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(54) **PULL-DOWN CABINET WITH A PISTON RESISTANCE MECHANISM AND A METHOD FOR ITS USE**

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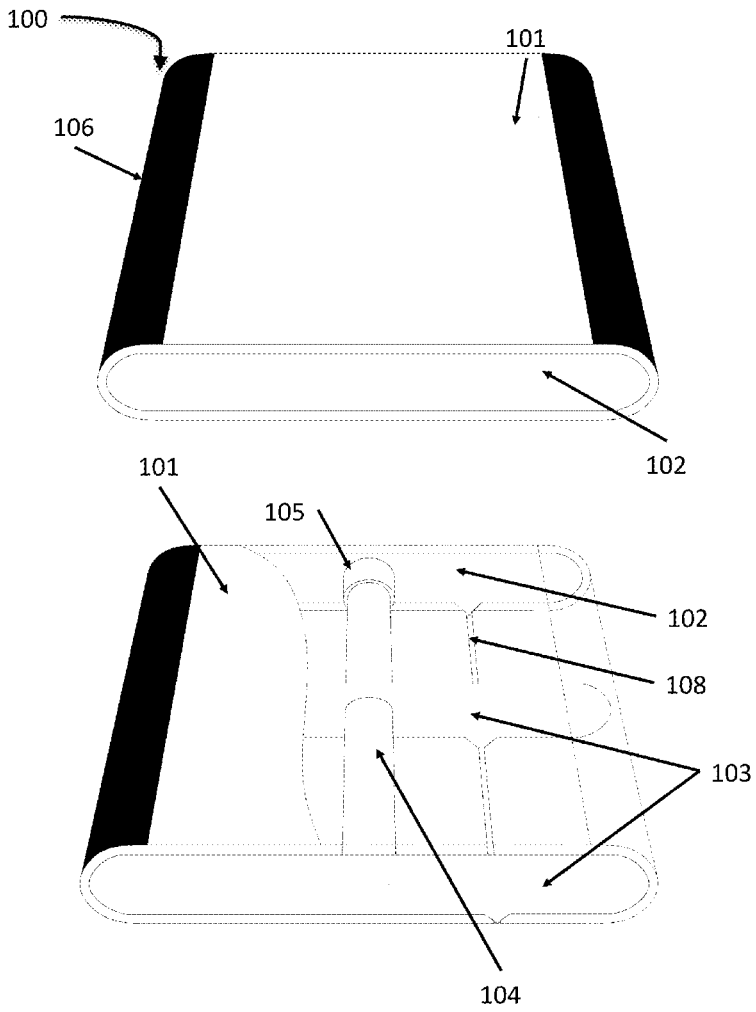
(57) **ABSTRACT**

A pull-down cabinet includes a first element fixed to an elevated structure, a second element having at least one storage surface, and at least one resistance mechanism comprising a tube having a substantially closed end, a piston within the tube creating a chamber between the piston and the substantially closed end, and a one-way valve communicating with the chamber such that the one-way valve opens, allowing fluid to pass through the one-way valve rapidly, when the piston is moved in a first direction within the tube, and closes, allowing substantially less fluid to pass through the one-way valve, when the piston is moved in a second direction within the tube, the resistance mechanism joining the first element to the second element so that when the second element slides away from the first element, the one-way valve closes, and when the second element slides toward the first element, the valve opens.



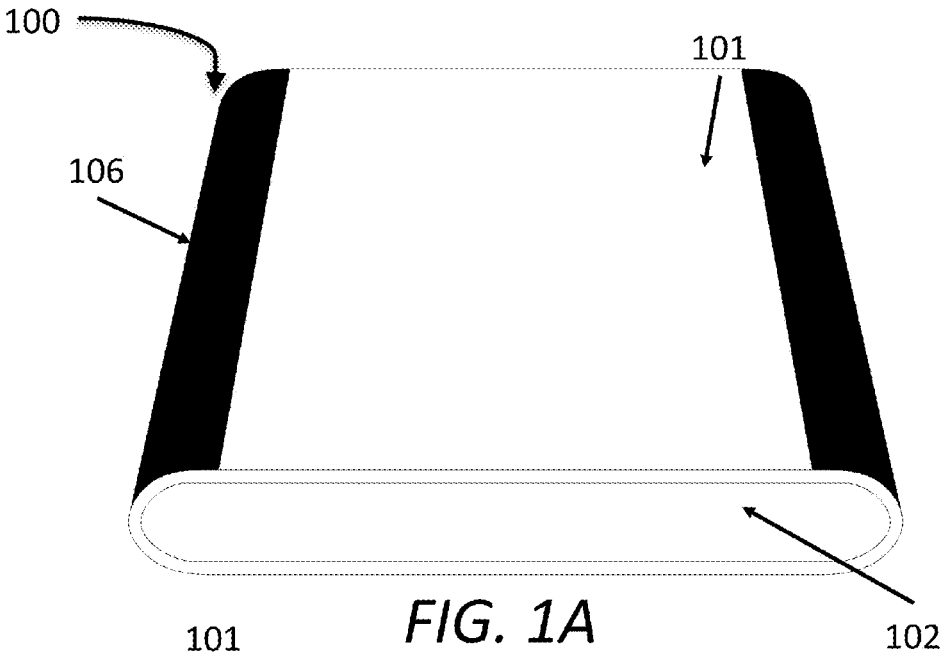


FIG. 1A

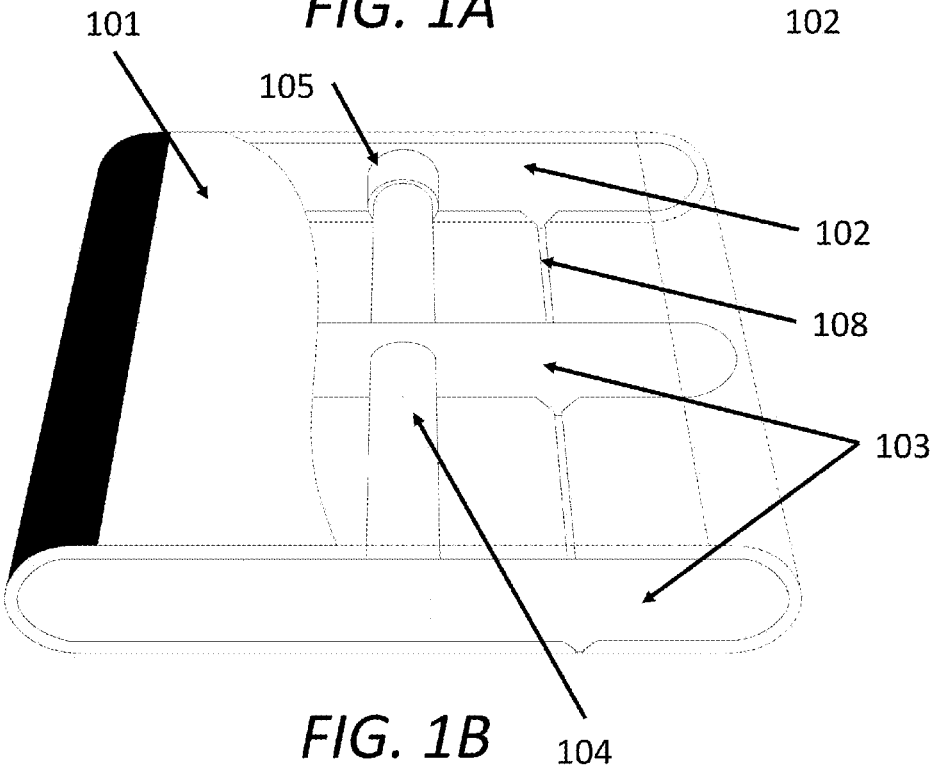


FIG. 1B

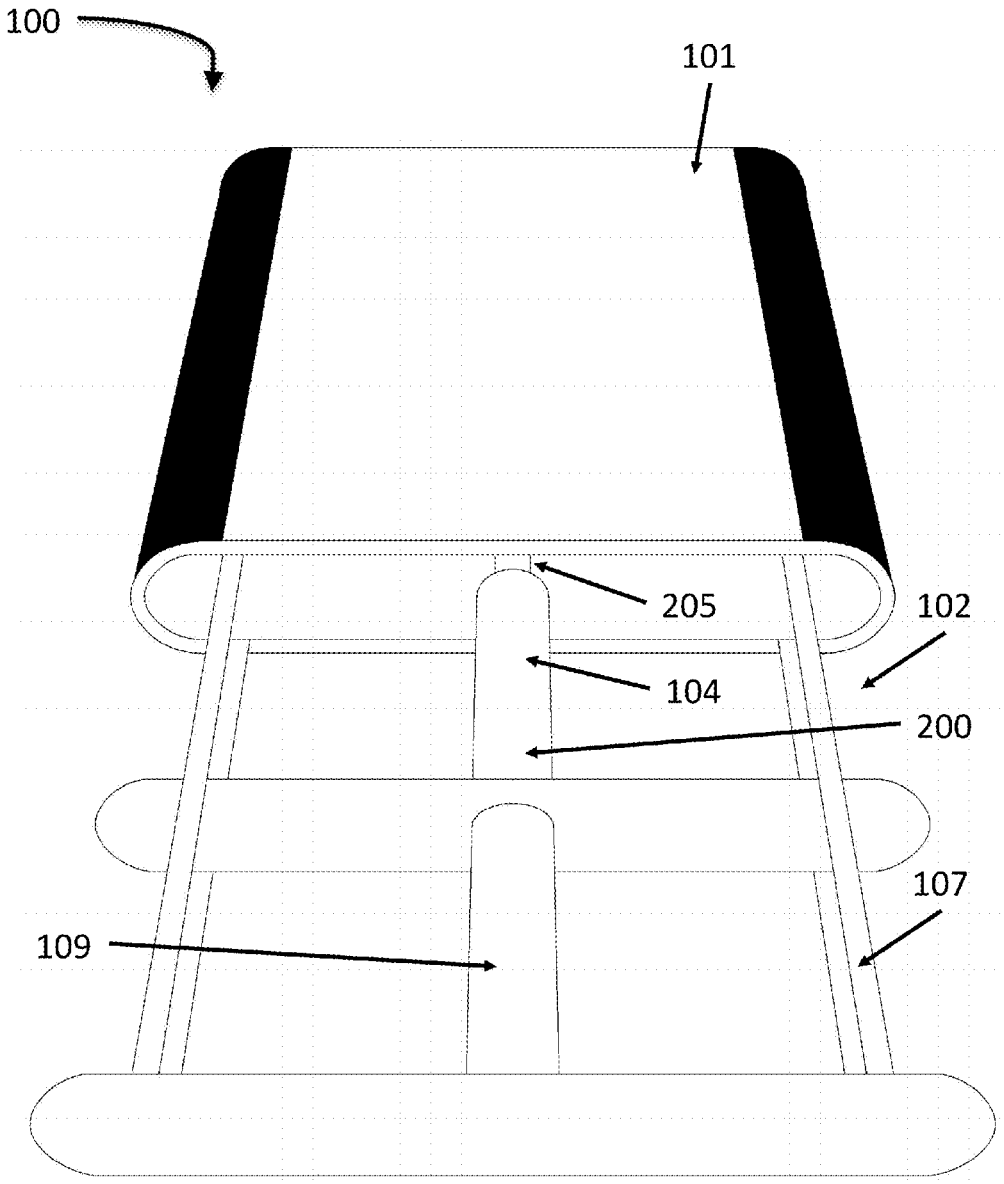


FIG. 1C

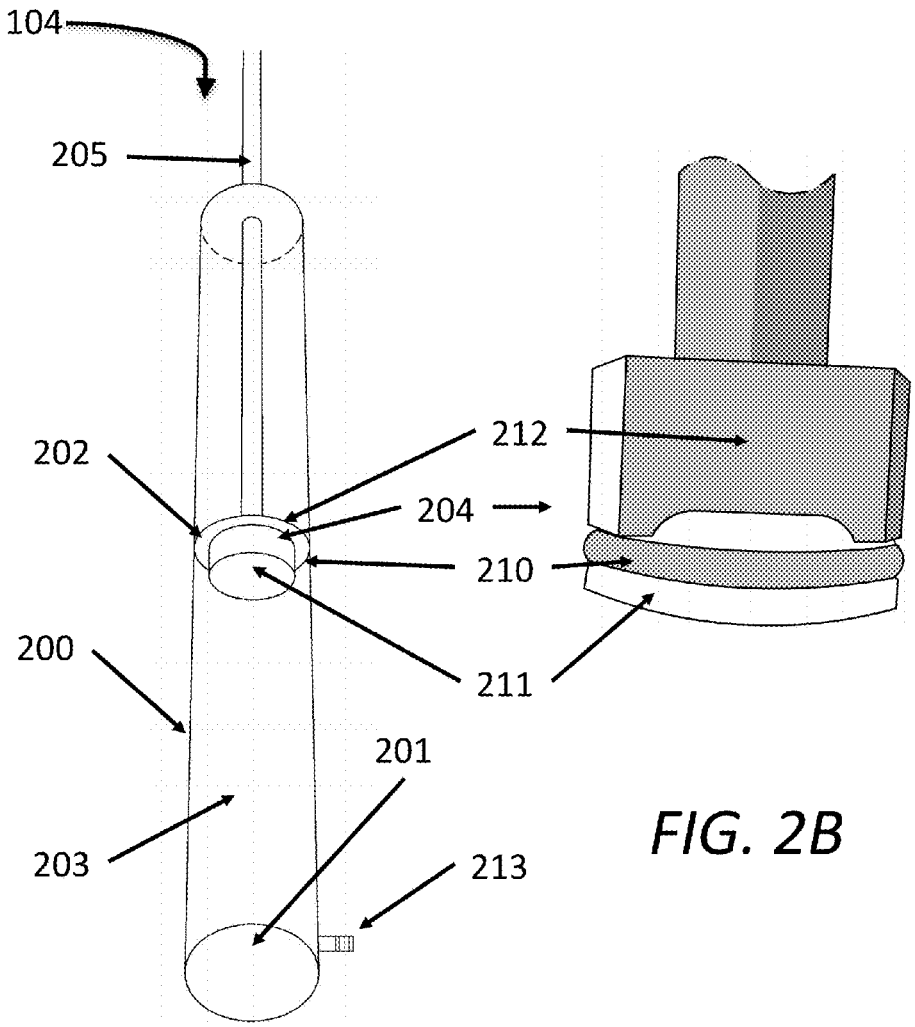


FIG. 2A

FIG. 2B

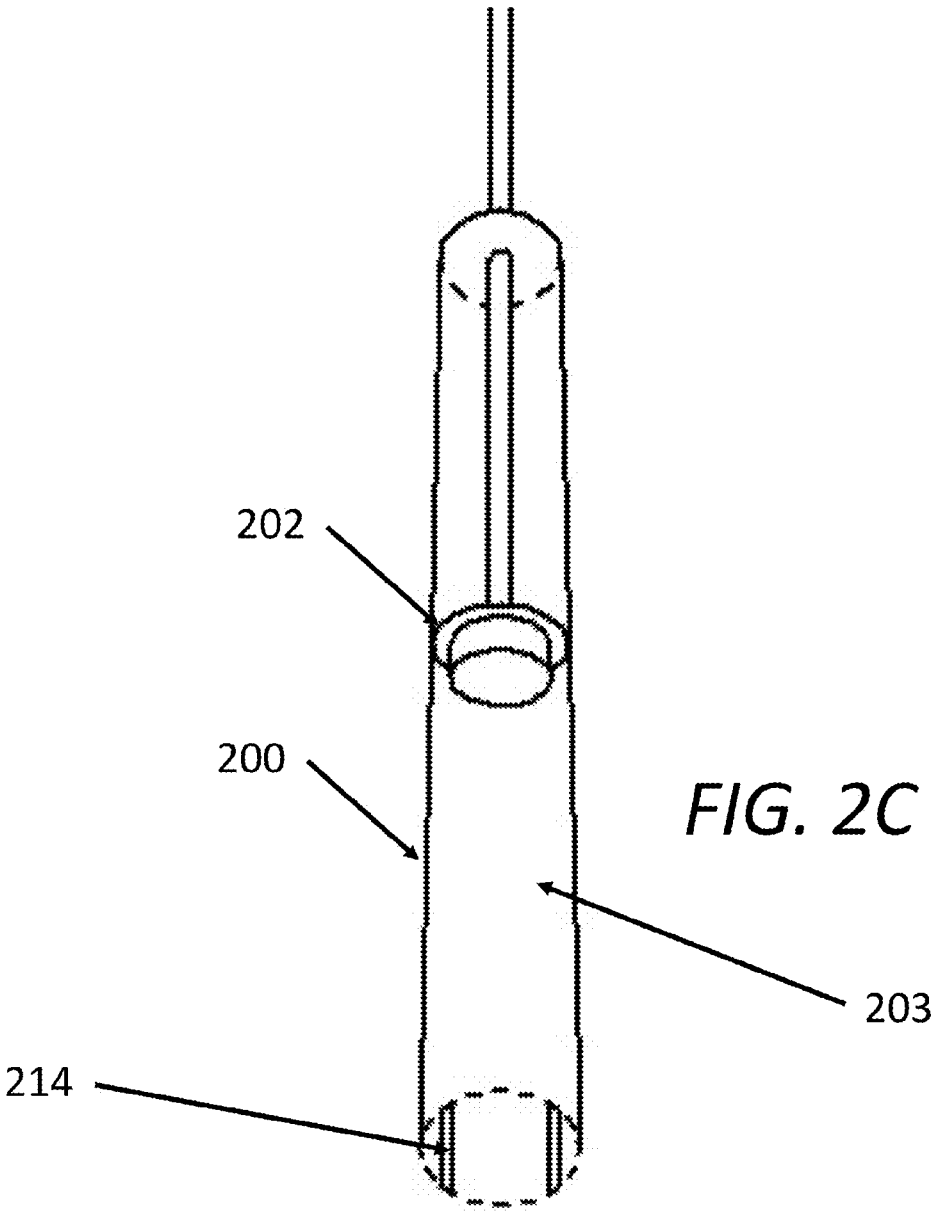


FIG. 2C

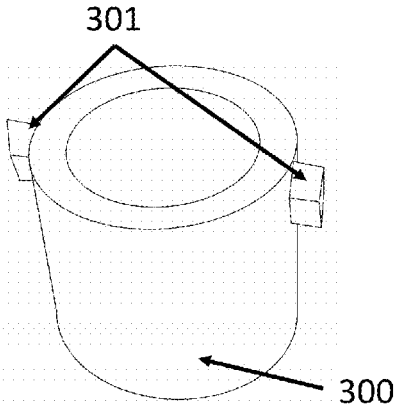


FIG. 3A

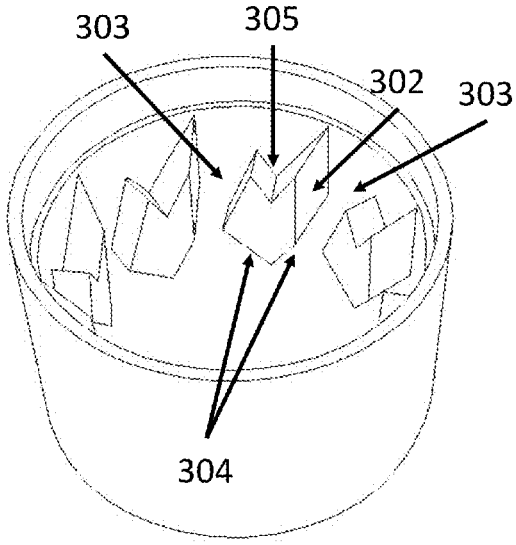


FIG. 3B

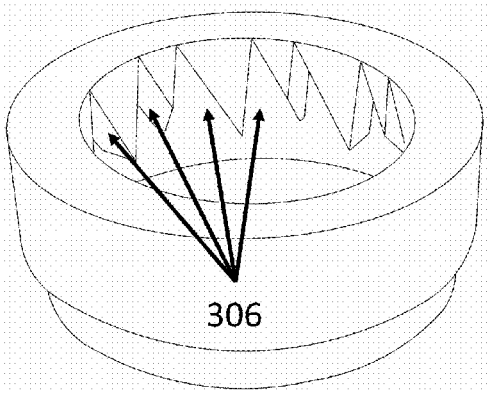


FIG. 3C

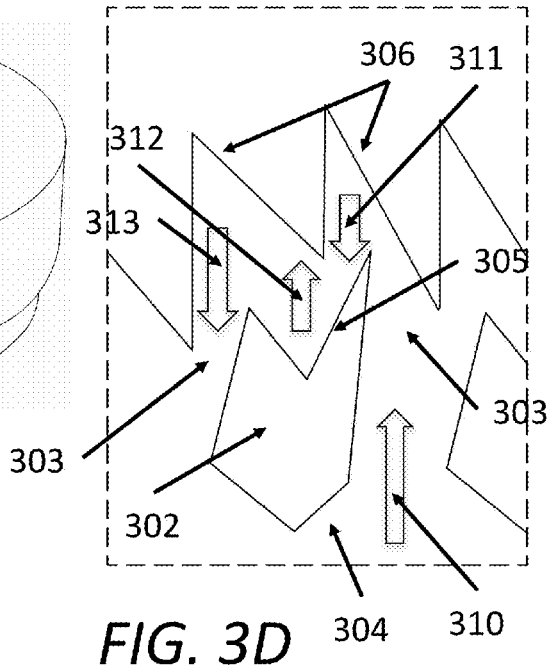


FIG. 3D

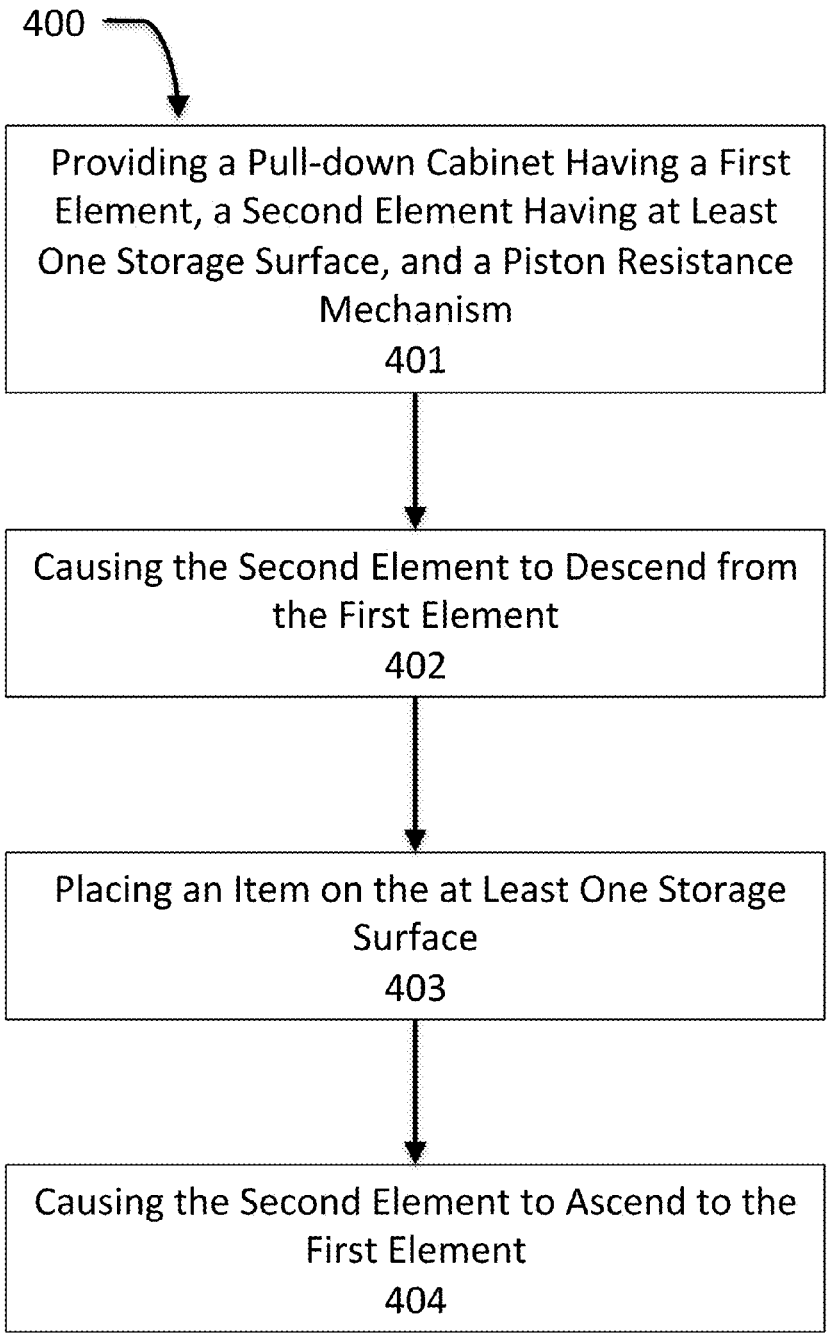

400
Providing a Pull-down Cabinet Having a First Element, a Second Element Having at Least One Storage Surface, and a Piston Resistance Mechanism
401
Causing the Second Element to Descend from the First Element
402
Placing an Item on the at Least One Storage Surface
403
Causing the Second Element to Ascend to the First Element
404

FIG. 4

PULL-DOWN CABINET WITH A PISTON RESISTANCE MECHANISM AND A METHOD FOR ITS USE

TECHNICAL FIELD

[0001] The disclosed device relates generally to storage systems, and particularly to cabinetry.

BACKGROUND ART

[0002] Finding sufficient space to store and organize household objects is a perennial challenge, particularly in urban environments. Installing shelving can help with organization, but generally at the expense of floor space. Shelves attached to walls higher up can leave more floor space, but are hard to reach. Past solutions to this issue have involved using stepladders or folding or sliding cabinets. The use of stepladders is unwieldy, and past pull-down cabinets have been heavy and inconvenient to use.

[0003] Therefore, there remains a need for a convenient pull-down cabinet for space-saving storage.

SUMMARY OF THE EMBODIMENTS

[0004] In one aspect, a pull-down cabinet with a piston resistance mechanism includes a first element fixed to an elevated structure, a second element having at least one storage surface, and at least one resistance mechanism including a tube having a substantially closed end, a piston within the tube creating a chamber between the piston and the substantially closed end, and a one-way valve communicating with the chamber such that the one-way valve opens, allowing fluid to pass through the one-way valve rapidly, when the piston is moved in a first direction within the tube, and closes, allowing substantially less fluid to pass through the one-way valve, when the piston is moved in a second direction within the tube, the resistance mechanism joining the first element to the second element so that when the second element slides away from the first element, the one-way valve closes, and when the second element slides toward the first element, the one-way valve opens.

[0005] In a related embodiment, the first element further includes a housing into which the second element slides when pushed upward. In another related embodiment, the one-way valve includes a washer that seals the piston against the side of the tube, a first support element that supports the washer against the side of the tube when the piston is being pulled in one direction, and a second support element that allows part of the washer to be forced away from the side of the tube by fluid pressure when the piston is being pushed in the opposite direction. In another related embodiment, the one-way valve includes a check valve. In an additional embodiment, the resistance mechanism further includes a bleed valve, communicating with the chamber, that allows a limited flow of fluid though the bleed valve. In another embodiment, the bleed valve may be adjusted to modify the rate of fluid flow permitted by the bleed valve. In another embodiment still, the fluid is a liquid. In yet another embodiment, the fluid is a gas. In an additional embodiment, the tube further includes at least one cross-sectional irregularity in the interior surface of the tube, the at least one cross-sectional irregularity allowing gas to pass around the piston when the piston passes over the at least one cross-sectional irregularity. In another embodiment, the at least one cross-sectional irregularity includes at least one groove.

[0006] An additional embodiment includes a latch that immobilizes the first element and second element relative to each other when the latch is engaged. In one embodiment, the latch further includes a cam follower element rotably attached to one element of the first element and second element, the cam follower element having an exterior surface and a cam follower mounted on the exterior surface, and a cam arrangement fixed to the other element of the first element and second element, and positioned so that the cam follower element is inserted within the cam arrangement when the first element and second element are together, the cam arrangement including a plurality of catch elements separated by grooves, each catch element having a cam surface that guides the cam follower into a groove when the cam follower element is inserted into the cam arrangement and a notch that admits the cam follower, such that when the cam follower rests in the notch the first element and second element are latched together, and a plurality of wedge cams positioned to guide the cam follower into the notch of one of the plurality of catch elements when the cam follower passes through one of the grooves prior to contacting the wedge cams, and to guide the cam follower into a groove when the cam follower exits a notch prior to contacting the wedge cams. Some embodiments further include at least one slide track coupling the first element to the second element.

[0007] In another aspect, a pull-down cabinet includes a first element fixed to an elevated structure, a second element slidably attached to the first element such that the second element may be pulled downward from the first element, the second element having at least one storage surface, and a latching mechanism, including a cam follower element rotably attached to one element of the first element and second element, the cam follower element having an exterior surface and a cam follower mounted on the exterior surface, and a cam arrangement fixed to the other element of the first element and second element, and positioned so that the cam follower element is inserted within the cam arrangement when the first element and second element are together, the cam arrangement including a plurality of catch elements separated by grooves, each catch element having a cam surface that guides the cam follower into a groove when the cam follower element is inserted into the cam arrangement and a notch that admits the cam follower, such that when the cam follower rests in the notch the first element and second element are latched together, and a plurality of wedge cams positioned to guide the cam follower into the notch of one of the plurality of catch elements when the cam follower passes through one of the grooves prior to contacting the wedge cams, and to guide the cam follower into a groove when the cam follower exits a notch prior to contacting the wedge cams.

[0008] In a related embodiment, the first element further includes a housing into which the second element slides when pushed upward. Another embodiment further includes at least one resistance mechanism that resists the motion of the second element when it slides away from the first element. An additional embodiment includes a return mechanism that pulls the second element up to the first element.

[0009] In another aspect, a method for using a pull-down cabinet with a piston resistance mechanism includes providing a pull-down cabinet as described above, causing the second element to descend from the first element, placing an item on the at least one storage surface, and causing the second element to ascend to the first element.

[0010] Other aspects, embodiments and features of the device will become apparent from the following detailed description when considered in conjunction with the accompanying figures. The accompanying figures are for schematic purposes and are not intended to be drawn to scale. In the figures, each identical or substantially similar component that is illustrated in various figures is represented by a single numeral or notation. For purposes of clarity, not every component is labeled in every figure. Nor is every component of each embodiment of the device shown where illustration is not necessary to allow those of ordinary skill in the art to understand the device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The preceding summary, as well as the following detailed description of the disclosed device, will be better understood when read in conjunction with the attached drawings. It should be understood that the device is not limited to the precise arrangements and instrumentalities shown.

[0012] FIG. **1**A is a schematic diagram depicting one embodiment of the disclosed pull-down cabinet;

[0013] FIG. **1**B is a schematic diagram depicting a partial cut-away of one embodiment of the disclosed pull-down cabinet;

[0014] FIG. **1**C is a schematic diagram depicting one embodiment of the disclosed pull-down cabinet;

[0015] FIG. **2**A is a schematic diagram depicting an embodiment of a piston resistance mechanism;

[0016] FIG. **2**B is a schematic diagram depicting an embodiment of a one-way valve;

[0017] FIG. **2**C is a schematic diagram depicting an embodiment of a piston resistance mechanism;

[0018] FIG. **3**A is a schematic diagram depicting an embodiment of a surface bearing a cam follower;

[0019] FIG. **3**B is a schematic diagram of one half of a cam arrangement;

[0020] FIG. **3**C is a schematic diagram of the other half of the cam arrangement depicted in FIG. **3**B;

[0021] FIG. **3**D is a schematic diagram showing a portion of the assembled cam arrangement and the path a cam follower follows through the arrangement; and

[0022] FIG. **4** is a flow diagram depicting a method for using a pull-down cabinet as described herein.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0023] FIGS. **1**A-**1**C illustrate some embodiments of a pull-down cabinet **100**. As a brief overview, the pull-down cabinet **100** includes a first element **101** fixed to an elevated structure. The pull-down cabinet **100** includes a second element **102** having at least one storage surface **103**. In some embodiments, the pull-down cabinet **100** has at least one resistance mechanism **104** joining the first element **101** to the second element **102** in such a way as to resist the motion of the second element **102** when the second element **102** slides away from the first element **101**. In some embodiments, the pull-down cabinet **100** includes a latch **105** that immobilizes the first element **101** and second element **102** relative to each other when engaged.

[0024] Referring to FIGS. **1**A-C in more detail, the pull-down cabinet **100** includes a first element **101** fixed to an elevated structure. The first element **101** may be constructed of any material or combination of materials of sufficient strength and rigidity to support the weight of the remainder of the structure and to withstand the additional stress imposed by the movement of the second element and a resistance mechanism if used, as described in further detail below. The first element **101** may be composed at least in part of a polymer; the polymer may be a plastic. The polymer may be a resin. The first element **101** may be composed at least in part of a metal, such as steel, aluminum or titanium. The first element **101** may be composed at least in part of wood. The first element **101** may be composed at least in part of a composite material such as fiberglass. The first element **101** may be composed at least in part of glass. The first element **101** may be composed at least in part of a textile, such as canvas.

[0025] The first element **101** is fixed to an elevated structure. In an embodiment, an elevated structure is a structure sufficiently elevated to permit the second element **102** to be slid far enough down from first element **101** to give the user full access to the at least one storage surface **103**. The elevated structure may be a wall. The elevated structure may be a ceiling. The elevated structure may be a door. The elevated structure may be a pillar, such as an anti-seismic pillar in an office or dwelling. The elevated structure may be a pole. The elevated structure may be a fixture, such as another cabinet; for instance, the first element **101** may be fixed to the side of an elevated set of kitchen cabinets. The elevated structure may be another item of furniture, such as a bookcase or desk. The first element **101** may be attached to the elevated structure by any device suitable for fixing one rigid object to another; the first element **101** may be nailed to the elevated structure. The first element **101** may be bolted to the elevated structure. The first element **101** may be screwed to the elevated structure. The first element **101** may be adhered to the elevated structure.

[0026] In some embodiments, the first element **101** includes a housing into which the second element **102** slides when pushed upward. The housing may enclose substantially all of the second element **102**. The housing may enclose enough of the second element **102** to conceal all of the at least one storage surface **103**. In some embodiments, the housing includes one or more detachable panels **106**. The one or more detachable panels **106** may be formed from any material or combination of materials suitable for the construction of the first element **101**. The one or more detachable panels **106** may have one or more colors contrasting with another portion of the first element **101**. The one or more detachable panels **106** may be interchangeable with other detachable panels **106**; for instance, the user may be able to select detachable panels **106** from an assortment of detachable panels having various colors, so as to cause the detachable panels **106**, and hence the pull-down cabinet **101** to match the user's desired decorative scheme. In other embodiments, the detachable panels **106** contain at least one light-producing element. The light-producing element may include an incandescent light bulb. The light-producing element may include a florescent light bulb, such as a compact florescent light. The light-producing element may include an electroluminescent device such as a light-emitting diode (LED). The light-producing element may be bioluminescent. The light-producing element may be phosphorescent; for instance, the one or more detachable panels **106** may contain phosphorescent dye. The light-producing element may be chemiluminescent. The light-producing element may be radioluminescent. The one or more detachable panels **106** may include a painting. The one or

more detachable panels **106** may include a bamboo panel. Although in the embodiments depicted in FIGS. **1**A-**1**C the one or more detachable panels **106** are located on the sides of the first element **101**, the one or more detachable panels **106** may comprise any exterior surface of the first element **101**, including its front or its top.

[0027] In some embodiments, the first element **101** and one or more detachable panels **106** are formed to accept an additional element between them. The additional element may have a display; for instance, the additional element may be a clock, television, computer monitor, tablet, or other electronic item that displays through a transparent detachable panel **106**. The additional element may be a picture. The additional element may be a work of art.

[0028] The pull-down cabinet **100** includes a second element **102** having at least one storage surface **103**. The second element **102** may be composed of any material or combination of materials suitable for constructing the first element **101**. The at least one storage surface **103** may be one or more shelves. The at least one storage surface **103** may include one or more drawers. The at least one storage surface **103** may include any storage element used in cabinets. The at least one storage surface **103** may include one or more slanted holders, such as those commonly used for toothbrushes. In some embodiments, the second element **102** includes one or more braces **107** that hold together portions of the second element **102**; the braces **107** may strengthen the second element **101**. The braces **107** may make it easier to move the second element as a unit; for instance, the braces **107** may make the second element **102** more rigid. The braces **107** may help the second element **101** to slide smoothly against or within the first element **101**. Some embodiments of the pull-down cabinet **101** include at least one slide track **108** coupling the first element to the second element. In one embodiment, a slide track **108** is a device such as a drawer glide or a groove and projection combination that constrains the second element **102** to slide along a certain path relative to the first element **101**. As a further example the slide track **108** may also include a rod fixed to the first element **101** that passes through one or more holes in the second element **102**, so that the second element **102** is constrained to slide up and down the rod. The rod may be fixed to the second element **102** and slide through at least one hole in the first element **101**, alternatively.

[0029] In some embodiments, the pull-down cabinet **100** has at least one resistance mechanism **104** that resists the motion of the second element **102** when it slides away from the first element **101**. In some embodiments, the resistance mechanism **104** includes a biasing means; the resistance mechanism **104** may include a spring. The spring may be a coil spring. The spring may be a leaf spring. The spring may be a gas spring made up of a piston sealed in a gas-filled tube, such that the elasticity of the gas causes the piston to exert a recoil force when pulled into or pushed out of the tube. The resistance mechanism **104** may include a weight; for instance, a cable attached to the second element **102** may pass over a pulley attached to the first element **101** and attach to a counterweight at the other end of the cable, such that pulling the second element **102** downward pulls the counterweight upward toward the pulley; as a result, the counterweight may exert a force resisting the downward motion of the second element **101**.

[0030] In other embodiments, as shown in FIG. **2**A, the at least one resistance mechanism includes a tube **200** having a substantially closed end **201**, a piston **202** within the tube creating a chamber **203** between the piston and the substantially closed end **201**, and a one-way valve **204** communicating with the chamber **203** such that the one-way valve **204** opens, allowing fluid to pass through the one-way valve **204** rapidly, when the piston **202** is in moved in a first direction within the tube **200**, and closes, allowing substantially less fluid to pass through the one-way valve **204**, when the piston **202** is moved to in a second direction within the tube **200**. In an embodiment, a valve is communicating with the chamber **203** if fluid flowing through the valve is flowing into or out of the chamber **203**. This resistance mechanism may be attached to the first element **101** and the second element **102** so that when the second element **102** slides away from the first element **101**, the one-way valve closes, and when the second element slides toward the first element, the one-way valve opens. In some embodiments, the tube **200** is attached to the first element **101**, and the piston **202** is attached to the second element **102** by a rod **205** that extends from the tube **200**. The substantially closed end **201** may be the end opposite where the rod **205** exits the tube **200** placing the chamber **203** between the piston **202** and that end **201**, as depicted in FIG. **2**A; the valve **204** may open when the chamber **203** contracts, allowing rapid flow of fluid out of the chamber **203**, and close when the chamber **203** expands, allowing a much lower flow of fluid out of the chamber **203**. Alternatively, the substantially closed end **201** may be at the end that the rod **205** exits from the tube **200**, with a substantially fluid-tight seal around the rod **205** where it exits the tube, and placing the chamber **203** on the other side of the piston **202**; in that case the one-way valve **205** may open when the chamber **203** expands, allowing rapid flow of air into the chamber, and close when the chamber **203** contracts, allowing much less rapid flow of air out of the chamber **203**. In some embodiments, both ends of the tube **200** are sealed, creating a double chamber **203** divided by the piston, so that the one-way valve **204** is effectively controlling how rapidly fluid flows from one chamber **203** to the other chamber **203**.

[0031] In other embodiments, the tube **200** is connected to the second element **102** and the piston rod **205** is connected to the first element **102**, as depicted in FIG. **1**C. The substantially closed end **201** may be the end opposite where the rod **205** exits the tube **200** placing the chamber **203** between the piston **202** and that end **201**, as depicted in FIG. **2**A; the one-way valve **205** may open when the chamber **203** contracts, allowing rapid flow of air out of the chamber, and close when the chamber **203** expands, allowing much less rapid flow of air into the chamber **203**. Alternatively, the substantially closed end **201** may be at the end that the rod **205** exits from the tube **200**, with a substantially fluid-tight seal around the rod **205** where it exits the tube, and placing the chamber **203** on the other side of the piston **202**; in that case the valve **204** may open when the chamber **203** expands, allowing rapid flow of fluid into of the chamber **203**, and close when the chamber **203** contracts, allowing a much lower flow of fluid out of the chamber **203**.

[0032] In some embodiments, as shown in FIG. **2**B, the one-way valve **204** includes a washer **210** that seals the piston **202** against the side of the tube **200**, a first support element **211** that supports the washer **210** against the side of the tube **200** when the piston **202** is being pulled in one direction, and a second support element **212** that allows part of the washer **210** to be forced away from the side of the tube **200** by fluid pressure when the piston **202** is being moved in the opposite direction. The washer may be formed from a flexible material

such as rubber, silicone, or an elastomer. For instance, in an embodiment where the one-way valve **204** is oriented to close when the piston **202** is moved to expand the chamber **203** and to open when the piston **202** is moved to contract the chamber **203**, the first support element **211** is positioned on the side of the washer **210** inside the chamber **203**, and the second support element **212** is positioned on the side of the washer **210** outside the chamber **203**, so that the washer **210** bends around the second support element **212** to allow fluid to escape past the washer **210** when the piston **202** is moved to contract the chamber **203**, as further illustrated by FIG. **2**A.

[0033] In other embodiments, the one-way valve **204** is a check valve. The valve **204** may be a diaphragm check valve. The valve **204** may be a swing check valve. The valve **204** may be a tilting disc check valve. The valve **204** may be a lift-check valve. The valve **204** may be an in-line check valve. The valve **204** may be a duckbill valve. The valve **2054**may be located at the substantially closed end **202** of the tube **200**.

[0034] In some embodiments, the resistance mechanism **104** further includes a bleed valve **213**, communicating with the chamber **203**, that allows a limited flow of fluid though the bleed valve **213**; this may result in some fluid being able to pass into or out of the chamber **203** even when the one-way valve **204** is closed. In some embodiments, the bleed valve **213** may be adjusted to modify the rate of fluid flow permitted by the bleed valve **213**. For instance, the bleed valve **213** may be threaded so that rotation in one direction opens the bleed valve **213** further while rotation in another direction closes the bleed valve **213** to a greater extent; a user may thus be able to adjust the resistance of the resistance mechanism by rotating the bleed valve **213**. The bleed valve **213** may be in the piston **202**; for instance, the bleed valve **213** may be a small hole in the piston **202**.

[0035] In some embodiments, the fluid used in the resistance mechanism **104** is a liquid. The liquid may enter and exit the chamber **203** via the one-way valve **204** and the bleed valve **213** through tubes connected to a tank containing the liquid. Alternatively, in a double-chambered embodiment, the tube may be sealed sufficiently at both ends to keep the fluid from leaking out. In other embodiments, the fluid is a gas. The fluid may be air, for instance, such as the ambient air where the pull-down cabinet **100** is located. In some embodiments, the tube includes at least one cross-sectional irregularity **214** in the interior surface of the tube **200**, the at least one cross-sectional irregularity **214** allowing gas to pass around the piston **202** when the piston passes over the at least one cross-sectional irregularity. For instance, the tube **200** may be slightly elliptical for a portion of its length, allowing some air to leak around a circular piston **202**. The at least one cross-sectional irregularity **214** may include at least one groove in the interior surface of the tube **200**. The at least one cross-sectional irregularity **214** may run along a portion of the length of the tube **200**. The at least one cross-sectional irregularity **214** may be located in a part of the tube **200** that the piston **202** passes through when the second element **102** begins to descend from the first element **101**, so that initially the descent has very little resistance, and the resistance gradually builds up as the second element **102** descends further and the piston **202** moves into the part of the tube **200** that has no irregularity **214**; this may have the effect of smoothly reducing the speed of descent of the second element **102** and preventing it ending its descent with a jerk.

[0036] The pull-down cabinet **100** may also include a return mechanism **109** that pulls the second element up to the first element. The return mechanism **109** may be a gas spring; in some embodiments, the gas spring is a piston **203** in a tube **200** as described above in relation to FIGS. **2**A-**2**B, but without the one-way valve, so that the gas remains in the chamber **204**. In other embodiments, the return mechanism **109** is the pulley, counterweight, and cable set described above in relation to FIGS. **1**A-**1**C. The return mechanism may be a spring. The return mechanism **109** may be motorized; for instance, the return mechanism may be a pump or impeller that drives fluid into the chamber **203** described above in reference to FIG. **2**A. The return mechanism **109** may be a cable and pulley as described above in reference to FIGS. **1**A-C, with the cable attached to a motorized winch. The return mechanism may allow the user to pull the cable in the cable and pulley system described above in reference to FIGS. **1**A-C; the user may be able to pull the cable directly, or to operate a crank-winch to pull on the cable.

[0037] In some embodiments, the cabinet **100** includes a power source (not shown). The power source may be hydraulic; for instance, the power source may be a line connected to the running water of the office or dwelling containing the cabinet **101**, e.g. using water pressure to force water into the chamber **203** as described above for a return mechanism **109** in reference to FIGS. **1**A-C. The power source may be pneumatic; for instance, the power source may be a line connected to an gas pressure source, e.g. using air pressure to force gas into the chamber **203** as described above for a return mechanism **109** in reference to FIGS. **1**A-C. The power source may be any electrical power source. For instance, the power source may be a cable connecting the cabinet **100** to the electrical system of the office or dwelling containing the cabinet; the power source may be a wall plug. The power source may be a battery pack; in some embodiments, the battery pack is rechargeable. The power source may be photovoltaic, such as a cable connected to an exterior solar panel, or a solar panel mounted on the first element **101**. The cabinet **100** may use the power source to power a motor driving the return mechanism **109** as described above in reference to FIGS. **1**A-**1**C. The cabinet **100** may use the power source to power a display as described above in reference to FIGS. **1**A-**1**C. The cabinet **100** may use the power source to power one or more charging ports (not shown). The one or more charging ports may be elements that charge electrical appliances; the one or more one or more charging ports may include an electrical outlet. The one or more one or more charging ports may include a universal serial bus (USB) port. The one or more one or more charging ports may include a device-specific port such as a port to charge a particular smartphone or tablet. The one or more one or more charging ports may include an inductive charging source.

[0038] In some embodiments, the pull-down cabinet **100** includes a latch **105** that immobilizes the first element **101** and second element **102** relative to each other when the latch **105** is engaged. The latch **105** may engage the bottom of the first element **101** and the bottom of the second element **102** when the first element **101** and the second element **102** are together; for instance, where the first element **101** includes a housing that can contain the second element **102**, the latch **105** may extend one or more catches from the edges of the housing to overlap the second element **102** when it is inserted, preventing the second element **102** from being pulled downward until the one or more catches are disengaged. FIGS. **3**A-**3**D illustrate another embodiment of the latch **105**. In some embodiments, the latch **105** includes a cam follower

element **300** rotably attached to one element of the first element **101** and second element **102**, the cam follower element **300** having an exterior surface and a cam follower **301** mounted on the exterior surface, and a cam arrangement fixed to the other element of the first element **101** and second element **102**, and positioned so that the cam follower element **300** is inserted within the cam arrangement when the first and second element are together. In some embodiments, the cam follower element **300** is the tube **200**. In other embodiments, the cam follower element **300** is attached to the tube **200**. In some embodiments, the cam arrangement includes a plurality of catch elements **302** separated by grooves **303**, each catch element **302** having a cam surface **304** that guides the at least one cam follower **301** into a groove when the cam follower element **300** is inserted into the cam arrangement and a notch **305** that admits the cam follower **301**, such that when the cam follower **301** rests in the notch **305** the first element **101** and second element **102** are latched together, and a plurality of wedge cams **306** positioned to guide the cam follower **301** into the notch **305** of one of the plurality of catch elements **302** when the cam follower **301** passes through one of the grooves **303** prior to contacting the wedge cams **306**, and to guide cam follower **301** into a groove **303** when cam follower **301** exits a notch **305** prior to contacting the wedge cams **306**. Where the cam follower element **300** is attached to the second element **102**, the cam arrangement may be attached to the first element **101**; likewise, where the cam follower element **300** is attached to the first element, the cam arrangement may be attached to the second element **102**. Persons skilled in the art will be aware that the latch will function in either position.

[0039] FIG. **3**D depicts an exemplary embodiment of a portion of the cam assembly, and the path that the cam follower **301** may take through the cam assembly. In the example, when the second element **102** is pushed up to the first element **101**, the cam follower element **300** enters the cam assembly, so that the cam follower **301** is guided by the cam surface **304** of one of the catch elements **302** into a groove **303**, rotating the cam follower element **300** as necessary to allow the cam follower **301** to be guided (**310**). Continuing the example, as it travels up through the groove, the cam follower **301** contacts a wedge cam **306**, which forces the cam follower to a position over a notch **305**, occasioning a further rotation of the cam follower element **300**. Further continuing the example, when the user releases the second element **102**, the cam follower **301** falls back down into the notch **305**, locking together the first element **101** and the second element **102** (**311**); the notch may also move the cam follower **301** sideways to position it for the next step. As the example continues, if the user wishes to lower the second element **101** again, the user pushes up on the second element **101**, causing the cam follower **301** to travel upwards from the notch **305** (**312**). Continuing the example, the cam follower **301** contacts a wedge cam **306**, forcing it to the side, and causing the cam follower element to rotate again **300**, so that it is over a groove **303**. Further continuing the example, when the user pulls down on the second element **102** or releases it to descend under its own weight, the cam follower **301** travels down through the groove **303**, allowing the second element **102** to descend fully.

[0040] FIG. **4** illustrates some embodiments of a method **400** for using a pull-down cabinet with a piston resistance mechanism. The method **400** includes providing a pull-down cabinet with a resistance mechanism including a tube, piston, and one-way valve, as described above in reference to FIGS. **1**A-**3**D (**401**). The method **400** includes causing the second element to descend from the first element (**402**); this may be implemented as described above in reference to FIGS. **1**A-**3**D. The method **400** includes placing an item on the at least one storage surface (**403**); this may be implemented as described above in reference to FIGS. **1**A-**3**D. The method **400** includes causing the second element to ascend to the first element (**404**); this may be implemented as described above in reference to FIGS. **1**A-**3**D. Some embodiments of the method **400** further include adjusting a bleed valve **213** as described above in reference to FIG. **2**A. Some embodiments of the method **400** further involve engaging a latch **105** as described above in reference to FIGS. **1**A-C and **3**A-D.

[0041] It will be understood that the device may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the device is not to be limited to the details given herein.

What is claimed is:

1. A pull-down cabinet with a piston resistance mechanism, the cabinet comprising:

a first element fixed to an elevated structure;

a second element having at least one storage surface; and

at least one resistance mechanism comprising a tube comprising a substantially closed end, a piston within the tube creating a chamber between the piston and the substantially closed end, and a one-way valve communicating with the chamber such that the one-way valve opens, allowing fluid to pass through the one-way valve rapidly, when the piston is moved in a first direction within the tube, and closes, allowing substantially less fluid to pass through the one-way valve, when the piston is moved in a second direction within the tube, the resistance mechanism joining the first element to the second element so that when the second element slides away from the first element, the one-way valve closes, and when the second element slides toward the first element, the one-way valve opens.

2. A device according to claim **1**, wherein the first element further comprises a housing into which the second element slides when pushed upward.

3. A device according to claim **1**, wherein the one-way valve comprises:

a washer that seals the piston against the side of the tube;

a first support element that supports the washer against the side of the tube when the piston is being pulled in one direction; and

a second support element that allows part of the washer to be forced away from the side of the tube by fluid pressure when the piston is being pushed in the opposite direction.

4. A device according to claim **1**, wherein the one-way valve comprises a check valve.

5. A device according to claim **1**, wherein the resistance mechanism further comprises a bleed valve, communicating with the chamber, that allows a limited flow of fluid though the bleed valve.

6. A device according to claim **5**, wherein the bleed valve may be adjusted to modify the rate of fluid flow permitted by the bleed valve.

7. A device according to claim **1**, wherein the fluid is a liquid.

8. A device according to claim **1**, wherein the fluid is a gas.

9. A device according to claim **1**, wherein the tube further comprises at least one cross-sectional irregularity in the interior surface of the tube, the at least one cross-sectional irregularity allowing gas to pass around the piston when the piston passes over the at least one cross-sectional irregularity.

10. A device according to claim **9**, wherein the at least one cross-sectional irregularity comprises at least one groove.

11. A device according to claim **1** further comprising a latch that immobilizes the first element and second element relative to each other when the latch is engaged.

12. A device according to claim **11**, wherein the latch further comprises:

a cam follower element rotably attached to one element of the first element and second element, the cam follower element having an exterior surface and a cam follower mounted on the exterior surface; and

a cam arrangement fixed to the other element of the first element and second element, and positioned so that the cam follower element is inserted within the cam arrangement when the first element and second element are together, the cam arrangement comprising:

a plurality of catch elements separated by grooves, each catch element having a cam surface that guides the cam follower into a groove when the cam follower element is inserted into the cam arrangement and a notch that admits the cam follower, such that when the cam follower rests in the notch the first element and second element are latched together; and

a plurality of wedge cams positioned to guide the cam follower into the notch of one of the plurality of catch elements when the cam follower passes through one of the grooves prior to contacting the wedge cams, and to guide the cam follower into a groove when the cam follower exits a notch prior to contacting the wedge cams.

13. A pull-down cabinet according to claim **1**, further comprising at least one slide track coupling the first element to the second element.

14. A pull-down cabinet, the cabinet comprising:

a first element fixed to an elevated structure;

a second element slidably attached to the first element such that the second element may be pulled downward from the first element, the second element having at least one storage surface; and

a latching mechanism, comprising:

a cam follower element rotably attached to one element of the first element and second element, the cam follower element having an exterior surface and a cam follower mounted on the exterior surface; and

a cam arrangement fixed to the other element of the first element and second element, and positioned so that the cam follower element is inserted within the cam arrangement when the first element and second element are together, the cam arrangement comprising:

a plurality of catch elements separated by grooves, each catch element having a cam surface that guides the cam follower into a groove when the cam follower element is inserted into the cam arrangement and a notch that admits the cam follower, such that when the cam follower rests in the notch the first element and second element are latched together; and

a plurality of wedge cams positioned to guide the cam follower into the notch of one of the plurality of catch elements when the cam follower passes through one of the grooves prior to contacting the wedge cams, and to guide the cam follower into a groove when the cam follower exits a notch prior to contacting the wedge cams.

15. A pull-down cabinet according to claim **14**, wherein the first element further comprises a housing into which the second element slides when pushed upward.

16. A pull-down cabinet according to claim **14** further comprising at least one resistance mechanism that resists the motion of the second element when it slides away from the first element.

17. A pull-down cabinet according to claim **14** further comprising a return mechanism that pulls the second element up to the first element.

18. A method for using a pull-down cabinet with a piston resistance mechanism, the method comprising:

providing a pull-down cabinet according to claim **1**;

causing the second element to descend from the first element;

placing an item on the at least one storage surface; and

causing the second element to ascend to the first element.

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