operated in this configuration, then the first member 11 would only be pushed down to the position shown in figure 4E, which would not close the drain. Therefore, to allow for manual operation, the automated device 40 takes the further step of moving the second member 12 down in the direction of the arrow shown in figure 4E. As the mechanism 10 is released from the second configuration at this point, as the second member 12 is moved down, the second member 12 moves relative to the first member 11 towards the extend position.

[0097] The automated device 40 may continue moving the leadscrew 43 downwards until the leadscrew 43 reaches the bottom casing 49. The configuration of the assembly 1 is shown in figure 4F, in which the leadscrew 43 reaches the bottom most position available. In this position, the mechanism is in the first configuration and the first member 11 is in the first position, which provides a gap between the seal 21 and the drain aperture. Thus, the drain is still open in the position shown in figure 4F whilst also allowing for manual operation of the assembly should that be desired.

[0098] In summary, the protrusion acts to prevent the first member from moving away from the second member, namely upwards, beyond the first position, namely the uppermost position of the first member. Thus, during operation, whether manual or automatic, the first member cannot move to a position beyond the first position. By restricting movement of the first member in this way, it is possible to provide both the manual operation and the automatic operation, in particular such that whichever of the manual operation and automatic operation was conducted previously, either of the manual operation and the automatic operation may next be performed irrespective of whether the first member is in the first position or the

second position.

[0099] With the first member in the first position and the mechanism in the first configuration, the automated device may move the second member towards the first member whilst the position of the first member is maintained in the first position by the protrusion until the mechanism reaches the stable second configuration. The automated device may then move the second member in the opposite direction, namely downwardly. The mechanism is in the stable second configuration and so the first member is moved by the automated device similarly in the downward direction until the drain is sealed. In this state, of course, manual operation may be performed so as to release the mechanism from its stable second configuration such that the first member moves upwardly away from the second member to the stable first configuration and the drain is opened. Alternatively, the automated device may be used to move the first member to the first position so as to open the drain. In particular, the automated device moves the first member and the second member together in the stable second configuration upward until the first member reaches the first position. Because the first member is prevented from moving beyond the first position by the protrusion, movement of the second member by the automated device upwards towards the first member causes the mechanism, namely the relative positions of the first and second member, to be compressed such that the stable second configuration of the mechanism is released. When the automated device then moves the second member downwardly away from the first member, the mechanism extends until the mechanism reaches the stable first configuration with the first member still in the first position.

[0100] As mentioned above, sensors may be used to determine the location of at least one component of the assembly (e.g. the sealing module and/or the first member) in order to determine the operation state of the assembly (i.e. whether the drain is open or closed). As the assembly 1 offers manual and automatic operation, it is beneficial to detect whether or not the drain is in the open or closed state. In this way, the automated device can determine whether or not it is necessary to move any components based on the user input. For example, if the drain is sealed and a user instructs the assembly to close the drain using the automatic mechanism (e.g. if the user is remote and does not know that the drain is already sealed), the assembly 1 can determine the operation state from the sensors and would determine that it is not necessary to move any of the components because the assembly 1 is already in the desired state.

[0101] The sensors 81, 82 may be attached to a part of the drain body 70, e.g. to the sensor supporting portion 78 on an outside of the drain body 70. The sensor supporting portion 78 may have a recess for each of the sensors in the wall of the drain body 70. This may be advantageous in effectively using the space available and to keep the sensors in place. A moving part of the assembly, e.g. connected to the first member 11 and/or

the cover 60, may comprise a sensing portion 28 which can be sensed by at least one of the sensors 81, 82. The sensing portion 28 may generally be moved up and down such that when in an upper position, the sensing portion 28 is aligned with an upper sensor 81 and when in a lower position, the sensing portion 28 is aligned with a lower sensor 82.

[0102] For example, the sensors 81,82 may be hall sensors and the sensing portion 28 may comprise a magnet. Thus, a magnet may be attached to the first member 11 and/or the cover, and may pass between two sensors. As the magnet moves up and down with the first member 11, the hall sensors 81, 82 will have a change in voltage as the magnetic field is changed by movement of the magnet. The change in voltage can be sent as an electronic signal to the automated device 40. The controller (or any appropriate circuit or processor) of the automated device 40 may determine the position of the magnet, and thus the first member 11, based on the received signal.

[0103] Other types of sensor may be used instead. For example, two infrared sensors may be positioned on an internal surface of the drain body and may be configured to determine the position of the sensing portions. Although two sensors are shown in the figures, only a single sensor may be provided. Alternatively, more than two sensors could be provided.

[0104] In the embodiments and variations described above, the automated device 40 comprises a motor, a leadscrew and multiple gears to move the second member 12. Overall, the rotation of part of the motor 46 results in rotation of an interim gear (the worm wheel 45), which interacts with the leadscrew 43 to move the leadscrew up and down. Alternative types of automated device may be used instead. Any automated device may be used which can provide a force to move the second member 12 in the linear direction as described. Alternative automatic devices are described below and are interchangeable with the automatic device 40 described above.

[0105] In a variation of the above, the leadscrew 43 may be connected to the rotating part of the motor 46 as shown in figures 5A, 5B and 5C. This means that the leadscrew 43 may be connected to, attached, or integral with a rotating part of the motor 46. Thus, the leadscrew 43 may rotate as the motor rotates. The leadscrew 43 may interact with the second member 12 to move the second member 12. Rotation of the leadscrew 43 may move the second member 12 in a linear direction. In this instance, the leadscrew 43 is connected to the second member 12 via a connector portion 40 with a threaded portion 35 which translates rotation of the leadscrew into linear motion of the second member up or down as indicated by the arrows in figures 5B and 5C.

[0106] When the leadscrew 43 rotates, the outer thread 48 of the leadscrew 43 engages with an internal thread of the threaded portion 35 which results in linear motion of the threaded portion 35 (i.e. up or down in Figs 5A, 5B and 5C). The threaded portion 35 may be connected to, attached, or integral with the connector portion 40. The

threaded portion 35 may be attached to the connector portion 40 in any appropriate way, e.g. using any appropriate adhesive or bonding technique. Preferably, the threaded portion 35 is connected to, attached, or integral with the connector portion 40 in such a way that these components are fixed to each other (i.e. there is no relative movement between the threaded portion 35 and the connector portion 40). Thus, as the leadscrew 43 rotates, the interaction with the threaded portion 35 results in the connector portion 40, and thus the second member 12, moving in the linear direction of the arrows in figures 5B and 5C. This variation may be beneficial because the automated device uses fewer components to provide a simpler assembly.

[0107] If the threaded portion 35 and the connector portion 40 are separate components, they may be the same material, e.g. metal or plastic. The threaded portion and the connector portion 40 may be different materials. For example, the threaded portion 35 may be a metal, such as brass, and the connector portion 40 may be plastic.

[0108] In a variation of the above, the automated device 40 comprises a solenoid device configured to move the second member 12 in a linear direction. In this case, the solenoid device would replace the whole leadscrew and motor assembly described above. The second member 12 may be connected to a movable electromagnet. The automated device 40 may comprise a coil of wire surrounding at least part of the electromagnet to form a magnetic field to move the electromagnet in a linear direction. The second member 12 may be connected to the electromagnet, directly (e.g. without any interim components such the threaded portion 35) or indirectly. The second member 12 may be connected to the electromagnet such that when the electromagnet moves in a linear direction, the second member 12 also moves in a linear direction. In this instance, the electromagnet may move along a main axis (i.e. a longitudinal axis through the solenoid, e.g. through the electromagnet) which may be aligned with a main axis of the second member 12. In this instance, there may be a fixed connection between the electromagnet and the second member 12. For example, the second member may be connected to the electromagnet using an adhesive, or welding for example. The second member may be connected to the electromagnet in any appropriate way. When an electromagnet is used as part of the automation device, it may be beneficial for any sensors which may be used to rely on detecting something other than the magnetic field to avoid the sensors being affected by the solenoid.

[0109] Other types of automated device may be appropriate for use in the above embodiments, so long as they can provide linear movement of the second member 12.

[0110] The cover 60 may be provided for covering the drain. The cover 60 also covers the other components of the assembly when in position. When in use, the cover 60 may be the only part of the assembly 1 which is readily visible to the user, especially when the drain is closed (in

which case the cover 60 is normally in a lower position). The cover 60 may be an uppermost part of the assembly 1. The cover 60 is generally the part which the user can contact to apply a force to the assembly 1.

[0111] Preferably the cover 60 is rigid. Thus, the cover 60 preferably does not deform when the user applies a force via the cover 60 to move parts of the assembly 1, or when a user steps on the cover 60 (for example if the assembly 1 is used for a bath drain in a combined bath and shower). For example, the cover 60 may be metal. For example, the cover 60 may be injection moulded plastic or die cast. Having a die cast cover may be preferable as it may provide an improved feel for a user. However, any appropriate material may be used.

[0112] Preferably, the cover 60 is larger in plan than the drain, and particularly the aperture of the drain. This is beneficial in effectively concealing the drain, particularly when the drain is closed. Preferably the cover 60 is larger in plan than the seal 21. This is beneficial in effectively concealing the seal 21. Additionally, this is beneficial in that the cover 60 may protect the seal 21 from being damaged during normal use because the cover may reduce unintentional user interaction with the seal 21. Additionally, it generally looks better aesthetically with all the internal components hidden by the drain cover.

[0113] A close up of the cover 60 and sealing module 20 is shown in figure 6. During normal use, the cover 60 and sealing module 20 may be positioned as shown in figure 7A when the drain is open and in figure 7B when the drain is closed. Generally, the cover 60 and sealing module 20 can be moved from an upper position in figure 7A (which corresponds to when the first member is in the first position as described above) to a lower position in figure 7B (which corresponds to when the first member is in the second position as described above). Thus, the drain can be closed as the cover 60 and sealing module 20 are moved lower. As already described, this can be done in an automated mode. In such an automated mode, the user may not be present to check the drain as the assembly 1 is operated. However, some sort of physical obstruction may be in the way upper part of the assembly 1, i.e. the cover 60. Examples of such an obstruction might be fingers or bathroom accessories in a bath. If an object is in the way, this could prevent the drain from being properly closed. Even worse still, the closing of the drain might damage the assembly or the object. Rather than force the cover 60 to lower, which could damage the object causing the obstruction and/or the drain assembly, the cover 60 can be released from the assembly.

[0114] When connected, the sealing module 20 and cover 60 are configured to move together in a linear direction as described above. However, the cover is automatically detaches from the sealing module 20 if an obstacle obstructs the movement of the cover 60. Thus, the cover 60 is configured to automatically detach from the sealing component. In other words, the cover 60 can detach from the sealing module 20 without any user input.

[0115] This is beneficial in that the cover 60 releases from the sealing module 20 when the assembly is moved to a different configuration if there is some form of obstruction in the way, for example as shown in figure 7C. Thus, if an obstacle obstructs movement of the cover 60 during normal use, the cover 60 detaches from the sealing module 20. As the seal 21 is connected to the sealing component 20, the seal 21 can still be used to close the drain, even if the cover 60 detaches. This allows the sealing module to seal the drain despite the obstruction.

[0116] Preferably the seal 21 is the outermost part of the seal module 20. As the seal 21 has some flexibility, it is less likely to be damaged by, or cause damage to the obstruction. Furthermore, as the seal 21 is generally radially inwards of the cover 61, the obstruction is less likely to be in the way of the seal 21 even when the obstruction is in the way of the cover 60.

[0117] The cover 60 and the sealing module 20 are releasably connected to each other. This means that the cover 60 and sealing module 20 are connected in normal use, but can also be detached from each other either of the cover 60 or sealing component 20. The cover 60 and sealing module 20 can be attached, detached and reattached by the same connection mechanism, some examples of which are described below. The cover 60 and sealing module 20 are configured to connect to each other and also to release each other. The cover 60 is configured to disconnect from the sealing module 20 without user interaction as described above. Once the obstruction is removed, preferably the cover 60 connects back on the sealing module 20 in the same position as before it was removed.

[0118] As well as providing the above described improvement in safety, the releasably attached cover 60 can also be more easily exchanged with affords greater design freedom to the user. This is beneficial in that it allows a user to pick between different types of cover 60. For example, a user may select the size, shape, style, colour and/or material of the cover 60. This may depend on aesthetic preference and/or on practical preference.

[0119] Preferably, the assembly 1 is configured to promote reattachment of the cover 60 and sealing module 20 when detached. Preferably the mechanism by which the cover 60 and the sealing module 20 are connected is also configured to apply a force to move the cover towards the sealing module when detached.

[0120] The assembly 1 may comprise an attachment portion configured to releasably attach the cover 60 and the sealing module 20. The assembly is configured to attach the cover 60 and sealing module 20 via the attachment portion. The attachment portion is reusable. Thus, the attachment portion can continue to releasably attach the cover 60 and the sealing module 20 after the cover 60 and sealing module 20 are detached from each other. Thus, the attachment portion is not generally damaged during normal use in which the cover 60 is attached or detached from the sealing module 20. The attachment portion may be configured to maintain a connection be-

tween the cover 60 and sealing component 20 when the cover 60 is detached. Various different types of attachment portion may be used, for example, including those described in further detail below.

[0121] The attachment portion may comprise magnets, for example as shown in figures 7A, 7B and 7C. For example, the assembly 1 comprises a first magnet 51 attached to the sealing module 20 and a second magnet 52 attached to the cover 20. The magnets 51, 52 may be positioned on surfaces of the cover 60 and sealing module 20 which face each other. A lower surface 61 of the cover 60 may face an upper surface 31 of the sealing module 20. The sealing module 20 may comprise a slot 30 on the upper surface 31 in which one of the magnets 51 can be positioned. The cover 60 may comprise a slot 62 on the lower surface 61 in which one of the magnets 52 can be positioned. The magnets 51, 52 are beneficial in keeping the cover 60 in place to releasably attach the cover to the sealing module 20. The magnets also allow the cover 60 to automatically detach from the sealing module 20 when a force due to the obstruction is greater than the attractive force between the magnets 51, 52. The magnets are also beneficial in that the magnets are configured to pull the cover and sealing module towards each other after the cover is removed, i.e. to promote reattachment of the cover 60 and the sealing module 20 when detached. This increases the likelihood that the cover 60 will be maintained in a preferred position on the top of the assembly after an obstruction is no longer in the way. Although the figures show one magnet for the cover 60 and one magnet for the sealing module 20, any appropriate number of magnets could be used. Alternatively, instead of having magnets attached to the cover 60 and/or sealing module 20, the cover 60 and/or sealing module 20 could be made of magnetic material.

[0122] Additionally or alternatively, the attachment portion may comprise a spring connected to the cover 60 and the sealing module 20. This is beneficial in allowing the cover 60 to move away from the sealing module 20 by extending the spring when the force due to the obstruction is greater than the force needed to stretch the spring. The spring may also apply a force to pull the cover back to the appropriate position on the sealing module 20. Thus, the spring may promote reattachment.

[0123] Additionally or alternatively, the attachment portion may comprise an elastic connector connected to the cover 50 and the sealing module 20. This is beneficial in allowing the cover to move away from the sealing module by stretching the elastic connector. The spring may also apply a force to pull the cover 60 back to the appropriate position on the sealing module 20. Thus, the spring may promote reattachment.

[0124] Additionally or alternatively, the attachment portion may comprise mating parts on the cover 60 and the sealing module 20. For example, the cover and sealing module may have parts which click or snap fit into place to maintain the position of the cover 60 on the sealing module 20. For example, at least one or both mating por-

tions may comprise a clip, e.g. that pops in and out of position. In this case, the mating portions may be pressed into position so that the clips engage with each other but release when pulled apart. At least one of the mating portions may comprise small bumps that engage with a clip and hold the cover 60 in place in normal use. This is beneficial in allowing the cover to automatically detach when the obstruction causes the parts to unclip (or otherwise detach). Such fastening means allows the cover 60 and sealing module 20 to be clicked back into place again, and thus, reattached.

[0125] The magnets may be the most preferred option as they allow the cover 60 to be more easily exchanged as there is no physical connection member between the cover 60 and the sealing module 20. Additionally, the spring or elastic connector or mating parts may become clogged with dirt from the waste water in the drain. However, overall, it is noted that there are various different connection mechanisms which could be used to attach the cover 60 to the sealing module 20. It may even be beneficial to use two different types of attachment portion, to improve the connection between the cover 60 and sealing module 20 and assist in promoting reattachment of the cover 60 and sealing module 20 when detached.

[0126] The cover assembly may comprise any or all of the features described above in relation to the drain assembly. Although the cover is shown in various figures in combination with other features of the assembly, a separate assembly could be provided with only the cover and the sealing module 20 as described herein. Thus, the cover assembly could be provided separately to other parts of the assembly described above. In this way, the cover assembly (comprising the cover and sealing module) could be fitted to other drain devices.

[0127] For example, the cover assembly may be used on other drain assemblies which provide manual and automatic operation, i.e. drain assemblies which function in different ways to the drain assembly described in relation to figures 1 to 5C.

[0128] For example, the cover assembly may be used on a manual drain assembly, i.e. without any automated parts. The cover assembly could be retrofitted to pre-existing drain assemblies. Even for use in a manual system, the cover assembly is beneficial in reducing the effects of obstruction of the cover 60 being pushed down, e.g. if the user has not noticed an object is in the way of the cover 60. Furthermore, the cover assembly being used in a manual drain assembly still provides the user with the option of easily swapping out different covers. Thus, the covers will be interchangeable which provides greater design freedom to the user.

[0129] For example, the cover assembly may be used on an automatic drain assembly, i.e. an assembly not configured for manual operation. This would still be particularly useful for preventing the cover from being lowered during automated operation when there is an obstruction.

[0130] The cover provided with the main drain assem-

bly described in relation to figures 1 to 5C is preferably the removable cover as described herein in relation to figures 6 to 7C. However, other types of cover 60 can be provided with the main drain assembly, or even no cover at all. It is preferred to include some form of cover positioned over the drain aperture to cover the seal 21 and the drain. However, this could be fixedly connected to other parts of the drain assembly such as the sealing module 20. Thus, the cover could be a known cover which may be attached by a thread to the sealing module 20.

[0131] In general, when the assembly 1 is in situ, it will be understood that at least part of the assembly 1 is exposed for operation by the user. Thus, the user can apply a force directly to the exposed part of the assembly 1. The exposed part of the assembly will normally be the sealing module 20 or cover 60, depending on whether or not the cover 60 is provided. When the drain is open, the cover 60 (if present) and at least the part of the sealing module 20 comprising the seal 21 may be positioned above the drain. For the most part, the remaining components of the assembly 1 may be positioned below the drain aperture, i.e. below the appliance in which the drain is provided, e.g. below the bath or sink.

[0132] It is described above that some components are fixed relative to each other, e.g. the leadscrew 43 and the second member 12 in figure 1A. It is noted that these components may be removably fixed to each other, i.e. fixed during normal use of the assembly. However, the components may be separated, e.g. by unscrewing the corresponding threads, for other reasons, e.g. during repair.

[0133] The first member 11 may move along the first direction, which may correspond to the longitudinal axis of the first member 11. The second member 12 may move along the same axis. The sealing module 20 may move along the same axis. Alternatively, sealing module 20 may move along an axis which is offset, i.e. parallel to, the longitudinal axis of the first member 11.

[0134] The automated device 40 may allow predetermined settings, for example to set when the automated operation takes place. For example, the automated device 40 may be used to open the drain when an amount of liquid in the bath reaches a pre-determined level. This is beneficial in reducing or avoiding the bath overflowing. In this case, the automated device may receive a signal from a further sensor which indicates the amount of water in the bath, or the water level in the bath. In another example, the automated device 40 may be configured to have a time limit which can be set by the user, for example to open the drain after a pre-determined amount of time, e.g. one hour after the water in the bath reaches a pre-determined level. Alternatively, the automated device may be configured to operate according to a pre-set schedule, e.g. to seal and/or open the drain at a certain time and/or day.

[0135] The assembly 1 may effectively be waterproof. For example, waterproof material may be used for most of the components. Any non-waterproof components,

e.g. electrical components for use with the automated device 40 may be protected from liquid by the drain body 70 or other housing. For example, parts of the automated device 40 may be positioned outside of the main passage of the drain body 70.

[0136] It will be understood that variations may be made to the above described assemblies. Some possible variations are described in further detail below.

[0137] Although it is described that the user input is received wirelessly, the user input could instead be received via a wired system. For example, the controller may be electronically connected via wires to another computing device and may receive the user input via the wired connection. For example, the controller may be electronically connected via wires to at least one button or user interface, e.g. positioned on a wall of the bathroom, which the user could press to open and/or close the drain.

[0138] It is described above that the at least one sensor is positioned on the stationary drain body and the sensing portion is connected to the first member. However, this could be the other way around. Instead, the sensor(s) could be connected to a moving part of the assembly, e.g. the first member and/or the sealing module. In this case, the sensing portion 28 may be positioned on the stationary part of the assembly, i.e. the drain body 70.

[0139] It is described above that the end position of the second member is based on a bottom casing 49 or a protrusion from physically preventing further motion of the leadscrew 43 or other moving component. The use of at least one physical protrusions being provided as a barrier is generally preferable as it ensures that the second member is not moved too far down, e.g. in case of malfunction of the automated device 40. However, there are other alternatives. For example, the automated device 40 may be configured to process the movement of the motor 46 to determine how many rotations have occurred and compare the amount to a pre-set value. Thus, the automated device 40 may be configured to carry out a set number of rotations to move the second member 12 up and down to close and open the drain as described.

[0140] Various components are described above as having threaded portions which connect to other threaded portions. Although the threaded portions are useful for providing a reliable connection between separate components, it will be understood that the threaded portions may be replaced with any appropriate connecting part or mechanism. For example, instead of the threaded portions, any mechanical and/or mating portions may be provided to join the components together. Additionally or alternatively, other forms of connection may be used such as adhesive or welding for forming fixed connections which do not have parts which move relative to each other.

[0141] It will be noted that any part of the description above refers in some cases to the relative position or direction of movement based on the assembly when provided in situ. Thus, any parts of the description which

refers to upper, uppermost, lower, lowermost, etc. is intended to describe the assembly based in normal use in the orientation shown in the figures. The assembly may of course be provided in other alternative orientations, for example, where the uppermost component is provided as a lowermost component and vice versa.

[0142] In the above described embodiments, a cover is described as an uppermost part of the assembly. Although the cover may preferably be included for example, for aesthetic reasons, it the cover is not a necessity in the drain assembly. If the cover is not included, the user can operate the assembly 1 manually by pressing on the sealing module 20. Thus, the cover could be provided separately to the rest of the drain assembly 1.

[0143] Although the drain body is described as part of the assembly above, the assembly could be provided without the drain body. For example, the assembly could be retrofitted to an existing drain portion. In this case, the existing drain may need to be adapted to ensure there is space for the automated device, e.g. to use existing pipework if possible or to adapt existing pipework to make space for the assembly. The seal may thus be formed between the seal 21 and an edge of the drain, e.g. an edge of the bathtub or sink or other apparatus in which the assembly is provided. In this case, the electronics of the assembly could be situated within or attached to the assembly 1, and could for example, be battery powered in a waterproof enclosure.

[0144] Although the above generally refers to using the assembly in a bath, the same advantages could be achieved in other appliances, e.g. any receptacle with a drain which may be filled with liquid. Particularly if being used in combination with a smart control for filling the appliance with liquid. For example, the assemblies described above could be used in any bathroom sink or kitchen sink.

Claims

1. An assembly for sealing a drain, wherein the assembly is configured to be operated manually and automatically, the assembly comprising:

a mechanism comprising a first member and a second member, the first member being configured to move a linear direction relative to the second member to move the mechanism between a first configuration, in which the mechanism is in a stable extended state, and a second configuration, in which the mechanism is in a stable compressed state;
a sealing module comprising a seal for sealing an aperture, the sealing module being connected to the first member so as to move with the first member in the linear direction;
a protrusion configured to limit movement of the first member; and

- an automated device connected to the second member;
 wherein during manual operation, the second member is stationary and the first member is moved by a user between a first position, in which the mechanism is in the first configuration, and a second position, in which the mechanism is in the second configuration, and
 wherein during automatic operation, the automated device is configured to move the second member so as to move the first member from the first position to the second position or from the second position to the first position.
2. The assembly of claim 1, wherein the first member is configured to move in the linear direction between the first position which is uppermost and the second position which is lowermost.
 3. The assembly of claim 1 or 2, wherein when the first member is in the first position, the aperture is open, and when the first member is in the second position, the seal is configured to seal the aperture.
 4. The assembly of claim 1, 2 or 3, wherein the protrusion limits upwards movement of the first member to the first position so that, during automatic operation, as the second member is moved upwards, the position of the first member in the first position is maintained.
 5. The assembly of any one of the preceding claim, wherein the protrusion prevents the first member from moving away from the second member when the automated device is operating to move the second member upwards towards the first member.
 6. The assembly of any one of the preceding claims, further comprising a drain body configured to be positioned within a drain, wherein the drain body is configured to house the mechanism and comprises the protrusion.
 7. The assembly of any one of the preceding claims, further comprising at least one sensor configured to determine the position of the first member and/or the sealing module.
 8. The assembly of claim 10, wherein one of: the at least one sensor is positioned on the drain body; and the sensor is connected to the first member and/or the sealing module.
 9. The assembly of either one of claims 7 or 8, further comprising a magnet, wherein the at least one sensor is a hall sensor.
 10. The assembly of any one of claims 7 to 9, wherein
- there are two sensors, comprising a first sensor configured to determine when the first member is in the first position and a second sensor configured to determine when the first member is in the second position.
11. The assembly of any one of the preceding claims, wherein the automated device receives user input wirelessly from a remote control or app.
 12. The assembly of any one of the preceding claims, wherein the sealing member comprises a body which is connected to the seal, optionally wherein the body is integral with the seal.
 13. The assembly of any one of the preceding claims, further comprising:
 - a cover for covering a drain, the cover and sealing module being releasably connected to each other, wherein the cover is configured to automatically detach from the sealing component.
 14. An assembly for sealing a drain comprising:
 - a sealing module comprising a seal for sealing an aperture, the sealing module being configured to connect to a mechanism configured to control movement of the sealing module in a linear direction; and
 - a cover for covering a drain, the cover and sealing module being releasably connected to each other, wherein the cover is configured to automatically detach from the sealing component.
 15. The assembly of either one of claims 13 or 14, wherein the assembly is configured to promote reattachment of the cover and sealing module when detached and comprises an attachment portion configured to releasably attach the cover and the sealing module, preferably wherein the attachment portion comprises:
 - a) a first magnet attached to the cover and a second magnet attached to the sealing component;
 - b) a spring connected to the cover and the sealing portion;
 - c) an elastic connector connected to the cover and the sealing portion; and/or
 - d) corresponding mating portions on the cover and sealing module, preferably wherein at least one of the mating portions comprises a clip.

Fig. 1A

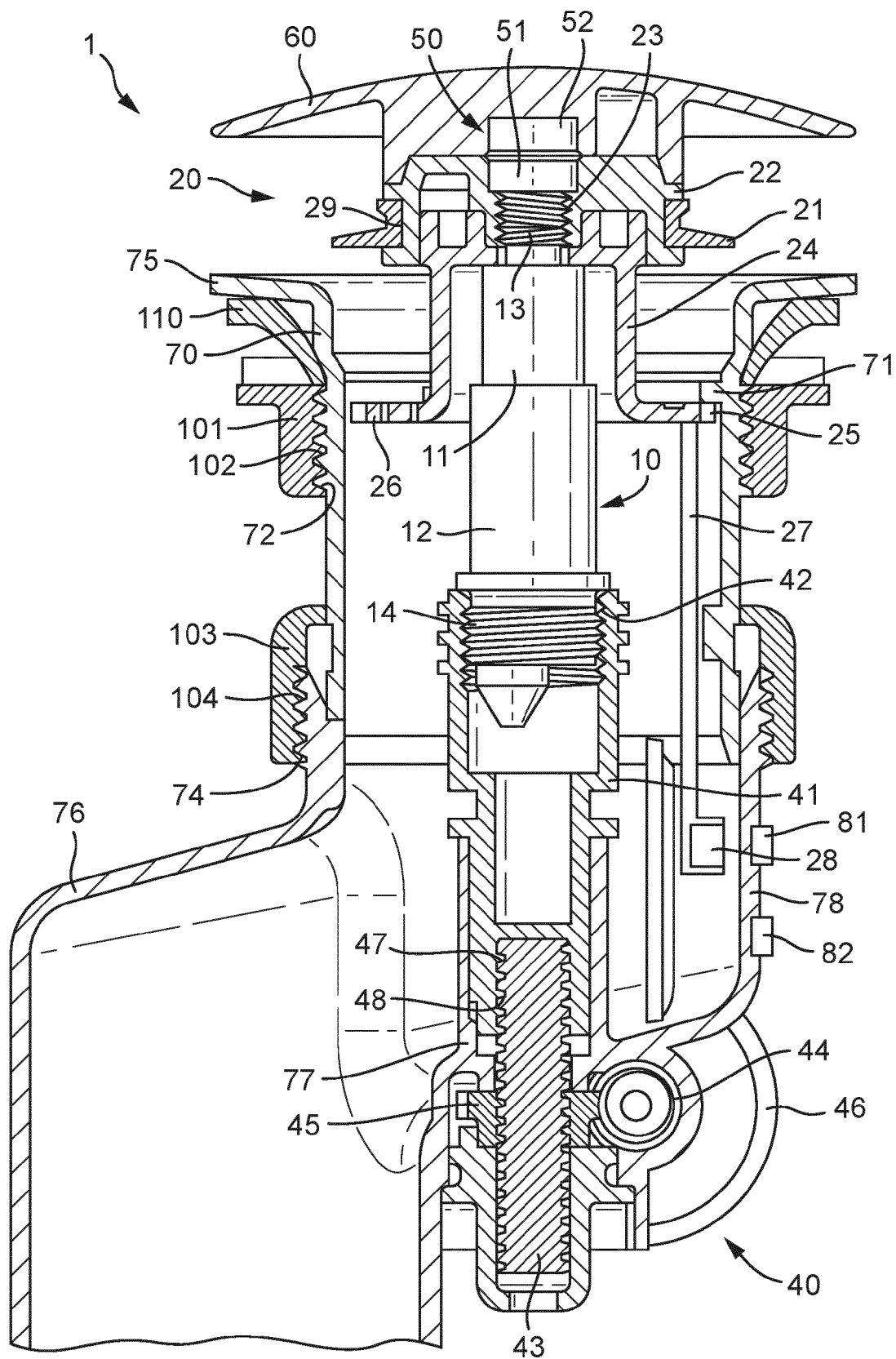


Fig. 1B

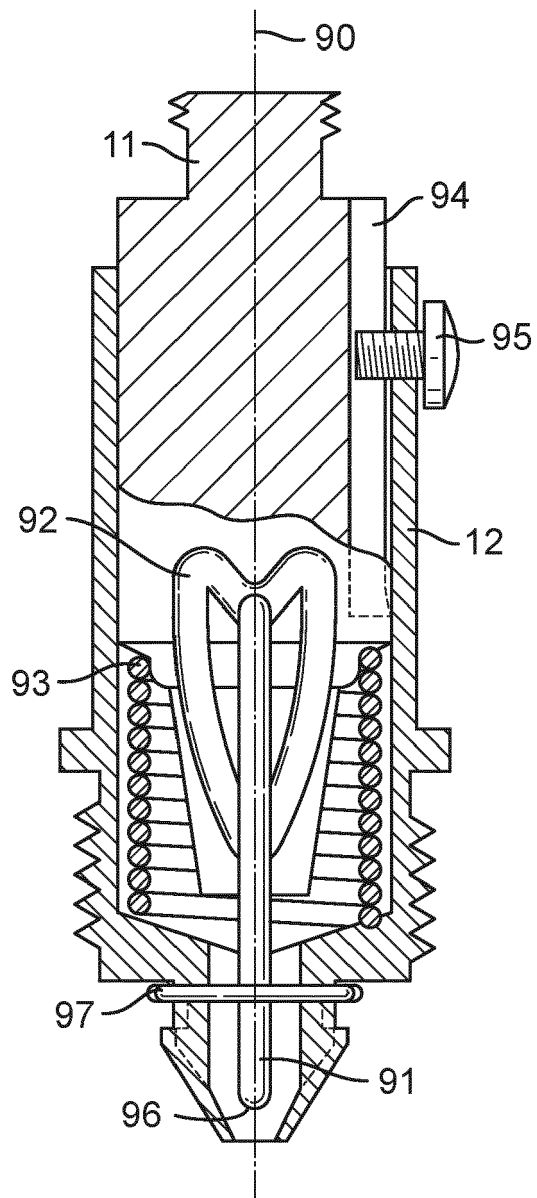
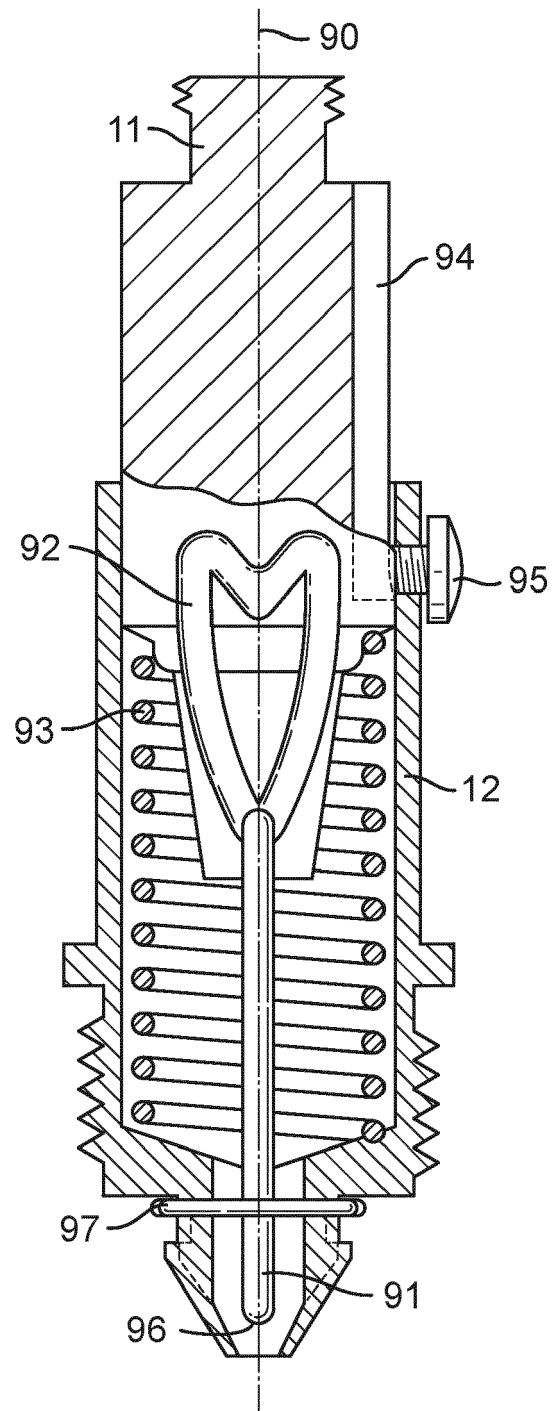


Fig. 1C



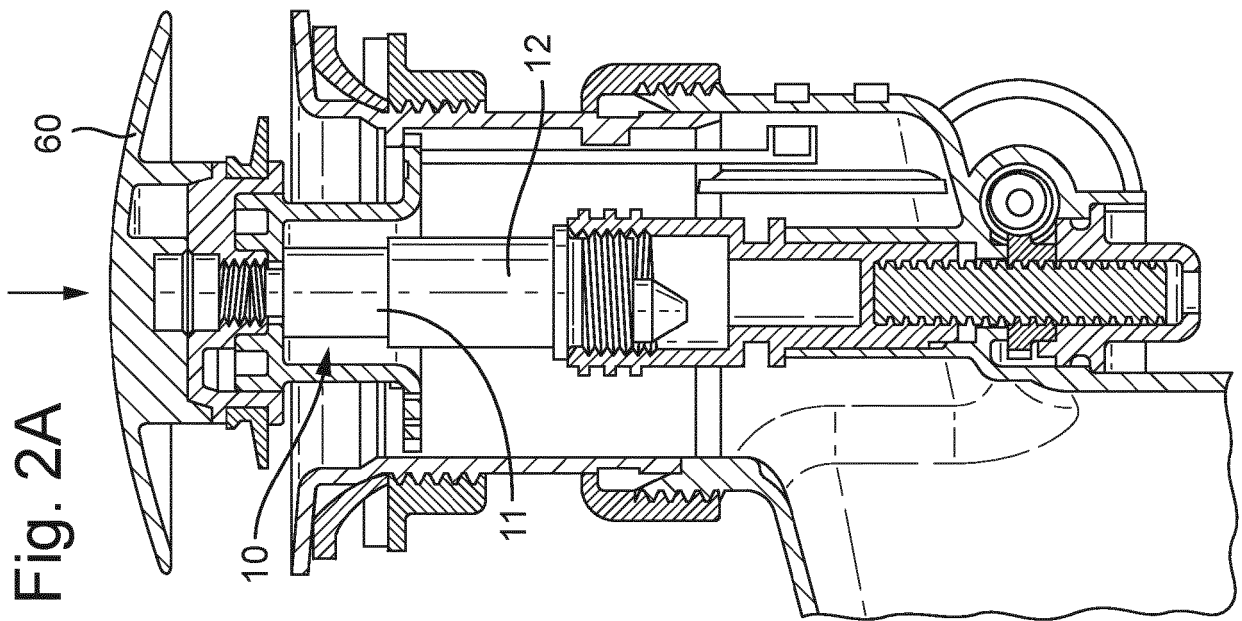
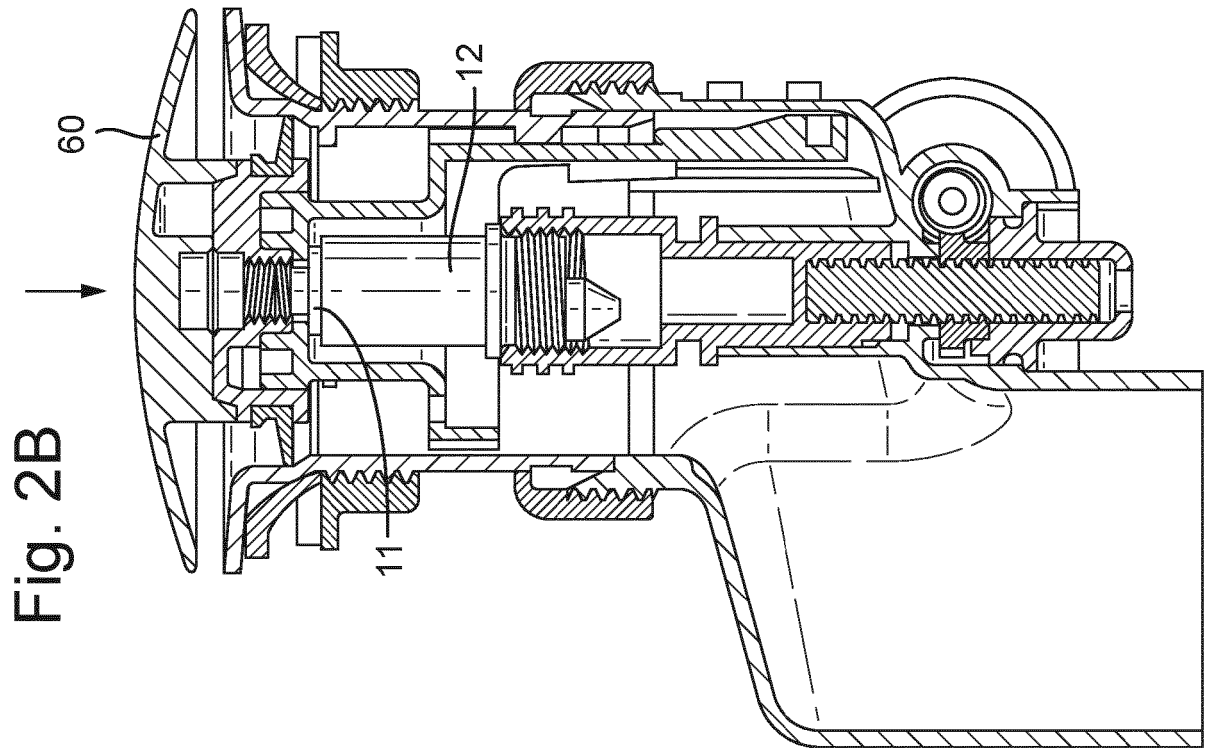


Fig. 3A

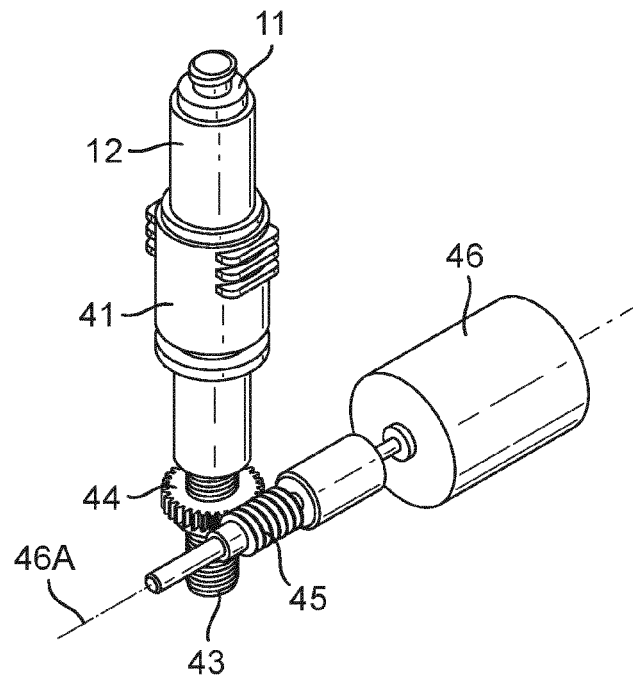


Fig. 3B

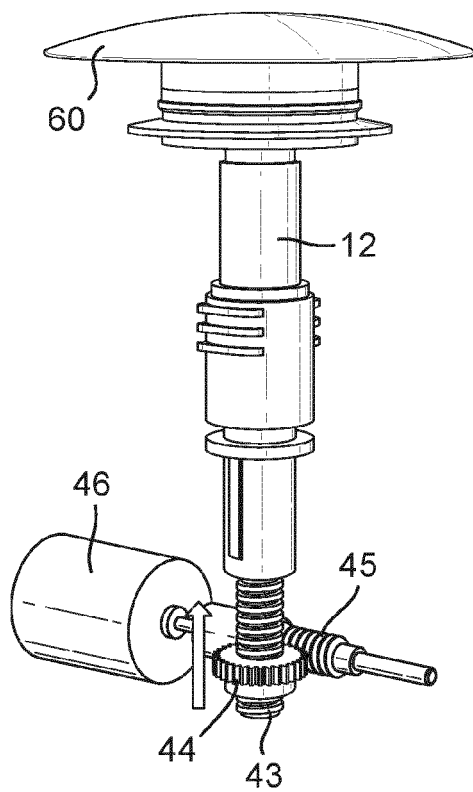


Fig. 3C

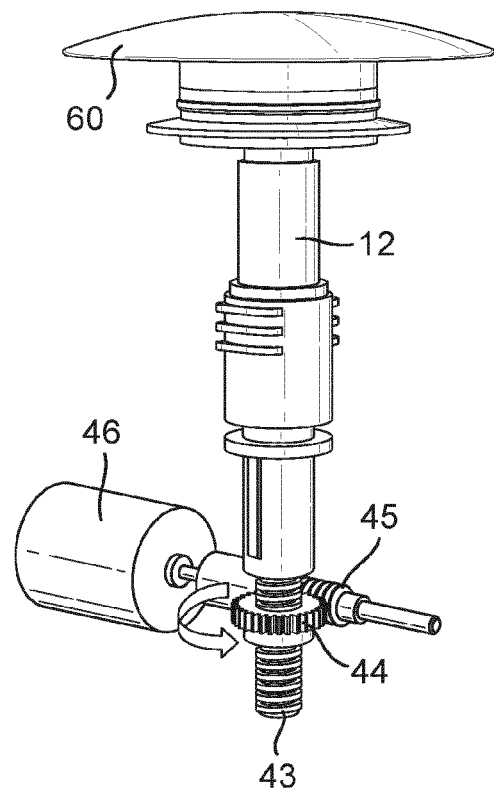


Fig. 4C

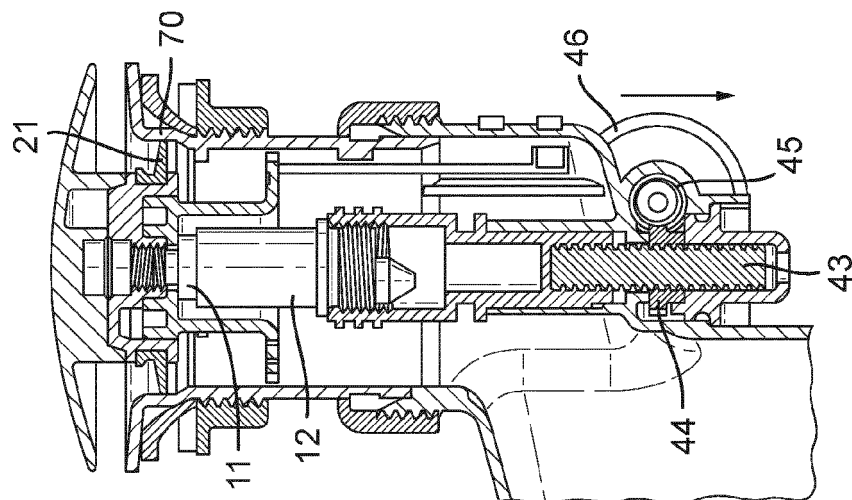


Fig. 4B

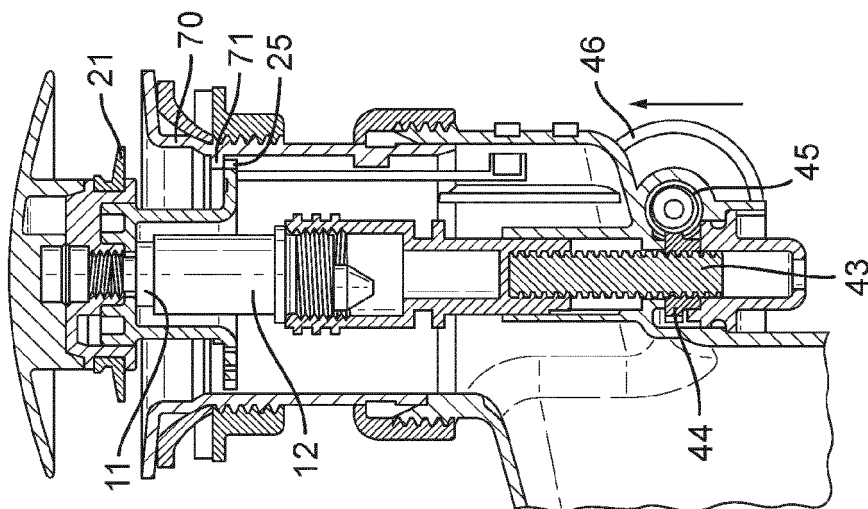


Fig. 4A

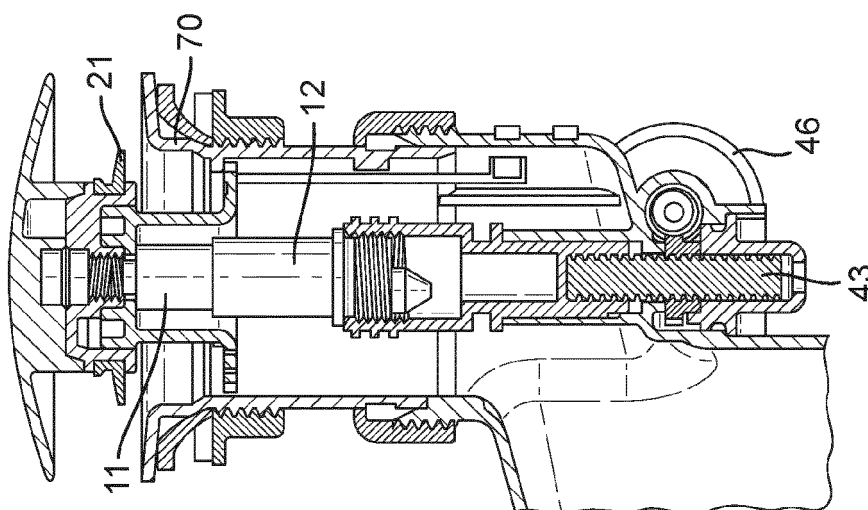


Fig. 4F

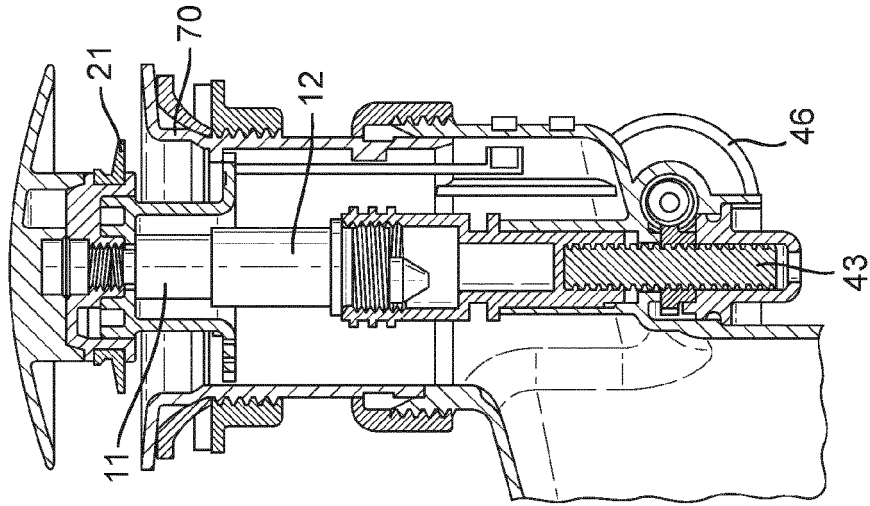


Fig. 4E

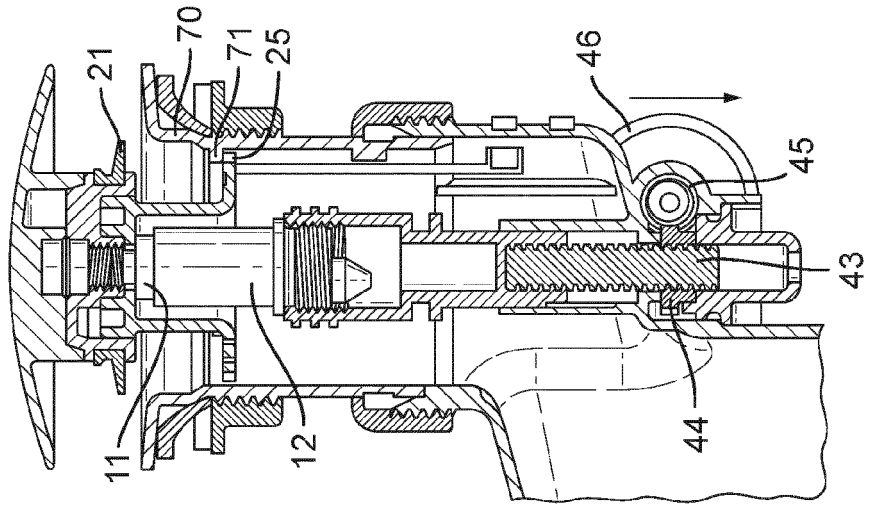


Fig. 4D

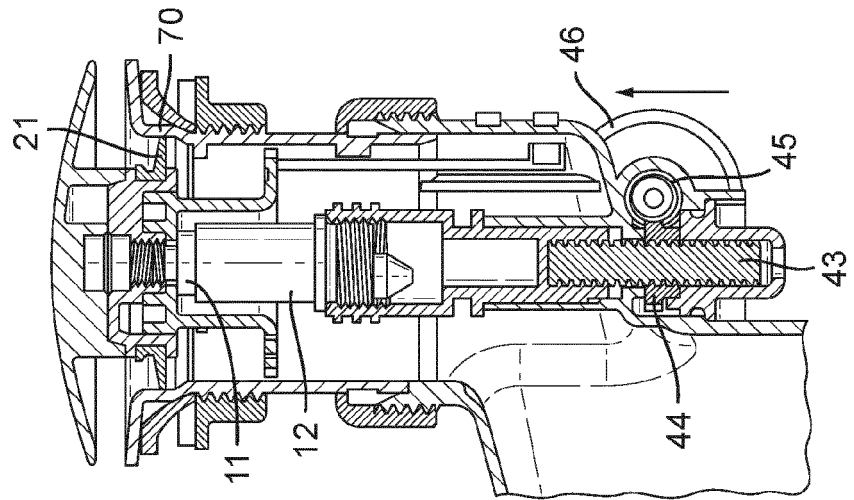


Fig. 5A

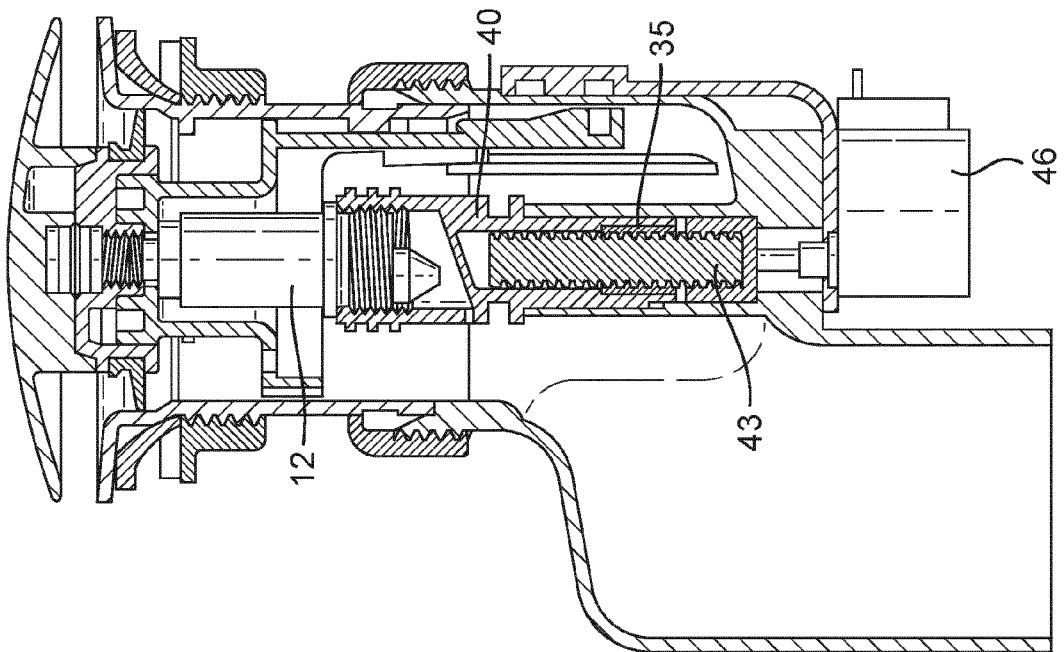


Fig. 5B

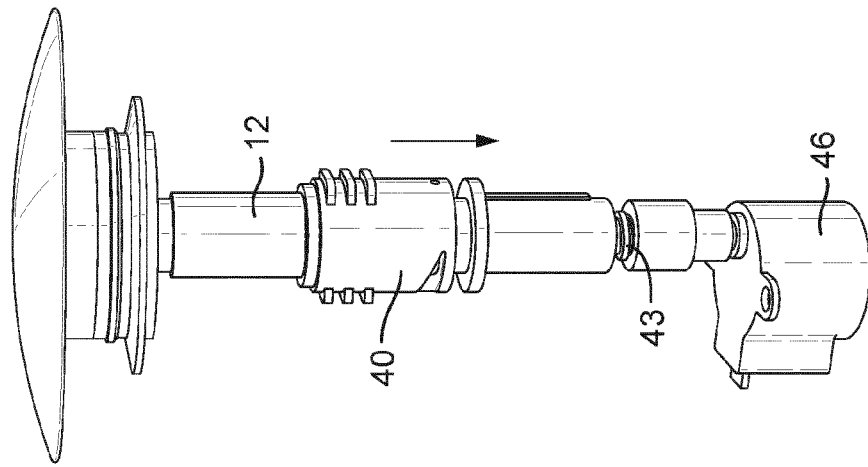


Fig. 5C

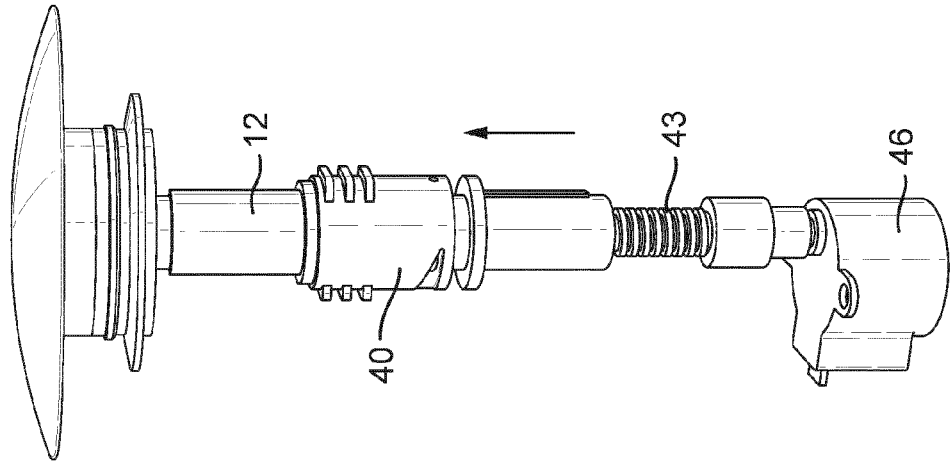


Fig. 6

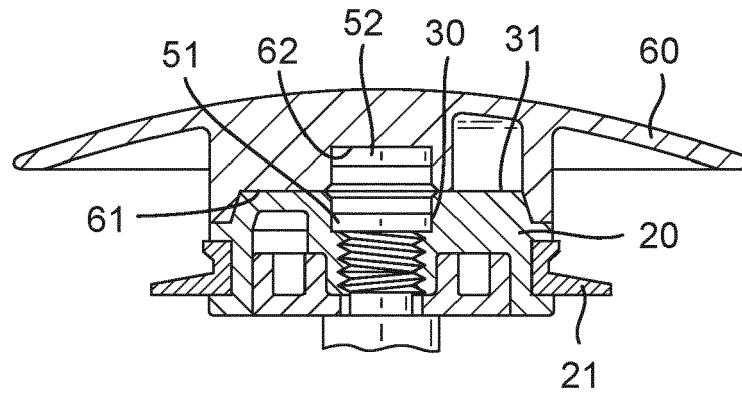


Fig. 7A

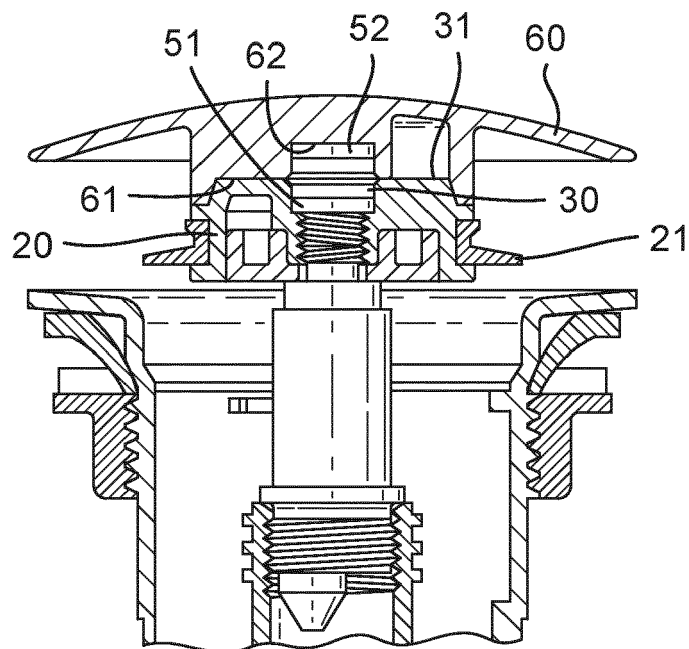


Fig. 7B

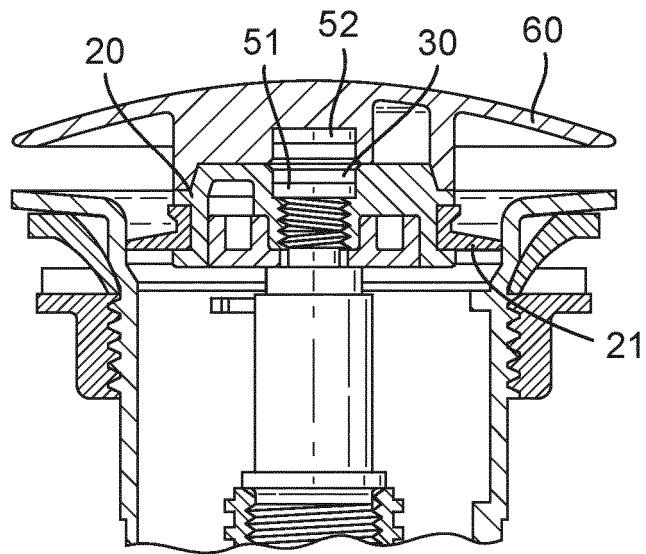


Fig. 7C

