

AN APPARATUS FOR COLLECTING RECYCLABLES

[001] The invention relates to an apparatus for collecting recyclables. More specifically, an apparatus applicable in reverse vending of recyclables, which accepts a continuous feed of items for identification, segregated disintegration, and sorted binning.

BACKGROUND OF THE INVENTION

[002] Reverse Vending Machines are a well-known solution to collect used beverage containers and increase the collection-for-recycling rate of these containers. In recent years, reverse vending machines (RVMs) have gained relative popularity as a waste management strategy as they serve as effective machines that foster recycling awareness among the general public. Typically, an RVM collects recyclable items, such as plastic bottles and aluminium cans, from the user. In return, it shall preferably provide a reward in exchange for the user's recycling efforts. RVMs have currently become prevalent in countries that prioritize sustainability and recycling, with them now present across the world.

[003] There are a few disclosed technologies over the prior art that relate to RVMs. Among the earliest known disclosure of the technology is US1560242A, which discloses a machine that is particularly adapted for use in dispensing bottled goods in exchange for coin return as compensation. Subsequent innovations to the technology are as disclosed in US5860503A, which relate to a combination of technical features that are found in most modern RVMs.

[004] However, regardless of these technological advancements in RVMs, they typically operate at a loss, and as such, are required to be subsidised under government-linked programs such as a Deposit Return Scheme. Hence, unless a country has similar programs in place, RVMs are unlikely to become widespread in the said country due to their poor intrinsic economics. The reason behind these poor economics is due to these machines having a low-quality recycling output. This is because the items collected by these machines are typically mixed in terms of material composition and/or colouration without consideration of their recyclability. Hence, these collected items have low recycling value as contaminants may be present within the collected items. Moreover, it is time-consuming

to manually separate the collected items based on their recyclability, material composition and colouration.

[005] In particular, recyclers of polyethene terephthalate (PET) plastic desire to acquire pure shredded fractions of plastics that are preferably separated by their colouration, i.e. clear colour, light blue colour, green colour, etc. Moreover, they desire for polyvinyl chloride (PVC) plastics to be removed from the collected items, as PVC is a dangerous contaminant in the conventional recycling process, and its presence can ruin a whole batch of recycled items, impacting their use case in high-value recycling applications such as food-safe recycled items.

[006] Among the technologies in RVMs that intend to fully or partially address the aforementioned concerns include US4653627A, which discloses a kind of RVM for recycling. A bulk of recyclable items is placed into the in-feed station of the machine. Each recyclable item from the bulk is then transferred to an on-load station having a rotating frame. Sensors along the on-load station sort the recyclables based on weights and metallicity. Accepted recyclable items are crushed and disposed in designated receptacles. Yet another disclosed technology includes DE10348009A1, which discloses a conveyor in the form of an outer rotating drum and an inner rotating drum receives a queue of recyclable items. One or more sensors are in place within the conveyor for the identification and registration of recyclable items. The conveyor sorts and disposes of the recyclable items accordingly into one or more receptacles.

[007] While the prior arts have disclosed technologies that intend to fully or partially address the aforementioned concerns, it is evident that further work is needed within this technological space. To improve the economics of recycling vending machines and make them profitable and optimal, increasing the density and purity of its output is key. Accordingly, it is desirable to have an apparatus applicable for use in RVMs that is configured for collecting items and for producing one or more groups of pure disintegrated recyclable material in that they are free from the contamination of PVC plastics.

SUMMARY OF INVENTION

[008] The main objective of the invention is to provide an apparatus for collecting recyclables, with said concepts of said apparatus being applicable in the machines or devices configured for the reverse vending of recyclables such as reverse vending machines (RVMs). To achieve this objective, the apparatus is configured to accept a continuous feed of items for identification, segregated disintegration, and sorted binning. The apparatus is configured to determine the recyclability of the items. Items that are deemed recyclable, such as PET bottles for example, are then sent for a segregated disintegration and a sorted binning based on their characteristics, i.e. their identified material composition and/or colouration. In particular, the apparatus has a single shredder that is partitioned to form two or more shredding sections that are adjacently sealed for performing the segregated disintegration. With each shredding section configured to receive the ejected items of the same characteristics accordingly, the shredder effectively prevents cross-contamination of items between shredding sections as they are disintegrated. Therefore, one or more groups of disintegrated recyclable matter are produced and each group undergoes a sorted binning into corresponding receptacles of a bin unit.

[009] Advantageously, the apparatus of the present invention is capable of allowing a user to provide a continuous feed of items thereinto for them to be appropriately handled to be prepared for recycling, without any limitations to the acceptance of a single type of item (i.e. only clear colour items, only PET items, etc.), thereby increasing its practicability in its operation and deployment of RVMs when used therein them. This also eliminates the need for the installation of a plurality of RVMs within a single location. With this, a more affordable solution is provided in terms of upkeep and maintenance.

[0010] Advantageously as well, the apparatus provides a partitioned shredder that may compactly fit within a single RVM for the segregated disintegration of items. With this, the apparatus may bin one or more groups of disintegrated recyclable matter. The partitioned shredder allows prevents cross-contamination of items of different characteristics between shredding sections. With this, the apparatus may operate on a profit without reliance on subsidy programs.

[0011] Advantageously as well, the identification of the characteristics of the items done by the apparatus prior to their segregated disintegration prevents future issues in downstream recycling processes, especially when the disintegrated recyclable matter are converted into a recycled item in a recycling process. With contaminants such as PVC removed from the recycling process, the recycled item will see its use case in high-value recycled product applications such as food-safe recycled items, especially after disintegrated recyclable matter undergoes a simplified food-grade recycling process at a food-grade recycling plant.

[0012] The present invention intends to provide an apparatus for collecting recyclables, comprising a loader unit for receiving one or more items inserted by a user, an identification unit for identifying characteristics of each item, a transport unit for transporting the items, an ejector unit for ejecting at least one item from the transport unit based on its identified characteristics, and a disintegrator unit for disintegrating the ejected item into disintegrated recyclable matter, which comprises a shredder that is partitioned to form two or more shredding sections that are adjacently sealed therebetween. Each shredding section is configured to receive the ejected items of the same characteristics accordingly such that the apparatus produces one or more groups of disintegrated recyclable matter.

[0013] Preferably, the shredder is configured to form a first shredding section, a second shredding section, and a third shredding section.

[0014] Preferably, the disintegrator unit further comprises an input chute and an output chute that are joined with the shredder in a sealed manner.

[0015] Preferably, the input chute is configured to have two or more compartments that include a first compartment, a second compartment, and a third compartment, and the output chute is configured to have two or more exits that include a first exit, a second exit, and a third exit.

[0016] Preferably, the disintegration unit defines one or more collateral paths in which the ejected item correspondingly travels amongst for disintegration that includes a first path defined to include the first compartment, the first shredding section and the first exit, a second path defined to include the second compartment, the second shredding section and

the second exit, and a third path defined to include the third compartment, the third shredding section and the third exit.

[0017] Preferably, the shredding sections of the shredder each have a set of blades that radially rotate about a shared shaft.

[0018] Preferably, the set of blades for each shredding section includes any one or a combination of blades of irregular lengths, blades having lengths that increase and decrease or vice versa, and blades of a fixed length.

[0019] Preferably, the shredder further comprises perforated panels fitted below each shredding section that ensures the item is separated into disintegrated recyclable material.

[0020] Preferably, the transport unit further comprises one or more moving belts, each with protrusions, the belts being laterally aligned to each other via said protrusions, for defining carriers that transport the items.

[0021] Preferably, the transport unit further comprises retaining walls for accommodating the item within the carrier as it is made to ascend, descend, or move at an under-side of the transport unit.

[0022] Preferably, the retaining walls of the transport unit are formed with one or more exposed sections for exposing the carriers for any one or a combination of receipt of items from the loader unit, ejection of items from the transport unit to the disintegrator unit by the ejection unit, and a discarding of items from the transport unit.

[0023] Preferably, the ejector unit comprises one or more displacers that correspondingly displace the item off the transport unit for it to exit the transport unit based on its identified characteristics.

[0024] Preferably, the characteristics identified by the identification include material composition of the item and colouration of the item.

[0025] Preferably, the apparatus further comprises a control unit for exerting control over at least any one or a combination of the transport unit and the ejector unit based on any one or both the material composition of the item and the colouration of the item.

[0026] Preferably, the item is of a material composition that includes polyethene terephthalate, high-density polyethene, polyvinyl chloride, low-density polyethene, polypropylene, and polystyrene, or any other known plastic polymers.

[0027] Preferably, the item is of a colouration that includes clear colour, blue colour, green colour, or any other colour.

[0028] The present invention further intends to provide a shredder for use in an apparatus for collecting recyclables, wherein the shredder is partitioned to form two or more shredding sections that each are adjacently sealed therebetween, and each shredding section is configured to receive one or more ejected items of the same characteristics accordingly such that the apparatus produces one or more groups of disintegrated recyclable matter.

[0029] The present invention also intends to provide a method for collecting recyclables, comprising the steps of receiving one or more items inserted by a user, by a loader unit, identifying characteristics of each item, by an identification unit, transporting the items, by a transport unit, ejecting the items from the transport unit, by an ejector unit, and disintegrating the ejected item into disintegrated recyclable matter, by a disintegrator unit, which comprises a shredder that is partitioned to form two or more shredding sections that are adjacently sealed therebetween. Each shredding section is configured to receive the ejected items of the same characteristics accordingly such that the apparatus produces one or more groups of disintegrated recyclable matter.

[0030] Preferably, the step of identifying characteristics of each item, by an identification unit, further comprises the steps of identifying the material composition of the items, and identifying the colouration of the items.

[0031] Preferably, the method further comprises the steps of determining the acceptability of the items for their collection based on their material composition, and instructing the

ejector unit to correspondingly eject items from the transport unit based on their colouration for their disintegration.

One skilled in the art will readily appreciate that the invention is well adapted to carry out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments described herein are not intended as limitations on the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] To facilitate an understanding of the invention, there is illustrated in the accompanying drawings the preferred embodiments from an inspection of which when considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

[0033] **FIG. 1** is a block diagram illustrating the apparatus of the present invention in its preferred implementation.

[0034] **FIGS 2a** and **2b** are diagrams illustrating perspective views of the apparatus from its front. In particular, **FIG. 2a** illustrates the apparatus with its front panel, whereas **FIG. 2b** illustrates the apparatus with its front panel removed.

[0035] **FIGS 3a** and **3b** are diagrams illustrating back and front views of the apparatus. In particular, **FIG. 3a** illustrates a front view of the apparatus with its front panel removed, whereas **FIG. 3c** illustrates a back view of the apparatus with its back panel removed.

[0036] **FIG. 4** is a diagram illustrating a perspective view of the loader unit of the apparatus.

[0037] **FIGS 5a** to **5d** diagrams illustrating the transport unit of the apparatus. In particular, **FIGS 5a** illustrates an upper-side perspective view of the transport unit with its retaining walls and **FIG 5b** illustrates an upper-side perspective view of the transport unit without its retaining walls. Whereas, **FIGS 5c** illustrates an under-side perspective view of the transport unit with its retaining walls and **FIG 5d** illustrates an under-side perspective view of the transport unit without its retaining walls.

[0038] **FIG 6** is a diagram illustrating a perspective view of the ejector unit of the apparatus from its under-side.

[0039] **FIG. 7a** illustrates the disintegrator unit of the apparatus comprising an input chute, a shredder, and an output chute. **FIG. 7b** illustrates a perspective view of the shredder viewed from the top. **FIG. 7c** illustrates a perspective view of the shredder unit viewed from the bottom. **FIG. 7d** illustrates a perspective view of portions of the shredder without its frame. **FIG. 7e** illustrates a perspective view of portions of the shredder without its frame, perforated panels, and rods. **FIGS 7f to 7h** illustrates one or more longitudinal side views of the blades on the shaft of the shredder unit. **FIGS 7i and 7j** illustrate one or more lateral side views of the blades on the shaft of the shredder unit. **FIG. 7k** illustrates the blades of the shredder. **FIG. 7l** illustrates the one or more collateral paths that are to be undertaken by an item for its disintegration.

[0040] **FIGS 8a and 8b** are diagrams illustrating the bin unit of the apparatus. In particular, **FIG. 8a** illustrates a perspective view of the bin unit viewed from its top. Whereas **FIG. 8b** illustrates a perspective view of the bin unit viewed from its bottom.

[0041] **FIG. 9** is a diagram illustrating an arrangement between the loader unit and the transport unit that is configured in the present invention for their interactions with the items.

[0042] **FIG. 10** is a diagram illustrating an arrangement between the transport unit, the ejector unit, and the disintegrator unit that is configured in the present invention for their interactions with the items.

[0043] **FIG. 11** is a diagram illustrating an example flowchart describing an intended operational flow of the apparatus as the user inserts items thereinto.

DETAILED DESCRIPTION OF THE INVENTION

[0044] The present invention relates to an apparatus that collects recyclables that accepts a continuous feed of items for their identification, disintegration and sorted binning.

[0045] According to the concept of the invention, the apparatus comprises a loader unit, an identification unit, a transport unit, an ejector unit, a disintegrator unit, and a bin unit. In particular, the loader unit supports a continuous feed of items. Upon identification of characteristics of said items, which may include their material composition and/or colouration, they are provided to the transport unit by the loader unit. The transport unit transports the items to be in the vicinity of the ejector unit, whereby items having a material composition acceptable for recycling are to be ejected, based on their colouration, into the disintegrator unit to undergo a segregated disintegration for them to become disintegrated recyclable matter. The disintegrated recyclable matter then undergoes a sorted binning as they are received by a corresponding receptacle of the bin unit. With each shredding section of the shredder configured to receive the ejected items of the same characteristics accordingly, one or more groups of disintegrated recyclable matter are produced by the apparatus. Items that have characteristics unacceptable for recycling are passed over for ejection and shredding, and are eventually discarded.

[0046] In the context of the present invention, it is to be noted that the apparatus of the present invention intends to be applicable in, or is, machines or devices configured for the reverse vending of recyclables, i.e. reverse-vending machines.

[0047] The invention will now be described in greater detail, by way of example, with reference to the figures. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0048] **FIG. 1** illustrates a block diagram of the apparatus **1** of the present invention in its preferred implementation. As shown, the apparatus **1** comprises a loader unit **11**, an identification unit **12**, a transport unit **13**, an ejector unit **14**, a disintegrator unit **15**, a display unit **16**, and a bin unit **17**. The apparatus further comprises a control unit **2** having a processor **21** that operates a plurality of modules pertaining to the intended operational flow of the

apparatus **1**, and a memory unit **22**. The apparatus is to be supplied with a feed of items **3**, by means of a successive insertion of one or more items **3** by a user into the apparatus **1**, for them to be identified, disintegrated, sorted, and binned therein.

[0049] It is to be noted that item **3** may or may not be suited for recycling.

[0050] In particular, the characteristics of item **3** may be in terms of its material composition. Its material composition, may be, by way of example, polyethene terephthalate (PET), high-density polyethene (HDPE), polyvinyl chloride (PVC), low-density polyethene (LDPE), polypropylene (PP), polystyrene (PS), or any other known plastic polymers. However, it should be noted that item **3** may also be of materials that include metals, glass, ceramics, or other recyclable materials known in the art.

[0051] In particular, the characteristics of item **3** may be in terms of its colouration. Its colouration, may be by way of example, clear colour, light blue colour, green colour, or any other colour known in the art of recyclable materials. It is to be noted that “clear colour”, in the context of the present invention, refers to item **3** lacking colouration and being transparent.

[0052] Furthermore, it is noted that item **3** may be, by way of example, in the form of a bottle, a container, a can, or the like.

[0053] It is to be noted that, a group of disintegrated recyclable matter is to be pure in that they are free from contamination by PVC plastics. Each group of disintegrated recyclable matter that results from the disintegration of items **3** that have the same characteristics in terms of their colouration, material composition, or both, wherein the items **3** that have the same characteristics may further mean that the items **3** at least have substantially similar characteristics with trace amounts of impurities.

[0054] It is to be noted that item **3** may further include the material composition of non-PEC (Polyethylene terephthalate Ethylene vinyl alcohol Copolymer) plastics mixed therein, which originates from the bottle caps or labels that may be present on the item **3**. Even so, since non-PEC plastics are easily separated in conventional recycling processes, it is not an impurity to be concerned about even if present in the disintegrated recyclable matter.

Therefore, this further supports the interpretation that a group of disintegrated recyclable matter further extends to the consideration that it may have trace amounts of impurities (non-PEC, HDPE, PP, etc.) that may be easily removable through a conventional recycling process known in the art. Though most importantly, each group of disintegrated recyclable matter must be free from PVC plastics.

[0055] **FIGS 2a** and **2b** illustrate perspective views of the apparatus **1** from its front. In particular, **FIG. 2a** illustrates the apparatus **1** with its front panel **1a**, whereas **FIG. 2b** illustrates the apparatus **1** with its front panel **1a** removed.

[0056] **FIGS 3a** and **3b** illustrate illustrating back and front views of the apparatus **1**. In particular, **FIG. 3a** illustrates a front view of the apparatus **1** with its front panel **1a** removed, whereas **FIG. 3c** illustrates a back view of the apparatus **1** with its back panel removed.

[0057] As shown in **FIG 2a**, the front panel **1a** of apparatus **1** supports the mounting of portions of the loader unit **11** and the entirety of the display unit **16**. Furthermore, the front panel **1a** includes an access door **1b**, which may allow a user or a collector to have access to specific internal portions of the apparatus **1**, preferably the receptacles of the bin unit **17**.

[0058] Shown in **FIGS 2b, 3a**, and **3b** are the internals of the apparatus **1**, which shall henceforth be described. The loader unit **11** is preferably positioned at a front-end of the apparatus **1** from within, and it is substantially adjacent to or overlaps with portions of the transport unit **13**. The ejector unit **14** is preferably positioned at a top-end of the apparatus **1** from within, and it is substantially adjacent to or overlaps with portions of the transport unit **13**. The disintegrator unit **15** is preferably positioned at a rear-end of the apparatus **1** from within, and it is substantially adjacent to both the transport unit **13** and the ejector unit **14**. The bin unit **17** is preferable positioned at a bottom-end of the apparatus **1** from within, and is substantially below the transport unit **13** and the disintegrator unit **15**. Whilst not shown, the positioning of identification unit **12** is well known in the art, and may be, by way of example, positioned to be in the vicinity of the loader unit **11** for it to perform its functions.

[0059] **FIG. 4** illustrates a perspective view of the loader unit **11**. As shown, it comprises an entry **111** and a linear conveyor **112**. The entry **111** preferably has an opening that is of appropriate width and height, and it is attached to the front panel **1a** as shown in **FIG 2a** for

enabling a user to insert items **3** into the apparatus **1**. Whereas, the linear conveyor **112** preferably further comprises a belt **1121** driven by a first actuator **1122**. Preferably, a feed of items **3** is inserted into apparatus **1** via the entry **111** with the item **3** being at an orientation in which it is laid upon the belt **1121** on its longitudinal sides. The first actuator **1122** may then actuate the belt **1121** to move the items **3** therealong for each of them to be picked up by transport unit **13** for their eventual disintegration or to be discarded.

[0060] **FIGS 5a to 5d** illustrate the transport unit **13**. In particular, **FIGS 5a** illustrates an upper-side perspective view of the transport unit **13** with its retaining walls **133** and **FIG 5b** illustrates an upper-side perspective view of the transport unit without its retaining walls **133**. Whereas **FIGS 5c** illustrates an under-side perspective view of the transport unit **13** with its retaining walls **133**, and **FIG 5d** illustrates an under-side perspective view of the transport unit **13** without its retaining walls **133**.

[0061] As shown in **FIGS 5a to 5d**, the transport unit **13** comprises a buffer conveyor that transports items **3** temporarily retained therewithin in a looped manner, preferably from bottom to top and vice versa. Preferably, the buffer conveyor is configured to have one or more distributed pulleys **131** that form a quadrilateral outline, or alternatively, a circular outline. These pulleys **131** are further interfaced with a second actuator **134** for their simultaneous rotational motion.

[0062] As shown in **FIGS 5a to 5d**, these pulleys of transport unit **13** are strapped with a plurality of belts **132a** that each comprises a plurality of protrusions **132b**. Preferably as well, the belts **132a** of the transport unit **13** are parallel to each another. When these belts **132a** are made to move by the pulleys **131** in a clockwise or an anti-clockwise direction, each protrusion **132b** of one belt **132a** is preferably laterally aligned with a protrusion **132b** of another belt **132a** of the transport unit **13** during movement. This alignment allows for a formation of a carrier **132** that moves an item **3** while it remains retained between a set of longitudinally opposing protrusions **132b**. The protrusions **132b** are preferably rigid and upright. The protrusions **132b** preferably has a panel-like shape. However, it may be any other shape as long as it provides an interruption onto the surface of the belts **132a** of the transport unit **13** while defining at least one carrier **132** as described that remains rigid while retaining and moving the item **3** therein.

[0063] As shown in **FIGS 5a to 5d**, the retaining walls **133** of the transport unit **13** support the retaining of the item **3** within the carrier **132** of the transport unit **13**, especially when the item **3** is conveyed along an under-side of the buffer conveyor, ascending along a side portion of the buffer conveyor, or descending along another side portion of the buffer conveyor. Preferably, the protrusions **132b** has a height that is slightly below the retaining walls **133** and its rigidity prevents items **3** from crossing between carriers **132** especially when they are made to ascend or descend.

[0064] As shown in **FIGS 5a and 5c**, the retaining walls **133** of the transport unit **13** is further formed with one or more exposed sections. In particular, on the upper-side of the transport unit **13**, there is a first exposed section that forms an ejection section whereby items **3** within the carriers **132** may be ejected therefrom by the ejector unit **13** to be disintegrated. In particular as well, on the under-side of the transport unit **13**, there is a second exposed section that forms a receiving section whereby items **3** on the liner conveyor **112** of the loader unit **11** may be picked up to enter the transport unit **13**. In particular as well, on the under-side of the transport unit **13**, there is a third exposed section that forms a discard section, whereby items **3** that reach said section may exit the transport unit **13** by falling into a corresponding receptacle of the bin unit **17**. Preferably, the ejection section exposes at least three carriers **132**, the receiving section exposes at least one carrier **132**, and the discard section exposes at least one carrier **132**.

[0065] Whilst not shown, the transport unit **13** may further comprise sensors for marking designations to the carriers **132** and determining an occupancy condition of the carriers **132**. Preferably, these sensors are distributed along each carrier **132** of the transport unit **13**.

[0066] **FIG 6** illustrates a perspective view of the ejector unit **14** from its under-side. As shown, the ejector unit **14** comprises a third actuator **141**, one or more displacers **142a**, **142b**, **142c**, one or more gates **143a**, **143b**, **143c**, a stopper **144**, and a cover **145**. When in use, the third actuator **141** actuates at one or a combination of the displacers **142a**, **142b**, **142c** to displace an item **3** retained in a carrier **132** that is at the ejection section of the transport unit **13**, preferably via an application of a push force. Preferably, any one or a combination of the displacers **142a**, **142b**, **142c** are actuated until they are adjacent to the stopper **144**. At this point, the displacers **142a**, **142b**, **142c** would have substantially displaced the item **3** off from its carrier **132** for it to exit the transport unit **13** via the gates **143a**, **143b**, **143c**.

[0067] FIGS 7a to 7k relate to the disintegrator unit 15 and its various components.

[0068] Shown in FIG. 7a is that the disintegrator unit 15 comprises an input chute 151, the shredder 152, and an output chute 153, with the shredder 152 being arranged to be in-between the input chute 151 and the output chute 153.

[0069] The input chute 151 is formed by a plurality of walls that include a front wall 1511, a rear wall 1512, side walls 1513, 1514, and one or more dividers 1515, 1516. In particular, a first compartment may be formed by a space between the first side wall 1513 and the first divider 1515, a second compartment may be formed by a space between the first divider 1515 and the second divider 1516, and a third compartment may be formed by a space between the second divider 1516 and a second side wall 1514. Moreover, the side walls 1513, 1514 and the dividers 1515, 1516 are shaped for the front wall 1511 to be inclined at an angle so that items 3 may slide down the input chute 151 to reach the shredder 152 after being ejected from the transport unit 13 by the ejector unit 14.

[0070] The output chute 151 is configured to have two or more exits that include a first exit 1531a, a second exit 1531b, and a third exit 1531c.

[0071] Shown in FIG. 7b is that the shredder 152 of the disintegrator unit 15 has an open-ended frame 1521 that supports the mounting of a shaft 1522, the shaft 1522 further supports a plurality of blades 1523 arranged therealong it within the frame 1521. The interior walls of the frame 1521 form a space, which is further partitioned into one or more sections by use of one or more partitions 1524a, 1524b. This allows for a separation of the blades 1523 into one or more sets.

[0072] With this, the shredder 152 may be deemed to have a first shredding section 1525a, a second shredding section 1525b, and a third shredding section 1525c, each section with its own corresponding set of blades 1523.

[0073] By way of example, as per FIG. 7b, the first shredding section 1525a includes a set of blades 1523 between a leftmost interior wall of the frame 1521 and a left-side surface of the partition 1524a, the second shredding section 1525b includes a set of blades 1523

between a right-side surface of the first partition **1524a** and a left-side surface of the second partition **1524b**, and the third shredding section **1525c** includes a set of blades **1523** between a right-side surface of the second partition **1524b** a rightmost interior wall of the frame **1521**.

[0074] The shaft **1521** may be connected to a motor of a gearbox that causes it to rotate in a radial motion, thereby radially rotating the blades **1523** attached to it for the blades **1523** to engage in the disintegration of items **3**.

[0075] Shown in **FIG. 7c** is the shredder **152** of the disintegrator unit **15** when viewed from its bottom, showing that it further comprises one or more perforated panels **1526** supported by rods **1527**. Preferably, each shredding section **1525a**, **1525b**, **1525c** correspondingly has a perforated panel **1526** fitted below the blades **1523**, and they are supported in place by the rods **1527** that transverses each shredding section **1525a**, **1525b**, **1525c**. Each perforated panel **1526** is to confine the ejected item **3** within the shredder **152** until the blades **1523** shred item **3** into disintegrated matter that are smaller than the perforations of the perforated panel **1526**. The perforated panel **1526** for each shredding section **1525a**, **1525b**, **1525c** may be configured to be similar or dissimilar. Furthermore, the perforated panels **1526** may be configured with perforations of fixed sizes or varying sizes. Additionally, the perforated panels **1526** may be configured with perforations of fixed distribution or varying distribution.

[0076] Also shown in **FIG. 7c** is that the partitions **1524a**, **1524b** are slotted within the frame **1521** in a sealed manner. Alternatively, the partitions **1524a**, **1524b** are secured to the frame **1521** in a sealed manner using fastening means, the fastening means may be, but shall not be limited to, nuts and bolts, screws, etc. Alternatively as well, the partitions **1524a**, **1524b** are secured to the frame **1521** in a sealed manner by use of an interference fit.

[0077] Shown in **FIG. 7d** are portions of the shredder **152** without the frame **1521**. Whereas, shown in **FIG. 7e** are portions of the shredder **152** without the frame **152**, perforated panels **1526** and rods **1527**.

[0078] Preferably, the perforated panels **1526** have a curved outline for maximising the contact between the ejected item **3** and the blades **1523** as it is tumbled and shredded into disintegrated matter by the blades **1523**.

[0079] For the partitions **1524a**, **1524b** to be in a fixed position during radial rotation of the blades **1523**, it is preferable they are affixed to the frame **1521** as described before. Furthermore, the partitions **1524a**, **1524b** have a central aperture (not shown) that allows the shaft **1521** to transverse between each shredding section **1525a**, **1525b**, **1525c**. The central aperture may be equipped with friction-reducing means for a frictionless interaction between partitions **1524a**, **1524b** and the shaft **1521** as the shaft **1521** rotates. The friction-reducing means, by way of example, are configurations that involve ball bearings, roller bearings, plain bearings, or the like. Furthermore, the friction-reducing means may be equipped with coverings for sealing gaps between the partitions **1524a**, **1524b** and the shaft **1521**. With the partitions **1524a**, **1524b** configured as such, it consequently remains in a fixed position during radial rotation of the blades **1523**.

[0080] For the perforated panels **1256** to be in a fixed position during radial rotation of the blades **1523**, it is preferable that they are supported by the rods **1257** as described before. Furthermore, the partitions **1524a**, **1524b** further includes one or more off-centre apertures that allow the rods **1257** to transverse between shredding sections **1525a**, **1525b**, **1525c**. Preferably, the off-centre apertures tightly fit with the rods **1257** for sealing gaps between the partitions **1524a**, **1524b** and the rods **1257**. With the rods **1257** and partitions **1524a**, **1524b** secured in such a fixed position, the perforated panels **1526** consequently remain in such a fixed position.

[0081] Shown in **FIGS 7f** to **7h** are the one or more configurations of the blades **1523** on the shaft **1521** of the shredder unit **152**. It is to be noted that the shredding sections **1525a**, **1525b**, **1525c** are well understood based on the previous figures and descriptions. In particular, **FIG. 7f** illustrates a first example blade configuration, wherein each shredding section **1525a**, **1525b**, **1525c** has blades **1523** of irregular lengths. **FIG. 7g** illustrates a second example blade configuration, wherein there is a shredding section with blades **1523** that have lengths increase and then decrease, in short, forming an outline that follows a first undulating pattern when viewed from the longitudinal sides; a shredding section with blades **1523** that have lengths that decrease and then increase, in short, forming an outline that follows a second undulating pattern when viewed from the longitudinal sides; and a shredding section with blades **1523** that are of a fixed length. **FIG. 7h** illustrates a third example blade configuration that is similar to that of the second example blade configuration of **FIG. 7g**, but with a different arrangement of the blade configuration. It is noted that configuring the blades **1523**

to be of different lengths manipulates the shredding speed for shredding sections **1525a**, **1525b**, **1525c**.

[0082] Shown in **FIGS 7i** and **7j** are lateral side views of the shaft **1521**, blades **1523** and the partitions **1524a**, **1524b**.

[0083] Shown in **FIG. 7k** are the blades **1523** of the shredder **152**. Preferably, the blades **1523** have a serpentine shape. Alternatively, the blades **1523** are of a straight shape. The blades **1523** are made to radially rotate about their centre axis by the shaft **1521**. In particular, the cutting edges of the blades **1523** are serrated, with each of its teeth at a distance away from an adjacent tooth based on an angle between them from the centre axis of the blade **1523**. The said angle, may be, for example, range from 5° to 15°, but is most preferably 10°.

[0084] **FIG. 7l** illustrate one or more paths in which the ejected item **3** may travel therethrough the disintegrator unit **15** for its disintegration. It is noted that in **FIG. 7c**, the rear wall **1512** of the input chute **151** is omitted to illustrate these paths.

[0085] Based on **FIG. 7l**, should items **3**, for example, be ejected from the transport unit **13** to enter the first compartment of the input chute **151**, it slides down therealong into the first shredding section **1525a** for it to be shredded into disintegrated recyclable matter. The disintegrated recyclable matter may then exit from the disintegrator unit **15** through the first exit **1531a**. This corresponds to a first path. Likewise, items **3** that enter the second compartment of the input chute **151** slides down into the second shredding section **1525b** to be disintegrated, and its disintegrated recyclable matter exits through the second exit **1531b**. This corresponds to a second path. Likewise, items **3** that enter the third compartment of the input chute **151** slide down into the third shredding section **1525b** to be disintegrated, and its disintegrated recyclable matter exits through the third exit **1531c**. This corresponds to a third path.

[0086] As seen in **FIG. 7l**, the perimeter of the bottom end of each compartment of the input chute **151** is substantially joined to the perimeter of the top end of each shredding section **1525a**, **1525b**, **1525c** of the shredder **152** in a sealed manner, with the top end of each shredding section **1525a**, **1525b**, **1525c** of the shredder **152** including at least one edge that is an edge of the partitions **1524a**, **1524b**.

[0087] Also seen in **FIG. 7l**, the perimeter of the bottom end of each shredding section **1525a**, **1525b**, **1525c** of the shredder **152** is substantially joined to the perimeter of the top end of each exit **1531a**, **1531b**, **1531c** of the output chute **153** in a sealed manner, with the bottom end of each shredding section **1525a**, **1525b**, **1525c** of the shredder **152** including at least one edge that is an edge of the partitions **1524a**, **1524b**.

[0088] With the input chute **151**, a shredder **152**, and an output chute **153** joined in such a way in a sealed manner, these paths are collateral, or substantially parallel with one another. Furthermore, with considerations made for the shredder **152** for it to be partitioned in a sealed manner, i.e. no gaps between each shredding section, there is no cross-contamination of item **3** as they are disintegrated within the disintegration unit **15** since they are properly segregated during the disintegration process. Moreover, since each shredding section **1525a**, **1525b**, **1525c** is configured to receive ejected items **3** of the same characteristics accordingly, therefore, only one group of disintegrated recyclable matter exits from each corresponding exit **1531a**, **1531b**, **1531c** of the disintegration unit **15** into a designated receptacle of the bin unit **17**.

[0089] **FIGS 8a** and **8b** illustrate the bin unit **17**. In particular, **FIG. 8a** illustrates a perspective view of the bin unit viewed from its top. Whereas **FIG. 8b** illustrates a perspective view of the bin unit viewed from its bottom.

[0090] As shown in **FIGS 8a** and **8b**, the bin unit **17** comprises one or more receptacles that receive disintegrated recyclable matter from the disintegrator unit **15**, and/or items **3** that were passed over for ejection. The receptacles may include a first receptacle **171**, a second receptacle **172**, and a third receptacle **173**, wherein each receptacle may receive disintegrated recyclable matter from the disintegrator unit **15**. In one alternative embodiment, there may be an additional receptacle that specifically stores items **3** that are discarded by the transport unit **13** due to being passed over for shredding. In yet another alternative embodiment, at least one existing receptacle may be configured to store both disintegrated recyclable matter from the disintegrator unit **15** and items **3** that were discarded by the transport unit **13** due to being passed over for ejection.

[0091] With reference to **FIGS 8a** and **8b**, and **FIGS 2a**, **2b**, and **3b**, the first receptacle **171** may be directly below the first exit **1531a** for receiving disintegrated recyclable matter therefrom. The second receptacle **172** may be directly below the second exit **1531b** for receiving disintegrated recyclable matter therefrom. The third receptacle **173** may be directly below the third exit **1531c** for receiving disintegrated recyclable matter therefrom. Additionally, it is noted that the second receptacle **172** may also be directly below the discard section of the transport unit **13** for receiving items **3** that were passed over for ejection.

[0092] The shredder **152** is partitioned to perform a segregated disintegration with each of its shredding sections being adjacently sealed, each receptacle **171**, **172**, **173** will only receive one group of disintegrated recyclable matter. For example, continuing from the descriptions above, only disintegrated recyclable matter from the first shredding section **1525a** will end up in the first receptacle **171** of the bin unit **17** and not the second or third receptacle **172**, **173**; only disintegrated recyclable matter from the second shredding section **1525b** will end up in the second receptacle **172** of the bin unit **17** and not the first or third receptacle **171**, **173**; and only disintegrated recyclable matter from the third shredding section **1525c** ends up in the third receptacle **173** of the bin unit **17** and not the first or second receptacle **171**, **172**. Hence, the purity of each group of the disintegrated recyclable matter collected by each receptacle **171**, **172**, **173** is ensured.

[0093] **FIG. 9** illustrates an arrangement between the loader unit **11** and the transport unit **13** that is configured in the present invention for their interactions with the items **3**. Whilst the retaining walls **133** of the transport unit **13** were omitted from the said figure, it is to be noted that the illustrated interaction takes place at the receiving section of the transport unit **13**. As shown, an item **3** is inserted into the loader unit **11** and is preferably picked up by the transport unit **3** by entering a carrier **132** of the transport unit **13** at its receiving section. Such a configuration preferably allows for a continuous feed of items **3** into apparatus **1**, as each successive item **3** may enter a successive carrier **132** of the transport unit **13** for it to be picked up and conveyed away from belt **1121** of the loader unit **11**.

[0094] **FIG. 10** illustrates an arrangement between the transport unit **13**, the ejector unit **14**, and the disintegrator unit **15** that is configured in the present invention for their interactions with the items **3**. Whilst the retaining walls **133** of the transport unit **13** were omitted from the said figure, it is to be noted that the illustrated interaction takes place at the ejection

section of the transport unit **13**. As an item **3** that is within the carrier **132** of transport unit **13**, having been deemed acceptable for recycling, reaches the ejection section of the transport unit **13**, any one or a combination of the displacers **142a**, **142b**, **142c** may displace the item **3** for it to exit the transport unit **13** into a corresponding compartment of the disintegrator unit **15** based on its identified characteristics, preferably its colouration, for them to be disintegrated by the shredder **152** into disintegrated recyclable matter.

[0095] Whilst not shown, the sensing unit **12** may comprise one or more sensors for obtaining information about the item **3**. Preferably, the identification unit **12** is to identify characteristics of item **3**, labels that remain on the item **3**, and/or the weight of the item **3**. The characteristics of the item **3** that are to be identified may include its which may include its material composition and/or colouration.

[0096] With this, the identification unit **12** may be inferred to include one or more sensors. These sensors may be distributed about the loader unit **11** for obtaining information of the item **3** as it travels on the linear conveyor **112** to the receiving section of the transport unit **13**.

[0097] In one example, there are included radiation-based sensors for determining characteristics of the item **3**, more specifically, the material composition of the item **3**. In yet another example, there are included vision-based sensors for determining characteristics of the item **3**, more specifically, its colouration. In yet another example, there is included a 360° barcode reader sensor for reading the barcodes that may be available on the item **3** for verification of the identity of the item **3**. In yet another example, there is included a weight sensor that identifies the weight of the item **3** for the verification of its expected weight.

[0098] The information from the item **3** will then be provided to the control unit **2** to confirm the recyclability of the item **3** for recycling and its designated ejection position within the ejection section of the transport unit **13**. The control unit **2** will then exert control over any one or a combination of the transport unit **13** and the ejector unit **14** based on these information.

[0099] In a preferred implementation of the invention, the sensors are to obtain information of the item, more specifically both the material composition of the item **3** and the colouration

of item **3**. With this, the control unit **2** may be informed on the type of plastic that the item **3** is made from and its colouration. Should item **3** be made from a plastic material that is acceptable for recycling (e.g. PET, HDPE, PP), the control unit **2** will control the transport unit **13** and ejector unit **14** to appropriately transport and eject the item **3**, based on its colouration (e.g. clear colour, blue colour, green colour), into a corresponding path of the disintegrated unit **15** to become disintegrated recyclable matter. Should item **3** be made from a material that is unacceptable for recycling (e.g. PVC or unidentifiable plastics), the control unit **2** will control the transport unit **13** and ejector unit **14** for the item **3** to be passed over for ejection so that the item **3** may be discarded at the discard section of the transport unit **3**. This preferred implementation may be further configured for other material compositions, such as metals and ceramics, by a person skilled in the art.

[00100] The display unit **16** is preferably a device that allows a user to interact with apparatus **1** through a user interface. Preferably, it is in the form of a display panel, screen, or the like, which is connected to control unit **2**. Configurations for interaction between the user and the apparatus **1** may be known to a person skilled in the art, especially regarding prompting the user to insert items **3** into the apparatus **1**, prompting the user to take away items **3** that were deemed unacceptable for recycling by the apparatus **1**, and providing incentives to the user for providing recyclable items **3** to the apparatus **1**.

[00101] As shown in **FIG. 1**, the system may further include a control unit **2**. The control unit **2**, may be, by way of example, an industrial computer, a programmable logic controller, a single-board computer, a microcontroller board, a chip-on-board, or the like. The control unit **2** may comprise a processor **21** and a memory unit **22**. The processor **21** of the control unit **2** runs an application software **21a** for operating a plurality of modules that pertain to the intended operational flow of apparatus **1**. It is noted that the loader unit **11**, the identification unit **12**, the transport unit **13**, the ejector unit **14**, the disintegrator unit **15** and the display unit **16** are interfaced with the control unit **2**. It is to be noted that the control unit **2** may provide a re-configurability to the operations of the present invention.

[00102] The processor **21** of the control unit **2** performs the scheduling and the execution of software instructions or computer logic instructions based on the application software **21a**. Preferably, it may be a conventional processor, an application-specific integrated circuit (ASIC), or a combination thereof. Moreover, processor **21** may be interfaced with memory

unit **22**. The memory unit **22** of computer **1** may comprise hardware that includes one or more non-volatile memory units, one or more volatile memory units, or a combination thereof. The non-volatile memory unit would store program files related to the application software **21a**. Whereas, the volatile memory unit would temporarily store processing data during the runtime of the application software **21a**. Information stored in the memory unit **22** may include a database of items **3**, information on the received items **3** obtained via the identification unit **12**, the designations marked for each carrier **132**, and the occupancy condition of each carrier **132**. In alternative embodiments, portions or the entirety of the processor **21** and memory unit **22** may be offloaded to a server provided via cloud computing as is at a remote location away from the apparatus **1**.

[00103] As shown in **FIG. 1**, the processor **21** that runs the application software **21a** operates a loader unit control module **211**, an identification unit control module **212**, a transport unit control module **213**, an ejector unit control module **214**, a disintegrator unit control module **215**, and a display unit control module **216**. It should be noted that the presented modules need not be in a software embodiment, and they may be in a hardware embodiment where they are connected to the processor **21** or an independent computer system. Ancillary modules may be further included to provide support for the aforementioned modules.

[00104] Regarding the loader unit control module **211**, it preferably allows the control unit **21** to control loader unit **11**, especially the speed of the linear conveyor **112** for the rate of movement of items **3** from the entry **111** to the receiving section of the transport unit **13**.

[00105] Regarding the identification unit control module **212**, it preferably allows the control unit **21** to control the identification unit **12**, especially on the identification of characteristics of the item **3**.

[00106] Regarding the transport unit control module **213**, it preferably allows the control unit **21** to control the transport unit **13**, especially the speed and coordination of the belts **132a** of the buffer conveyor to ensure that the carriers **132** are defined at all times. The buffer conveyor may also be made to have a discrete movement or a continuous movement.

[00107] Regarding the ejector unit control module **214**, it preferably allows the control unit **21** to control the ejector unit **14**, especially the timing and actuation of any one or a

combination of displacers **142a**, **142b**, and **142c** to displace items **3** at the ejection section of the transport unit **13** from their carriers **132** to exit the transport unit **13** via the gates **143a**, **143b**, **143c** based on the identified colouration of the item **3**.

[00108] Regarding the disintegrator unit control module **215**, it preferably allows the control unit **21** to control the disintegrator unit **15**, especially the rotational speed of the shaft **1523** in which the blades of shredder **152** are connected thereto. This may allow adjustments to be made to the shredding time of the shredder **152**.

[00109] Regarding the display unit control module **216**, it preferably allows the control unit **21** to control the display unit **216**, especially the user interface (UI) displayed thereon for prompting interactions between a user and the apparatus **1**.

[00110] Preferably as well, the loader unit control module **211**, the identification unit control module **212**, and the transport unit control module **213** are involved in a first coordination between the loader unit **11**, the identification unit **12**, and the transport unit **13**. The said coordination pertains to the identification of the material of item **3** as it travels from the entry **111** to the receiving section of the transport unit **13**.

[00111] Preferably as well, the transport unit control module **213** and the ejector unit control module **214** are involved in a second coordination between the transport unit **13** and the ejector unit **214**. The said coordination pertains to the ejection of item **3** into a corresponding compartment of the input chute **151** of the disintegrator unit **15** based on the colouration of the item **3** as identified by the identification unit **12**.

[00112] It is noted that for the rest of the description, the hardware and software components of the apparatus may not be directly implicated. However, it is to be understood by a skilled person that the descriptions of the hardware and software components above provide support for the rest of the description.

[00113] Whilst not shown, there may be a combination of sorting technologies that use the information obtained by the identification unit **12** for identifying the item **3** by linking identified bar codes on the item **3** with an online database. Furthermore, machine learning

may be involved in the identification of item **3** for identifying its material composition, its colouration, its recyclability and its destination within apparatus **1**.

[00114] **FIG. 11** illustrates an example flowchart describing an intended operational flow of the apparatus **1** as the user inserts items **3** therein. It is noted that the steps described in this flowchart are not to be interpreted as non-limiting, and minor modifications to the steps (e.g. additions, omissions, or swaps) are permissible by a skilled person without substantial deviation from as described. Whilst the flowchart of **FIG. 11** primarily focuses on one item **3**, it should be noted that its descriptions thereof is applicable to each successive items **3** inserted into the apparatus **1** by a user.

[00115] As shown in **FIG. 11**, there is a first step being step **S1**. Here, the step of receiving, by the loader unit **11** of the apparatus **1**, at least one item **3**, is done.

[00116] Following step **S1** is step **S2**, which is the step of identifying, by an identification unit **12**, the item **3** that is on the loader unit **11**, to obtain information about the item **3**, especially its material composition and its colouration.

[00117] Following step **S2** is step **S3**, which is the step of providing, by the identification unit **12**, the information of item **3** to the control unit **2**.

[00118] Following step **S3** is step **S4**, which is the step of passing the item **3**, by the loader unit **12**, to be picked up by one carrier **132** of the transport unit **13** via the receiving section of the transport unit **13**. Preferably, the carrier **132** is in an unoccupied condition.

[00119] Following step **S4** is step **S5**, which is the step of informing the control unit **12**, by the transport unit **13**, of an updated occupancy condition of the said carrier **132** from step **S4**. The updated occupancy condition is to indicate that the carrier **132** is currently occupied.

[00120] Following step **S5** is step **S6**, which is the step of transporting, by the transport unit **13**, the item **3** that is retained in carrier **132** to an ejection section of the transport unit **13**, for it to be in the vicinity of the displacers **142a**, **142b**, **142c** of the ejector unit **14**.

[00121] Following step **S6** is step **S7**, which is a decision step whereby it is determined, by the control unit **21**, whether or not the identified material composition of the item **3** is acceptable for recycling, for it to be collected by apparatus **1**. Should it be the case, step **S7** proceeds to step **S8**. Else, step **S7** proceeds to step **S14**.

[00122] In step **S8**, since it was determined that the material composition of the item **3** is deemed acceptable for recycling, item **3** is to be collected by apparatus **1**. Hence, the step of coordinating, by the control unit **2**, the transport unit **13** and the ejector unit **14** for the item **3** to be appropriately positioned with respect to a corresponding displacer **142a**, **142b**, **142c** based on its identified colouration, is done.

[00123] Following step **S8** is step **S9**, which is the step of ejecting, by the ejector unit **14**, the item **3** into a corresponding compartment of input chute **151** of the disintegrator unit **15**.

[00124] Following step **S9** is step **S10**, which is the step of informing the control unit **12**, by the transport unit **13**, of an updated occupancy condition of the said carrier **132** from step **S9**. The updated occupancy condition is to indicate that the carrier **132** is currently unoccupied.

[00125] Following step **S10** is step **S11**, which is the step of shredding the item **3**, by the shredder **152** of the shredder unit **15**, into disintegrated recyclable matter.

[00126] Following step **S11** is step **S12**, which is the step of directing, by an output chute **153** of shredder unit **15**, the disintegrated recyclable matter into a corresponding receptacle of the bin unit **17**. This is essentially a sorted binning of a group of disintegrated recyclable matter.

[00127] Following step **S12** is step **S13**, which is the step of receiving, by a corresponding compartment of bin unit **17**, the disintegrated recyclable matter. This step marks a first end of the flowchart of **FIG. 11**.

[00128] In step **S14**, since it was determined that the material composition of the item **3** is deemed unacceptable for recycling, item **3** is to be rejected by apparatus **1**. Hence the step of passing the item **3** retained in carrier **132** over for ejection by the ejector unit **14**, by the transport unit **13**, is done.

[00129] Following step **S14** is step **S15**, which is the step of transporting the item **3** retained in carrier **132** to a discard section of the transport unit **13**.

[00130] Following step **S15** is step **S16**, which is the step of discarding, by the transport unit **13**, the item **3** into a corresponding receptacle of the bin unit **17**.

[00131] Following step **S16** is step **S17**, which is the step of informing the control unit **12**, by the transport unit **13**, of an updated occupancy condition of the said carrier **132** from step **S6**. The updated occupancy condition is to indicate that the carrier **132** is currently unoccupied. This step marks a second end of the flowchart of **FIG. 11**. With this, the flowchart of **FIG. 11** has been fully described.

[00132] With reference to **FIG. 11**, **FIG. 10**, **FIGS 8a to 8c**, and **FIG. 6**, and by way of a first example, the apparatus **1** may be configured to accept items **3** that have a material composition that includes PET and reject items **3** that have a material composition that include PVC or other material compositions. With this, as per steps **S8** to **S9**, an item **3** deemed to have a clear colour may be ejected into a first compartment of the input chute **151** by a first displacer **142a**, an item **3** deemed to have a blue colour may be ejected into a second compartment of the input chute **151** by a second displacer **142b**, and an item **3** deemed to have a green colour be made of PP may be ejected into a third compartment of the input chute **151** by a third displacer **142c**. Items **3** that have a material composition that include PVC or any other material composition may be passed over for ejection and eventually fall off from the transport unit **13** at its discard section as per steps **S14** to **S16**. With this, one or more groups of disintegrated PET matter with different colour is produced by the apparatus **1**.

[00133] With reference to **FIG. 11**, **FIG. 10**, **FIGS 8a to 8c**, and **FIG. 6**, and by way of a second example, the apparatus **1** may be configured to accept items **3** that have a material composition that includes PET, HDPE, PP, and reject items **3** that have a material composition that include PVC. With this, as per steps **S8** to **S9**, an item **3** deemed to be made of PET may be ejected into a first compartment of the input chute **151** by a first displacer **142a**, an item **3** deemed to be made of HDPE may be ejected into a second compartment of the input chute **151** by a second displacer **142b**, and an item **3** deemed to be made of PP may

be ejected into a third compartment of the input chute **151** by a third displacer **142c**. Items **3** that have a material composition that include PVC may be passed over for ejection and eventually fall off from the transport unit **13** at its discard section as per steps **S14** to **S16**. With this, one or more groups of disintegrated matter with different material composition is produced by the apparatus.

[00134] It is to be noted that based on the descriptions above, it is imperative that alternative embodiments of the present invention may have a shredder unit that is partitioned to form two shredding sections or more than three shredding sections. The shredding sections may be made to disintegrate an item **3** based on its material composition and/or colouration, and the technicalities of each of these shredding sections and the control configuration may be as per described in this description. For example, in a shredder **152** with four shredding sections, the first shredding section may shred PET items **3** of clear colour, the second shredding section may shred PET items **3** of blue colour, the third shredding section may shred PP items **3** of clear colour, and the fourth shredding section may shred PP items **3** of blue colour.

[00135] It is to be noted that based on the descriptions above, it is imperative that the shredder of the apparatus may be reconfigured for its shredding section to differently receive ejected items of the same characteristics accordingly. For example, in a first deployment round, the first shredding section may be configured to shred PET items **3** of clear colour, in a next deployment round, the first shredding section may be re-configured to receive and shred PET items **3** of blue colour, and so forth.

[00136] With this, the details pertaining to an apparatus **1** which collects recyclables that allow for a continuous feed of items for their identification, disintegration and sorted binning, along with its method of operation, have been elucidated. Whilst the apparatus **1** had been described to be primarily involved in the recycling of plastics, it is to be noted that it may be readily generalised by a person skilled in the art for usage for any other recyclable items known in the art. Moreover, the use of a single shredder **152** within the disintegration unit **15** that is partitioned into two or more shredding sections in an adjacently sealed manner allows for the output of one or more groups of disintegrated recyclable matter, which are then correspondingly received by designated receptacles of the bin unit **17** with zero cross-contamination between the resulting output.

[00137] The present disclosure includes as contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the scope of the invention.

CLAIMS

1. An apparatus for reverse vending of recyclables, comprising
a loader unit for receiving one or more items inserted by a user;
an identification unit for identifying characteristics of each item;
a transport unit for transporting the items;
an ejector unit for ejecting at least one item from the transport unit based on its identified characteristics; and
a disintegrator unit for disintegrating the ejected item into disintegrated recyclable matter, which comprises a shredder that is partitioned to form two or more shredding sections that are adjacently sealed therebetween, with the shredder having perforated panels each fitted below each shredding section;
wherein each shredding section is configured to receive the ejected items of the same characteristics accordingly with perforated panel confining the ejected items within the shredder until the ejected items become disintegrated matter that is smaller than perforations of the perforated panel, so that the apparatus produces one or more groups of disintegrated recyclable matter.
2. The apparatus according to claim 1, wherein the shredder is configured to form a first shredding section, a second shredding section, and a third shredding section.
3. The apparatus according to claim 1 or 2, wherein the disintegrator unit further comprises an input chute and an output chute that are joined with the shredder in a sealed manner.
4. The apparatus according to claim 3, wherein
the input chute is configured to have two or more compartments that include a first compartment, a second compartment, and a third compartment; and
the output chute is configured to have two or more exits that include a first exit, a second exit, and a third exit.
5. The apparatus according to claim 4, wherein the disintegration unit defines two or more collateral paths in which the ejected item correspondingly travels amongst for disintegration that includes

a first path defined to include the first compartment, the first shredding section and the first exit;

a second path defined to include the second compartment, the second shredding section and the second exit; and

a third path defined to include the third compartment, the third shredding section and the third exit.

6. The apparatus according to any one of the preceding claims, wherein the shredding sections of the shredder each have a set of blades that radially rotate about a shared shaft.

7. The apparatus according to claim 6, wherein the set of blades for each shredding section includes any one or a combination of

blades of irregular lengths;

blades of varying lengths; and

blades of a fixed length.

8. The apparatus according to any one of the preceding claims, wherein the perforated panels fitted below each shredding section ensures the item is separated into disintegrated recyclable material.

9. The apparatus according to any one of the preceding claims, wherein the transport unit further comprises one or more moving belts, each with protrusions, the belts being laterally aligned to each other via said protrusions, for defining carriers that transport the items.

10. The apparatus according to claim 9, wherein the transport unit further comprises retaining walls for accommodating the item within the carrier as it is made to ascend, descend, or move at an under-side of the transport unit.

11. The apparatus according to claim 10, wherein the retaining walls of the transport unit are formed with one or more exposed sections for exposing the carriers for any one or a combination of

receipt of items from the loader unit;

ejection of items from the transport unit to the disintegrator unit by the ejection unit;
and
a discarding of items from the transport unit.

12. The apparatus according to any one of the preceding claims, wherein the ejector unit comprises one or more displacers that correspondingly displace the item off the transport unit for it to exit the transport unit based on its identified characteristics.

13. The apparatus according to any one of the preceding claims, wherein the characteristics identified by the identification include material composition of the item and colouration of the item.

14. The apparatus according to claim 13, further comprising a control unit for exerting control over at least any one or a combination of the transport unit and the ejector unit based on any one or both the material composition of the item and the colouration of the item.

15. The apparatus according to claim 13 or 14, wherein the item is of a material composition that includes metals, polyethene terephthalate, high-density polyethene, polyvinyl chloride, low-density polyethene, polypropylene, and polystyrene, or any other known plastic polymers.

16. The apparatus according to any one of claims 13 to 15, wherein the item is of a colouration that includes clear colour, blue colour, green colour, or any other colour.

17. A method for reverse vending of recyclables, comprising the steps of
receiving one or more items inserted by a user, by a loader unit;
identifying characteristics of each item, by an identification unit;
transporting the items, by a transport unit;
ejecting the items from the transport unit, by an ejector unit; and
disintegrating the ejected item into disintegrated recyclable matter, by a disintegrator unit, which comprises a shredder that is partitioned to form two or more shredding sections that are adjacently sealed therebetween, with the shredder having perforated panels each fitted below each shredding section;

wherein each shredding section is configured to receive the ejected items of the same characteristics accordingly with perforated panel confining the ejected items within the shredder until the ejected items become disintegrated matter that is smaller than the perforations of the perforated panel, so that the apparatus produces one or more groups of disintegrated recyclable matter.

18. The method according to claim 17, wherein the step of identifying characteristics of each item, by an identification unit, further comprises the steps of
identifying the material composition of the items; and
identifying the colouration of the items.

19. The method according to claim 18, further comprising the steps of
determining the acceptability of the items for their collection based on their material composition; and
instructing the ejector unit to correspondingly eject items from the transport unit based on their colouration for their disintegration.