

VESTIBULE STORAGE ASSEMBLIES AND STORAGE APPARATUS

Field

[0001] The present disclosure relates to storage, and more particularly to vestibule storage apparatus, storage assemblies and structures incorporating vestibule storage assemblies.

5 Background

[0002] Useable space is one of the most valuable resources in many major cities. Shortage of useable and convenient storage space is a major issue for many city dwellers.

Disclosure

[0003] A vestibule storage system is disclosed. The system is an ensemble of apparatus and
10 comprises a storage arrangement which is hinge-mounted on a vestibule sidewall of a vestibule. The storage arrangement comprises a storage assembly for article storage and a wall-mount assembly mounted on the vestibule sidewall and comprising a hinged connection portion having a hinge axis. The storage assembly is mounted on the wall-mount assembly and rotatable relative to the vestibule sidewall between a first position when the storage assembly forms an
15 obstruction or a partial obstruction at the vestibule and a second position when the storage assembly is at an angle to the vestibule to permit un-obstructed passage through the vestibule.

[0004] A storage assembly of a storage arrangement comprising a storage apparatus and a wall-mount apparatus for attaching the storage apparatus to a load-bearing support structure is disclosed. The storage apparatus comprises a storage compartment or a plurality of storage
20 compartments formed on a rigid mounting apparatus. The wall-mount apparatus comprises a wall-mount portion for mounting on the support structure, a weight-bearing portion for carrying or supporting the storage apparatus when the wall-mount portion is mounted on the weight-bearing structure, and a hinged connection portion interconnecting the wall-mount portion and the weight-bearing portion. The weight-bearing portion is pivotally movable and radially extendable
25 relative to the wall-mount portion about a hinge axis of the hinged connection portion, the hinge axis defining an axial direction and a radial direction orthogonal to the axial direction.

Figures

[0005] The disclosure is described by way of example with reference to the accompanying Figures, in which:

30 Figure 1 is a schematic elevation view of a storage arrangement comprising a storage assembly mounted on a load bearing structure in an un-parked configuration,

Figure 1A is a transversal cross-sectional view of Figure 1 taken along the line A-A' and viewed from above the top portion of the storage arrangement, with a dotted arrow showing movement of the storage assembly from a stowed position to an opened position,

Figure 1B is a partially exploded view revealing components of the storage assembly 100 of Figure 1,

Figure 1B1 shows a portion of an example backing assembly and an example wall-mount assembly,

Figure 1B2 shows some components of the example backing assembly of Figure 1B1,

Figure 1B3 is an enlarged view of an example wall-mount section,

10 Figure 1B4 is an enlarged view of a portion of an example backing assembly of Figure 1B1,

Figure 1C is a schematic elevation view of the arrangement of Figure 1 with the example storage arrangement removed,

Figure 2A is a transversal cross-sectional view of the storage arrangement of Figure 1 when the storage assembly is in the stowed position,

15 Figure 2A1 is a transversal cross-sectional view of the storage arrangement of Figure 2A taken at an axial level below the level A-A' of Figure 1 and with example dimensions in mm,

Figure 2A2 is a transversal cross-sectional view of Figure 2A1, with an external gate GD opened,

Figure 2B is a longitudinal cross-sectional view of the storage arrangement of Figure 2A taken along line W-W of Figure 2A,

20 Figure 2C is a front elevation view of the storage assembly 100 in the mode of Figure 2A2 when viewed from outside,

Figures 3A1, 3A2 and 3A3 show example a series of example operation movements of an example storage compartment,

25 Figures 3B1 to 3B4 show a series of expansion or contraction movement of an example wall-mount section,

Figures 4A1 to 4A4 show a series of door opening and closing movements,

Figures 4B1 to 4B4 are transversal cross-sectional views corresponding respectively to the door opening and closing movements of Figures 4A1 to 4A4,

Figures 5A1 to 5A4 show a series of door opening and closing movements,

Figures 5B1 to 5B4 are transversal cross-sectional views corresponding respectively to the door opening and closing movements of Figures 5A1 to 5A4,

Figures 6A to 6I show example variations of the storage apparatus, and

Figures 7A1 to 7A3 show example operational uses of an example storage apparatus.

5 **Description**

[0006] An integrated storage system **10** comprises a storage arrangement **100** which is mounted on a support structure **20**, as depicted in Figures 1 and 1A. The storage arrangement **100** comprises a storage assembly **120** and a wall-mount assembly **140**. The storage assembly **120** comprises a storage apparatus and a support apparatus supporting the storage apparatus.

10 The support apparatus is optionally a backing assembly **122** having a rigid backbone structure to support the storage apparatus **124**. The storage apparatus **124** provides storage space, for example, temporary storage space for articles which people need when entering or exiting an apartment. An example storage apparatus comprises a plurality of storage compartments and optionally the storage apparatus may comprise a single storage compartment. The storage

15 apparatus may be detachably mounted on or integrally formed with the backing assembly **122**. The rigid backing assembly **122** maintains the lateral span and/or shape and dimensions of the storage apparatus when the storage apparatus is flexible or of indefinite shape.

[0007] The storage arrangement **100** is optionally mounted as a single unit or as an integral structure on the support structure **20**, and the weight of the storage arrangement **100**, including

20 the weight of the load carried by the storage assembly **120**, is borne entirely or at least substantially by the support structure **20**. The storage assembly **120** is mounted on the support structure **20** by the wall-mount assembly **140** and the weight of the storage assembly **120** is transferred to the support structure by the wall-mount assembly **140**.

[0008] The wall-mount assembly **140** comprises a load-bearing portion and a wall-mount portion.

25 The load-bearing portion is for bearing the weight of the loaded storage assembly **120** and the weight of the loaded storage assembly **120** is transferred to the support structure by means of the wall-mount portion. The wall-mount portion is for mounting the wall-mount assembly **140** on the support structure **20** so that the weight of a loaded storage assembly **120** is borne or substantially borne by the support structure **20**. To facilitate rotational movement of the storage

30 assembly **120** between a closed position and an open position about a door hinge, the load-bearing portion is rotatable relative to the wall-mount portion (and therefore the support structure) between a closed position and an open position. To facilitate rotation of the load-bearing portion

about a rotation axis, the wall-mount portion comprises a hinged connection portion having a hinge axis which defines the rotation axis. The hinged connection portion may, for example, be an expandable hinged connection portion which is extendable and retractable in a radial direction with respect to the rotation axis of the load-bearing portion, the radial direction being orthogonal to the hinge axis of the hinged connection portion and the axial direction defined by the hinge axis. The hinge axis of the hinged connection portion, also referred to as the connection portion hinge axis, is parallel to the hinge axis of a door in applications where the storage apparatus **124** is rotational coupled to the door. The connection portion hinge axis is vertical or substantially vertical and the storage assembly **120** is pivotally movable horizontally or substantially horizontally about the hinge axis in normal or typical vestibule storage applications. The hinged connection portion facilitates pivotal movement of the load-bearing portion relative to the wall-mount portion about the hinge axis of the hinged connection portion. In some embodiments, the hinged connection portion has its hinge axis slightly inclined to facilitate self-return of the storage assembly **120** to the stowed position when the storage assembly **120** is moved away from the stowed position.

[0009] In example applications, the storage assembly **100** is for indoor or outdoor installation, for example, is installed inside or outside a house, a building or a building unit such as an apartment (collectively, "premises"). To enhance space utilization efficiency, the storage arrangement **100** is mounted on a mounting receptacle which is situated inside or outside the premises and proximal to a vestibule at the entrance portion of the premises. The mounting receptacle defines a vestibule receptacle compartment.

[0010] An example support structure **20** is a part, for example, an integral part, of a wall of a building structure such as an apartment, as depicted in Figures 1 and 1A. The example wall is a partitioning wall, for example, a partitioning wall which separates a private or enclosed area **22** inside an apartment from public or communal areas outside the private area. An entry aperture is defined on the wall. The entry aperture defines an entrance to the apartment and is delineated by a boundary wall, which may be an interior boundary wall or an exterior boundary wall, comprising a first side wall **24** and a second side wall **26** which cooperate to define a vestibule at the entrance of the apartment and which cooperate to define an entry plane. Each one of the first sidewall and the second sidewall is a vestibule sidewall and each vestibule sidewall is a vertical sidewall, and the entry plane is orthogonal to the vestibule sidewall. In this example, the second sidewall is parallel to and opposite facing to the first sidewall and cooperate with the first sidewall to define width of the vestibule.

[0011] In general, the first and the second side walls have same thickness and the thickness defines the depth of the vestibule space, while the separation distance between the first sidewall and the second side wall defines width of the vestibule. The first sidewall and the second sidewall are symmetrically disposed about a center axis which is an axis of lateral symmetry of the vestibule. The center axis is parallel to the first sidewall and is on the entry plane. The entry plane is generally orthogonal to an entry direction along which a person moves in and out of the premises through the vestibule or the entry aperture. The width is measured in a direction orthogonal to the center axis and the entry direction and the depth or thickness of the first side wall is measured along the entry direction. The boundary wall optionally includes a top portion and a bottom portion which cooperate to define height of the vestibule.

[0012] The example boundary wall defines a vestibule frame which is to optionally function as a door mounting frame. The first sidewall **24** and the second sidewall **26** are two lateral sidewalls (that is, left and right sidewalls) of an example vestibule frame which cooperate to define a door mounting receptacle. One entry guard of a plurality of entry guards may be mounted on the door mounting receptacle. In the example of Figures 1A and 1B, a first entry guard and a second entry guard are mounted on the door mounting receptacle. The example first entry guard is for example an inner door **27A** which is mounted on an inner end of the mounting receptacle, for example, by hinged connection on an inner end of the first sidewall, to define a first entry side. The example second entry guard is for example an outer door in the form of a metal grille gate **27B** which is mounted on an outer end of the mounting receptacle, for example, by hinged connection on an outer end of the first sidewall **24**, to define a second entry side. The first entry guard and the second entry guard cooperate to define a vestibule storage space, also known as a vestibule storage volume **28**. The storage arrangement **100** in its stowed position is located or accommodated inside the vestibule storage space **28**, which is an inter-door space in this example, as depicted in Figures 1A and 2A.

[0013] In the example of Figure 1, the wall-mount assembly **140** is mounted on the first sidewall **24** and intermediate the inner and outer ends of the vestibule frame, as depicted in Figure 1B1. The example wall-mount assembly **140** comprises an example plurality of four wall-mount sections. Each wall-mount section comprises a wall-mount device **142** and a load-bearing device **144** which is connected to the wall-mount device **142**. The wall-mount device **142** is for attaching to the support structure and for interconnecting the support structure and the load-bearing device **144**. The wall-mount device comprises a wall-mount plate and a hinged connection joint interconnecting the wall-mount plate and the load-bearing device **144**. The hinged connection

joint has a joint axis which is a hinge axis parallel to the first sidewall and parallel to the door hinge axis. The load-bearing device **144** is for bearing the weight of the storage assembly **120** and comprises a load-bearing member **145A** which extends laterally in a direction orthogonal to the hinge axis of the wall-mount device **142**. The load-bearing device **144** comprises an expansion device **145B** to facilitate extension and contraction of the load-bearing device **144** in the lateral direction, which is a radial direction with respect to the hinge axis of the hinged connection joint of the wall-mount device **142**. The load which is borne by the load-bearing device **144** is transferred to the wall-mounting plate (and therefore the support structure) via the hinged connection joint. The example expansion device **145B** is a foldable joint depicted in Figures 1B1 and 1B3. The example foldable joint is a double hinged joint comprising a first bar portion and a second bar portion which is joined by a hinge joint having a hinge axis parallel to the hinge axis of the wall-mount device **142**. The first bar portion is connected to the hinge joint of the wall-mount device **142** and the second bar portion is connected to the load-bearing member **145A**, for example, by another hinge joint having a joint axis parallel to the hinge axis of the wall-mount device **142**. During example opening operations when the door **27A** is being from a closed position to an opened position, the load-bearing device **144** expands progressively from a substantially folded configuration of Figure 3B1, to a more unfolded configuration of Figure 3B2, to a substantially unfolded configuration of Figure 3B3, and finally to the fully unfolded configuration of Figure 3B4. Conversely, when the door **27A** is being closed, the load-bearing device **144** retracts progressively from the fully unfolded configuration of Figure 3B4 to the substantially folded configuration of Figure 3B1. The radial expansivity and contractability of the load-bearing device **144** facilitates a continuous weight support linkage between the load-bearing device **144** and the backing assembly **122** during opening and closing operations when the radial distance between the backing assembly **122** and the hinge axis of the connection joint progressively changes. Therefore, the radially expandable load-bearing device **144** facilitates provision of load-bearing support to the storage apparatus **124** while the storage apparatus **124** is under rotation about the hinge axis during which the radial distance between storage apparatus **124** and the hinged connection portion keeps changing.

[0014] The load-bearing member **145A** is elongate and comprises for example a metal bar of steel, aluminum or an aluminum alloy, or a hard-plastic bar made for example of PC, ABS or other hard plastics, to provide sufficient weight bearing strength. The bar portions of the expansion device **145B** are optionally made of the same material. In some embodiments, the load-bearing device **144** may comprise a plurality of expansion devices connected in series

and/or in parallel to provide sufficient load-bearing strength. In example embodiments, the load-bearing device **144** may have a single wall-mount section.

[0015] The laterally extending wall-mount sections of the example wall-mount assembly **140** of Figure 1B1 are connected together by a longitudinally extending rigid connector to provide longitudinal reinforcement to support heavier loads. In the example, all the second bar portions of the expansion devices **145B** are rigidly joined by a rigid longitudinal bar. In some embodiments, the ends of the load-bearing member **145A** proximal the wall-mount device may be rigidly connected together. When the wall-mount sections are rigidly connected, movements of the connected bar portions are synchronized so that all the constituting connected bar portions pivots in synchronization about the first sidewall and expands and/or retracts in synchronization with respect to the first sidewall. The load-bearing devices **144** collectively form the load-bearing portion and the wall-mount devices **142** collectively form the wall-mount portion of the wall-mount assembly **140**.

[0016] Each of the wall-mount sections may be individually or independently mounted. When the wall-mount sections are independently mounted, each load-bearing device **144A**, **144B**, **144C**, **144D** is independently movable and is independently extendable and/or independently retractable, as depicted in Figure 1B2. Alternatively, a selected plurality of wall-mount plates may be formed on a single bar to facilitate more expeditions mounting.

[0017] The backing assembly **122** is to provide a backbone structure to support the storage apparatus **124** and comprises a rigid backing apparatus for carrying weight of the storage apparatus **124**. An example backing apparatus comprises a rigid backing frame, as depicted in Figures 1B and 1B1. The example backing frame comprises a plurality of rigid hollow bars **123A**, as depicted in Figure 1B4. Each of the hollow bars **123A** extends laterally and the hollow bars are distributed at different axial levels. The laterally extending hollow bars are optionally connected by a plurality of rigid longitudinal bars **123B**, **C** and the rigid hollow bars cooperate to form a single backing assembly **122**. The rigid longitudinal bar extends orthogonally to the rigid hollow bars to form a rigid backing structure. In some embodiments, the rigid hollow bars may not be connected together or may not be rigidly connected. Each hollow bar has an interior wall defining an internal bore. The internal bore is shaped and dimensioned to match the cross-section of the load-bearing member **145A** so that the elongate load-bearing member **145A** can slide smoothly into and out of the internal bore of the rigid hollow bar **123A**. Each load-bearing member **145A** and a corresponding rigid hollow bar **123A** when assembled form a telescopic pair and the load-bearing member **145A** can move telescopically into and out of the internal

aperture of the rigid hollow bar **123A**. The load-bearing member **145A** and a corresponding rigid hollow bar having an internal aperture also forms a rail-and-channel assembly. In alternative embodiments, the load-bearing member **145A** may be formed as a rigid hollow bar and the bar **123A** is slidable into the internal aperture of the load-bearing member **145A**.

5 [0018] A plurality of friction reduction means, for example, ball bearings, is optionally provided on an upper surface of the load-bearing member **145A**, which is the load-bearing surface, to facilitate smooth insertion and extraction. In some embodiments, the backing frame may comprise only a single rigid hollow bar.

10 [0019] To mount the storage assembly **120** onto the wall-mount assembly **140**, the backing assembly **122**, whether mounted or not mounted with the storage apparatus **124**, is aligned with the wall-mount assembly **140** such that each of the rigid hollow bars is aligned with a corresponding load-bearing member **145A** of the wall-mount assembly **140**. When the storage assembly **120** and the wall-mount assembly **140** are aligned for attachment, the backing assembly **122** is pushed into the load-bearing members **145A**. When the storage assembly **120**
15 is mounted on the wall-mount assembly **140**, the storage assembly **120** is slidable relative to the wall-mount assembly **140** in the radial direction and is detachable from the wall-mount assembly **140** by sliding away from the support structure. Where the backing assembly **122** does not have the storage apparatus **124** mounted on it at the time of attachment with the wall-mount assembly **140**, the storage apparatus **124** can be post-mounted.

20 [0020] The storage assembly **120** is movement coupled, and more particularly rotationally coupled, to the inner door **27A** ("coupled door"). When the storage apparatus **124** is rotationally coupled with the coupled door, the storage assembly is to follow the rotational movement of the coupled door about the door hinge axis during door opening and closing. The example rotational movement coupling between the storage assembly **120** and the door **27A** is facilitated by an
25 example movement coupling device **30**, as depicted in Figure 1B4. The movement coupling device **30** is mounted on an outward facing surface of the door and follows the rotational movement of the door. The example storage apparatus **124** is rotationally coupled with the door, but not axially coupled with the door so that the storage apparatus **124** and the door are free to move relative to each other in the axial direction, which is the direction of the door hinge axis.
30 The movement coupling device **30** comprises a first plate portion which is fixed on an outer surface of the door **27A**, a second plate portion which is parallel to and displaced from the outer surface of the door **27A**, and an intermediate plate portion which interconnects the first and second plate portions. A vertical slot **30A** is formed on the second plate portion. In the example,

the vertical slot is open at the lower free end of the second plate portion to define an entry aperture to the slot and the slot extends upwards from the entry aperture. The movement coupling device **30** is to cooperate with a movement follower device **125** on the storage apparatus **124** to facilitate movement following with no or minimum loading on the door. The

5 example follower device **125** is mounted on a forward-facing surface of a laterally extending rigid hollow bar **123A**, for example, a lateral bar **123A** which forms the uppermost portion of the backing assembly **122**. The forward-facing surface is a surface which faces the vestibule. An example movement follower device **125** comprises a stem portion having a base end mounted on the hollow bar **123A** and an enlarged head portion at a free end of the stem portion distal to

10 the base end, as depicted in Figure 1B4. When the storage assembly **120** and the inner door **27A** are movement coupled, the second plate portion is forward of the forward-facing surface of the rigid hollow bar **123A** and the stem portion protrudes through the slot. The stem portion and the enlarged head portion of the follower device **125** cooperate with the second plate portion to facilitate linking and retention of linking between the storage assembly **120** and the inner door

15 **27A** when the door is subject to pivotal or turning movements about the first side wall. The mechanical movement linkage will be removed when the movement coupling device **30** is detached from the door or is moved out of range of the follower device **125**, or when the enlarged head portion is removed from the stem portion. In example embodiments, the stem portion may be threaded and the enlarged head may be screwed onto a free end of the threaded

20 stem portion to form a movement follower device **125** having a detachable head portion. In some embodiments, the slot **30A** is a closed slot. To mitigate or minimize possible transfer of weight from the storage apparatus to the door, the slot has a width that is larger or slightly larger than the width of the stem portion so that the stem portion is allowed to slide freely along the slot and/or in and out of the slot in a direction orthogonal to the outer surface of the door. The slot

25 also limits or restricts relative radial movement between the storage apparatus and the coupled door.

[0021] Referring to Figures 1A and 2A, a door mounting receptacle is formed on the weight bearing support structure **20**. The door mounting receptacle comprises the first sidewall **24** and the second sidewall **26** which cooperate to define an entry plane and an entry aperture to the

30 premises. A first door mounting frame is mounted on one lateral side of the support structure to form the first side wall **24** of the door mounting receptacle and a second door mounting frame is mounted on an opposing lateral side of the support structure to form the second side wall **26** of the door mounting receptacle. The first door **27A** is mounted on a first entry side of the door mounting receptacle and the second door **27B** is mounted on a second entry side of the door

mounting receptacle. Each of the first door **27A** and the second door **27B** is movable between a closed state and an open state with respect to the door mounting receptacle. When the door is in the closed state, the door is parallel to the entry plane and forms a transversal barrier to block or partially block the entry aperture. When the door is in the open state, the door is at an angle
5 to the entry plane and defines a passageway to permit entry into the premises or to permit exit therefrom. The first door **27A** is movable about its door hinge axis between a closed state and an open state. A vestibule storage space **28** is defined between the first door **27A** and the second door **27B**. A storage assembly **120** is mounted inside the vestibule storage space **28**. The storage assembly **120** is mounted on the support structure by means of a hinged
10 connection portion of the mounting assembly **140** which is mounted on the first side wall and the weight of the storage assembly **120** is substantially, if not entirely, supported by the wall-mount assembly **140**. The hinged connection portion of the mounting assembly **140** has a hinge axis which is radially displaced from the hinge axis of the door **27A**. The storage assembly **120** is rotational coupled to the first door **27A** so that rotation of the first door **27A** about its door hinge
15 will bring about rotational movement of the storage assembly **120** about the door hinge axis. Since the storage assembly **120** is to rotate about a first hinge axis which is the door axis of the door **27A** while under load-bearing linkage to the hinged connection portion having a hinge axis which is radially displaced from the door axis.

[0022] Referring to Figures 2A and 2A1, the storage assembly **120** is parked in a stowed
20 position. When in the stowed position, the storage assembly **120** is accommodated entirely within the vestibule storage space **28**, and the storage assembly **120** forms at least a partial barrier at the vestibule. When in the stowed position, the storage apparatus **124**, including the backing assembly **122** is orthogonal to the first sidewall and is parallel to or coplanar with the entry plane. When in the stowed position, the load-bearing portion of the wall-mount assembly
25 **140** is orthogonal to the first sidewall and is parallel to or coplanar with the entry plane.

[0023] In the example situation of Figure 2A, both the inner door **27A** and the outer door **27B** are closed, or in the parked state. When closed or in the parked state, each of the doors is parallel to the entry plane to obstruct entry or orthogonal to the vestibule sidewall, and forms an entry barrier across the entrance vestibule. When the outer door is un-parked or opened, as
30 depicted in Figure 2A2, the storage assembly **120** is exposed to the outside but remains in the stowed position, as depicted in Figures 2B and 2C. In some embodiments, the outer door is mounted on a slide rail and is slidable to open and close.

[0024] On the other hand, when the inner door is opened, that is, rotated away from the vestibule storage volume or the entry plane by an angle θ , as depicted in Figure 1A, the storage apparatus **124** follows the rotational movement of the door **27A**, and is at the angle θ to the entry plane to permit entry. Typically, the angle is more than 30 degrees, and usually between
5 **30** degrees and 90 degrees. When the door **27A** is being opened, the movement follower device **125** follows the opening movement of the door and moves pivotally relative to the hinge axis of the wall-mount device **142**, and the resulting pivotal movement of the follower device **125** brings about the pivotal movement of the storage apparatus **124**. Since the door **27A** and the storage apparatus **124** is mechanically and non-weight coupled such that the door does not need to bear
10 the weight, or any significant weight, of the storage apparatus **124**, it is only necessary to exert a rotation driving force on the coupled door and about the door hinge axis which is sufficient to facilitate turning of the loaded door in order to rotate the coupled door.

[0025] When the storage arrangement **10** is removed from the vestibule storage volume **28**, the vestibule and the vestibule storage volume **28** is freed up, as depicted in Figure 1C.

15 [0026] An example series of door opening and closing operations is depicted in Figures 4A1 to 4A4 and 4B1 to 4B4.

[0027] Initially, the storage system **10** is in the closed state of Figure 2A when the inner door **27A**, the outer door **27B** and the storage assembly **100** are in the parked state. When in this closed state, the inner door **27A**, the outer door **27B** and the storage assembly **100** are all entry
20 barriers at the vestibule.

[0028] To exit from the premises, a person will cause the inner door **27A**, i.e., the coupled door, to open. When the coupled door is being opened, the angle between the coupled door and the entry plane progressively increases from zero (when the coupled door is parallel to the entry plane) to an opening angle, for example, θ , which is sufficient for entry. Due to the movement
25 coupling between the storage apparatus and the coupled door, the angle between the storage apparatus and the entry plane also progressively increases from zero to θ , as depicted in Figure 4A1 and 4B1. When in this partially opened state, the outer door is exposed to the interior of the premises while remaining as an exit barrier to obstruct exit.

[0029] Next, the user will progress from the interior **22** of the premises and move into the
30 vestibule region to cause the outer door to open, as depicted in Figures 4A2 and 4B2. When in this dual opened state, both the inner door and the outer door are open and a through-passageway interconnecting the interior and outside space is formed.

[0030] When the user is outside the vestibule, the user will cause the inner door and the outer door to close, and the storage system will resume its closed state, as depicted in Figures 4A3, 4A4 and 4B3 and 4B4.

5 [0031] An example series of door opening and closing operations is depicted in Figures 5A1 to 5A4 and 5B1 to 5B4.

[0032] Initially, the storage system **10** is in the closed state of Figure 2A. When in this closed state, the vestibule is closed in both the entry direction and exit direction and the vestibule storage space is a closed or enclosed space enclosed between the inner door and the outer door.

10 [0033] To gain entry into the premises, a person will cause the outer door **27B** to open. When the outer door is at an angle sufficient for entry, the inner door **27A** and the storage apparatus are exposed and accessible while remaining as an entry barrier to obstruct entry, as depicted in Figures 5A1 and 5B1. When the storage system **10** is in this partially opened state, the inner door **27A** and the storage assembly **100** remain as entry barriers at the vestibule.

15 [0034] Next, the user will cause the inner door **27A**, i.e., the coupled door, to open while the outer door remains open. When the coupled door is being opened, the angle between the coupled door and the entry plane progressively increases from zero degree (when the coupled door is parallel to the entry plane) to an opening angle, for example, θ , which is sufficient for entry. Due to the movement coupling between the storage apparatus and the coupled door, the
20 angle between the storage apparatus and the entry plane also progressively increases from zero to degree θ , as depicted in Figures 5A2 and 5B2. When in this further partial opened state, all the entry barriers at the vestibule is released.

[0035] After the coupled door **27A** has been opened, the user will enter the interior of the premises and cause the outer door **27B** to close, as depicted in Figures 5A3 and 5B3.

25 [0036] Subsequently, the user will cause the outer door **27B** to close, as depicted in Figures 5A4 and 5B4 and the system **10** resumes the closed state of Figure 2A.

[0037] A user may access the storage apparatus for article storage and/or retrieval when in for example the opened states of Figures 4B1, 4B2, 4B3, and 5B1, 5B2, 5B3.

30 [0038] Each of the first door and the second door herein is intended to function as an entry barrier (also known as an entry guard), and more specifically, a re-closable entry barrier to block or obstruct passage through the vestibule.

[0039] In some embodiments, the storage system may have only a single entry-barrier, for example, only an outer door or an inner door, and the storage arrangement **100** may be rotationally coupled to the single-entry barrier or may not be movement coupled to an entry barrier. When the storage system has a single entry-barrier, the vestibule storage space is always accessible from the interior or the exterior of the premises. Where the vestibule storage arrangement is rotationally coupled with a coupled door, a thoroughfare is formed at the vestibule when the single-entry barrier or all entry barriers is in an open state.

[0040] In alternative embodiments, the storage system may have no additional door as an entry barrier, and the storage system in its stowed position may function as an entry barrier or a partial entry barrier across or at the vestibule. Where the vestibule storage arrangement has no additional entry barrier to the storage assembly, the vestibule is closed or opened depending on whether the storage system is in the open state or closed state.

[0041] In some embodiments, the movement coupling mechanism which facilitates rotational coupling between a coupled entry barrier (also known as a coupled door) and the storage assembly is a releasable coupling mechanism which is to facilitate independent operation of the storage assembly when needed or desired. When rotational movement coupling between the entry barrier and the storage assembly is released, the storage assembly is not or no longer mechanically linked to the hinge of the coupled entry barrier. When in this released or non-coupled state, the storage assembly is to rotate about its own hinge, which is the hinge axis of the hinged connection portion of the wall-mount assembly during opening and closing operations, and does not rotate about the hinge axis of the coupled entry barrier.

[0042] In some embodiments including the one of Figure 1, the entry barriers include a grille entry guard such as a metal grille door and a non-grille sealing door such as a wooden door.

[0043] An example storage apparatus **120** comprises a plurality of storage compartments, as depicted in Figures 1, 2B, and 6A to 6I. The storage compartments are arranged into a plurality of rigid storage cabinets each having a definite shape and a definite storage volume. The storage compartments are mounted on a back panel and arranged in a matrix of rows and columns. The storage cabinets may be modular storage cabinets each of which can be individually or independently attached to the rigid backbone member of the backing assembly **122**. In some embodiments, the storage cabinets may be formed as a singular set of storage cabinets. In some embodiments, the storage cabinets may be integrated with the rigid backbone member as a singular unit without loss of generality. In some embodiments, the storage

compartments may comprise storage pockets made of soft and/or flexible materials and may have no definite shape to facilitate flexible storage utility.

[0044] An example storage cabinet is a self-returning cabinet as depicted in Figures 3A1 to 3A2. The storage cabinet is hinged mounted on a rigid main cabinet frame by a pair of hinges having a horizontal hinge axis. The pair of hinges is mounted proximal a lower end of the cabinet and the cabinet is designed such that its center of gravity, whether with or without load, will cause the cabinet to self-return to its closed position when open due to moment of the center of gravity about the hinge axis. In general, the center of gravity of the cabinet is to always locate behind and above the hinge axis.

[0045] The support structure or the vestibule frame may be made of concrete, mortar, timber, steel, aluminum, galvanized iron, metals or alloys of metals, composite material, plastics, any materials suitable for formation of a support structure, or their combination.

[0046] The door mounting frame may be made of timber, steel, aluminum, galvanized iron, metals or alloys of metals, composite material or plastics, any materials suitable for formation of a door and gate mounting.

[0047] While the disclosure has been described with reference to the examples and figures, it should be appreciated that the examples and figures are not intended as limitations or restrictions. For example, the terms vertical, horizontal, parallel, orthogonal, etc. herein includes, respectively, substantially vertical, substantially horizontal, substantially parallel, substantially orthogonal, etc., without loss of generality. For, a singular noun is not limited to a singular item and may cover plural items, unless the context otherwise specifies. Likewise, a plural noun is not intended as a limitation to refer to a plurality of items and may refer to a singular item where the context requires or allows or unless the context otherwise specifies.

[0048] Table of numerals

storage system	10	support structure	20
		Inside area	22
		first sidewall	24
storage arrangement	100	Second sidewall	26
		Vestibule storage space	28
storage assembly	120	movement coupler	30
Backing assembly	122	wall-mount assembly	140
Lateral member	123A	wall-mount device	142
Axial member	123B	load-bearing device	144
		load-bearing member	145A
storage apparatus	124	Expansion device	145B
Follower device	125		