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(71) Applicant: **Re-Circula Solutions, S.L.**
08006 Barcelona (ES)

(72) Inventors:
• **MAJCAN, Alexandro**
08006 BARCELONA (ES)
• **BERGUINZO MARTÍNEZ, Jordi**
08006 BARCELONA (ES)

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(74) Representative: **Ponti & Partners, S.L.P**
C. de Consell de Cent 322
08007 Barcelona (ES)

(54) **SMART DEVICE FOR WASTE CONTAINERS, WASTE CONTAINER INCORPORATING THE SAME AND MODE OF OPERATION OF THE WASTE MANAGEMENT SYSTEM INCLUDING THE SAME**

(57) The present invention relates to a smart device installed in containers or similar elements disposed for the storage of waste, enabling the identification of the user who deposits therein the waste, likewise the detection of the activity of managing the waste performed, both in the management of the waste inserted and the highlighting of the user's action and the better configuration of the structure of global selective waste collection, em-

ploying for this purpose a device which is attached to the containers, be they existing or of a new design, with a system for the reading of codes/charts for the identification of the waste inserted, usually packaging waste, and employing vibration-absorbing means to minimise the effect of impacts and vibrations caused during the process of emptying the container.

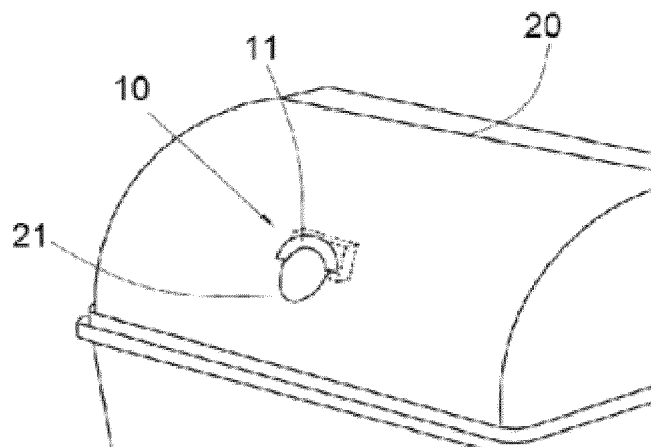


Fig. 1

Description

[0001] The present invention relates to a device installed in containers or similar elements disposed for the storage of waste, enabling the identification of the user who deposits therein the waste, likewise the detection of the activity of managing the waste performed, both for the management of the waste inserted and the highlighting of the user's action and the better configuration of the structure of global selective waste collection.

Background of the invention

[0002] The need to increase the quantity and proportion of selectively managed urban waste, with ever-increasingly ambitious environmental goals in order to reduce and minimise the environmental impact of great quantities of waste, has caused the phase of traditional user waste collection to become a phase that currently does not contribute the necessary value to the management chain.

[0003] In Europe, over 84 million tons of waste corresponding to packaging are produced yearly, that is, about 165 kg per inhabitant. In contrast, although the percentage of recycled waste has increased in recent years, approximately 36.4% of household packaging is still dumped or incinerated in Europe, translating into 11 million tons incinerated and 18 million tons dumped. These global results vary according to country and specific material; as an example, only 39.8% of plastic containers are recycled in the EU, while the plastic container recycling rates are 25.5% in France and 27.4% in Hungary, respectively. The intention of the Administrative bodies is to increase these percentages, employing European Directives for this purpose, such as Directive 2018/852, with the aim of reaching a plastic container recycling rate of 55% in 2030, which would be more than double the current recycling rate.

[0004] Currently, packaging waste has a great impact on the environment, as it must be borne in mind that 0.591 kg of CO₂ is generated for each kg of packaging waste dumped, this producing 10.64 million tons of CO₂. The management of packaging not recovered for recycling makes necessary the allocation of considerable resources, with a potential market value of 209 euros per ton of fragments of unrecovered packaging waste, plus 80 euros per ton dumped, causing losses of 5,199 million euros. For this reason, the organisation of waste collection systems has become crucial, for the recovery of said waste, its valuation and, more importantly, to encourage recycling.

[0005] Until the present, with regard to the urban waste collection containers available and permanently accessible to users in general, their only improvement has been in the process of emptying the containers; containers featuring sensors which detect the degree of fullness thereof, from which data concerning the fullness of the container may be sent to a management system, and thus optimise the container emptying routes and the number of emptying actions.

[0006] On the other hand, strategies to encourage the user-consumer of products with recyclable containers are well known, such as a reward for the correct management of the waste, particularly waste corresponding to packaging and/or glass; these have been created and exist in order to encourage the selective management of this type of waste. These strategies have been implemented in stores, where specific devices have been designed. These systems make necessary the confirmation of the correct insertion of the waste item deposited, and the correct identification of the type of product.

[0007] For the detection of the waste item inserted, optical detection systems are known which involve a specific configuration and a significant cost, representing an impediment for the implementation of this solution for confirmation of the correct identification of the waste item.

[0008] The execution of these attempts to add value in the collection of user waste in containers has made necessary the conception and creation of, and investment in new equipment, requiring an initial outlay which complicates the launching of the implementation strategy of urban waste management, and also the scrapping of the existing related products.

[0009] Due to the aforementioned technical complications required to carry out the setting-up and configuration of a smart container, it is necessary that the emptying processes associated with said new containers should be new and much more delicate, as the movements habitually performed by waste collection trucks when emptying conventional containers might damage and cause improper functioning in said existing improved containers. These new collection systems increase greatly the cost of the adaptation or introduction of known smart containers into the urban waste collection systems currently implemented.

Description of the invention

[0010] The aim of the present invention is to provide a smart device for waste containers, also to provide a waste container equipped with the same, and a mode of operation of the waste management system including the above, which resolves the aforementioned drawbacks while presenting other advantages, to be described below.

[0011] By way of clarification, the use of the term "smart" in the present description is applied denominatively with regard to the device, implying solely, as will be seen in the description, the use of processing, control and communication systems to execute an operating procedure and to contribute an added value to the product on which it is installed.

[0012] In accordance with this objective, in a first aspect the present invention is based on a smart device for waste containers, of the type installed in said containers or on the associated external structures thereof, having elements for its attachment to the container, and also identification and/or communication means with the users of said container and means for the generation and storage of its own electrical power.

[0013] The present invention is characterised in that the smart device comprises, at least:

- a start module for the active operation of the device;
- one or more code/chart readers, at least for the waste to be inserted;
- one or more volume detectors to detect the entry of the waste into the container;
- a processing and control system with wireless communication means with an external server for user management and container emptying programming; and
- a system for absorbing shocks and vibrations at the point of attachment between the smart device and the waste container on which it is installed.

[0014] It must be borne in mind that in the present description of the invention, both the walls of an independent conventional container and devoid of any external auxiliary containment structure for one or more containers, and those auxiliary structures that enable the installation of the smart device and the insertion of the waste in the container desired are considered to be analogous.

[0015] This configuration is further characterised in that the start module executes the activation of the code/chart readers and volume detectors, which start from a mode of operation at stand-by or deactivated, with minimal electricity consumption.

[0016] Also, advantageously, the device is constituted compactly in a single body with all of its components, these being the start module, code/chart readers, volume detectors and the processing and control systems, this compact device being attached to the container.

[0017] This disposition enables the provision of a smart device that can be coupled to existing containers or incorporated in containers of a new design, thanks to a compact configuration, in a single body for its coupling, with all its basic functional elements governed by the processing and control system. This configuration performs the necessary functions of identification of the user, detection and identification of the waste item inserted, and communication with an external server, in an energy-efficient manner. The assembly is powered by its own electrical energy generation and storage means, formed by its own power generation system, usually solar panels, and/or a battery which supplies said power to the device, requiring smaller batteries than those used in other smart containers known in the state of the art, and which make them much more costly.

[0018] This provides an advantageous saving of energy, thanks to the inclusion of a start module for the code/chart readers and volume detectors, which start from a mode of operation at stand-by or deactivated, with minimal electricity consumption.

[0019] The activation of the readers and detectors, by one of the systems forming the start module, occurs with the code/chart readers and volume detectors starting at stand-by, being activated by the sending of impulses from the processing and control means to said reader and detection elements. These systems forming the start module may be based on Bluetooth, RFID, WiFi, a manual push-button and/or motion detectors. It must be borne in mind that a reader can consume between 56 and 132 mA in operating mode, with a voltage of 3.3 V, and that at stand-by it has a consumption of between 1 mA and 5 mA; the energy saving is therefore between 90 and 99%.

[0020] When the activation of the readers and detectors by one of the systems acting as a start module occurs with the code/chart readers and volume detectors deactivated, in order to activate the same a trigger is used so that when the waste item passes through the detection zone of the start module, the sensors are activated directly. In this case, the consumption is even lower than said energy-saving percentages, as in the deactivated readers and detectors with trigger-operated activation this is between 0.001 mA and 0.002 mA.

[0021] The use of the reading of the codes/charts on the waste, this being principally packaging with its corresponding bar code, enables the simple identification of the waste item thanks to the databases of bar codes; said reading can therefore provide a complete description of the type, size and other characteristics of the waste item inserted, saving the assembly the costs and complexity of the system for the identification of the waste inserted.

[0022] In accordance with one embodiment of the invention, the code/chart readers are located in at least part of the opening for the entry of waste into the container, or around said opening at the area nearest thereto, said readers pointing toward said opening, the device being compactly integrated in said location.

[0023] The area near the opening should be understood to be the area where the code/chart readers are located and are oriented in order to read the code/chart on the waste item while the waste item is inserted through said opening; their distance from the opening itself must therefore be reduced.

[0024] This makes possible the provision of a device attached to a container with a minimal variation of the usual

known configuration of these containers, enabling its adaptation to conventional containers, having a compact device which is installed complete, preferably in a single body once assembly has been performed, with all its components in the area of the opening for the entry of waste, with part of said smart device at said opening, these being the activation devices and the code/chart readers, and another internal part, the volume detectors and optionally the processing and control systems, which may also be located externally, outside the shell of the container.

[0025] Alternatively, the code/chart readers may be located on the exterior of the container, remotely from the opening for the entry of waste into the container, and remotely from the area adjacent to said opening.

[0026] This enables an embodiment where the reading of the codes/charts of the waste items is performed in an action different from their insertion into the container, the reading being prior to and not simultaneous with said action of insertion. Likewise, and alternatively, this embodiment would comprise a compact smart device forming, once assembled, a single body, although it consists of two assembly components, one external and one internal which are coupled together, or of similar configurations of a single component likewise configuring a single body with external and internal elements.

[0027] This alternative configuration of the compact device disposed remotely from the opening of the container includes at the internal part thereof a double volume sensor, one oriented toward the internal part of the opening to confirm the insertion of the product moments after its identification and another, oriented downward, for the detection of the fill volume.

[0028] With regard to the different configurations of the start module for the electronic components of the smart device, which are usually at stand-by, it is understood that optionally, the start module is constituted by a manual push-button connected to the processing and control system.

[0029] This option makes it possible to dispense with sensors exclusively devoted to detecting the presence of an item being inserted into the container or the reader, although it involves contact with the smart device installed in the container, a situation that users prefer to avoid in this type of containers.

[0030] This type of pulse may be performed via a simple push-button or via a user-interactive display touch screen.

[0031] With regard to the start module, the start-up action is performed preferably by a system for the detection of the presence of a body in the proximity of the smart device.

[0032] This configuration enables the avoidance of contact between user and container and smart device, and the ability simply to activate readers and detectors when a body is detected in the vicinity of the code/chart readers, this indicating the possible insertion of a waste item. This configuration also enables an additional functionality, this being, with the participation of the volume detectors, the confirmation of the insertion into the container of the waste item read by the device, and that attempted deception or theft has not occurred where, subsequent to the reading, said item is removed from the container; if entry into the container is not confirmed by the internal volume detector, and the motion detector detects the disappearance of the item read, this reading is cancelled.

[0033] Motion detectors are usually based on infra-red detectors, although other known sensors/detectors may also be used.

[0034] Another possible option for the configuration of the start module is a communication system with a mobile device such as a mobile telephone, tablet or identification card, by means of RFID, WiFi and/or Bluetooth wireless technology.

[0035] This option enables embodiments where, at the time when the user uses a device featuring wireless technology for his identification by the smart device, said smart device executes the identification of the user and activates the processing and control system, which in turn activates the corresponding readers and sensors to proceed with the reading of the waste item. This start-up method by means of the wireless connection between the user and the smart device may be additional or alternative to other start-up systems, such as those described: motion detector means or the code/chart readers themselves, which may also be additional or alternative in a particular embodiment of the smart device.

[0036] As has been mentioned, this configuration of communication between the mobile device and the smart device installed in the container carries out the identification of the user by said device by means of the communication established with the mobile device.

[0037] Optionally, but preferably, this communication causes the communication means with the external server for user management and the programming of container emptying to be carried out indirectly via the connection with the mobile device of the user employed for the identification thereof.

[0038] This advantageously achieves a significant saving in the power consumption of the device, as preferably a Bluetooth Low Energy (BLE) connection is employed, with which it is possible to replace the alternative and/or additional communication of a direct communication module of the smart device, which would normally use a GSM or NB-IOT module, with a much higher consumption than connection with the user's device. This will always depend on the user's device having GSM, NB IOT or similar communication, in order to send to the external server.

[0039] The saving for each connection is 200 mA (IOT, narrow band) or 1000 mA for GSM (3G-4G) compared with the 20 mA of Bluetooth Low Energy. This, combined with the use of low-consumption processing means, an embedded software and the use of a start module, enabling a considerable saving of energy, has enabled the design of an optimised

product entailing, in this advantageous configuration, the simplification of components and battery sizes and their maintenance, yielding in the present smart device a more economical configuration than in known devices.

[0040] In a preferred embodiment of the invention, the volume detector is an ultrasonic sensor. This detection by ultrasound enables the verification, reliably and with a low consumption of electricity, of the entry of the waste item into the container and confirmation that the same waste item as read is inserted, in the event of having a motion detector and code/chart reader at the opening thereof. In alternative embodiments, and for a type of waste which is not transparent, it is understood that the volume detector could be a laser device.

[0041] Also, preferably, the volume detector, be it an ultrasonic sensor or similar alternative, is located within the container, oriented toward the opening in the container for the entry of waste, and also toward the interior of said container to measure, in turn, the level of fullness of said container.

[0042] This configuration, with a single component, enables confirmation of the entry of the product, due to it being directed toward the opening for the entry of waste, and detection of the level existing therein due to it being directed toward the interior of the container, understood to be in a direction toward the centre of the container from the point of its installation, with the angle necessary to be able to confirm the entry of the waste item.

[0043] In a preferred embodiment of the invention, the smart device has at least three code/chart readers in an arc-shaped component corresponding to the location at the container opening, or surrounding the same.

[0044] This embodiment enables an accumulation of code/chart readers at one portion of the opening to enable, on the one hand, a wider reading of the code of the waste item, by merely orienting it toward the area covered by said arc of readers, and on the other hand, reducing the costs that would be involved in the installation of 360° reading means.

[0045] In another preferred embodiment of the invention, the smart device has between three and five code/chart readers in a 360° ring corresponding to the location at the opening for the entry of waste into the container, or surrounding the same.

[0046] This embodiment enables a distribution of code/chart readers around the entirety of the perimeter of the opening, where thanks to readings with a coverage of 90° and their homogeneous distribution, three readers may be sufficient, in the worst case obliging the user to perform a minimal rotation of the waste item until an area with reader coverage is found. The installation of 5 readers would ensure direct, rapid reading, as this would cover, with a safety margin, the entire 360° of the opening, without the user having to direct or rotate the waste item for it to be read.

[0047] In the previous case, where the invention is configured in such a way that the code/chart reader is directed toward an area not associated with the opening for the entry of waste into the container, the user identification means are formed by the code/chart reader directed toward an area not associated with the opening for the entry of waste into the container.

[0048] Thus, in this embodiment, the device may carry out the identification of the user in an alternative or additional manner to other means, using a code or chart associated with the user for his identification, with no need for additional means for said identification.

[0049] Preferably in this invention, the processing and control system is connected to and governs the electronic components that form the smart device, also performing the capture and storage of data provided by said devices, and also having a module for communication with the user and/or the external server.

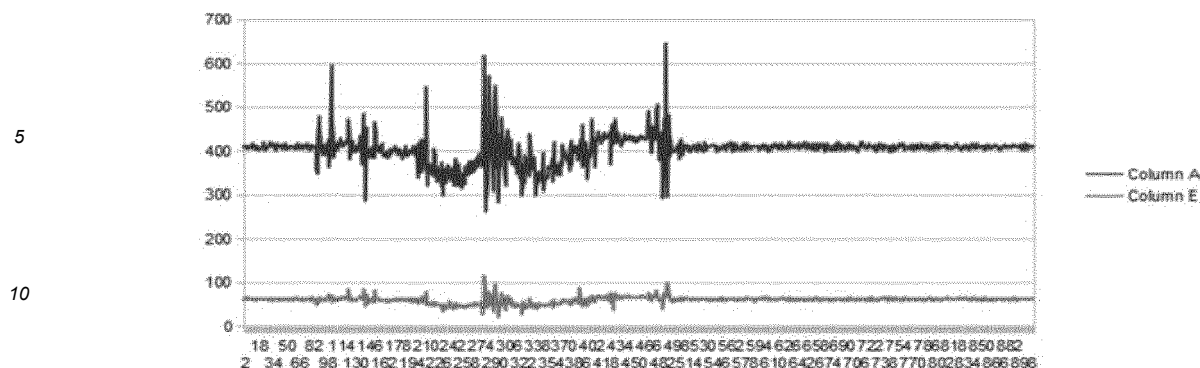
[0050] These electronic components in communication with the processing and control system include the start module, motion detectors, push-buttons and/or screens, likewise the means employed for the activation of devices at stand-by or deactivated; the code/chart readers, the volume detectors, the accelerometer or tilt sensor of the device, the battery and the electrical power supply/generation means, and the means of communication with the user's mobile device and/or the external server.

[0051] The electronic components listed above are governed by and/or send data to the processing and control system in order to execute the mode of operation to be described below.

[0052] Preferably, the impact and vibration absorption system is formed by a chamber fixed to the container, with the points of contact between the device and the container executed with one or more layers of impact- and vibration-absorbing material.

[0053] This enables their integration in conventional containers or in containers of the new design with traditional emptying by upturning, minimising the impacts and vibrations caused in said emptying actions, and therefore minimising the adverse effects on the electronic components and detectors/readers.

[0054] By using layers of impact- and vibration-absorbing material, such as expanded polyethylene with a density of 10 kg/m³, reductions in impact of 25% are achieved, as has been tested and may be seen in the following graph, showing the vibration in Newtons, where the upper graph corresponds to a sensor located on the container, and the lower graph corresponds to a sensor located in a device with the impact- and vibration-absorbing chamber.



[0055] Also, preferably, additionally and/or complementarily, the impact- and vibration-absorbing system features a chamber internal to the smart device wherein the electronic components are located, without said electronic components being in contact with the sides of the smart device itself, creating an air space surrounding these internal electronic components.

[0056] This chamber enables better thermal insulation of the interior of the container, as very high temperatures may be caused therein under climatic conditions of direct sunlight and a hot atmosphere.

[0057] Optionally, although preferably, the smart device may include an accelerometer connected to the processing and control system in order to deactivate the electronic components in the event that the container surpasses a specific tilt angle, meaning that it is in the process of being emptied, and therefore with a greater probability of impacts and vibrations.

[0058] This enables the deactivation of the electronic components and measuring/reading components in order to minimise the consequences of the impacts and vibrations to which the container is subjected during its emptying. Furthermore, as this system enables the identification of the time when the emptying process is performed, it will be aware of and be able to communicate the datum of the exact moment of said emptying.

[0059] In accordance with a second aspect, the present invention proposes a waste container characterised in that it incorporates a smart device for the identification of users and the detection and identification of the waste to be managed, such as that indicated in the preceding characteristics of the present invention.

[0060] This achieves the affordable inclusion, in both existing containers and in newly-made containers, of a smart management system. The advantageous application of the smart device, in its compact format and attached to an existing container in the various ways explained above, with no need to make the global outlay for the renewal of the stock of containers already purchased, enables their adaptation for smart waste management use, and the use of the information obtained during the use thereof, for the better organisation of the collection routes and the optimisation of resources, and also the better determination of the location of the containers, depending on the use thereof, or even the management of the users for the encouragement thereof.

[0061] In accordance with a third aspect, the present invention proposes a mode of operation of the waste management system including the smart device for waste containers and said containers of the type indicated in the preceding characteristics.

[0062] This method is characterised in that the system comprises at least the following steps:

- a. The smart device installed in each of the containers, which includes code/chart readers and volume detectors at stand-by, is activated by means of a start module.
- b. The user identifies himself prior to or subsequent to the insertion of the waste into the container, associating the data of the waste items inserted with said user.
- c. The user inserts the waste through the opening of the container, subsequent to the reading of the codes/charts of the waste item itself by the readers of the device.
- d. The volume detector confirms the insertion of the waste item into the container, or nullifies the same if the falling of the waste item through the opening into the container is not confirmed.
- e. The data concerning the user and the insertion of waste into the container are stored temporarily for their subsequent sending to an external server, or are sent directly via the connection to said server.
- f. The volume detector, at each use of the device, also detects the volume available in order to send a notification for its collection.
- g. The data are sent to the external server for user management and the programming of the emptying of the container on the optimised container route.

[0063] By means of this method, the waste collection and management system enables an optimised system in energy

consumption, due to both the elements employed in its configuration, and the stand-by or deactivated condition of the reader and detection devices and their subsequent start-up by the means described; also due to the alternative system for communication with the external server, employed in step (g), which can employ communication with the user's mobile device to send the user's waste input data to the server, likewise the status of the device itself and the container (fullness, battery level, detected emptyings, etc.).

[0064] Preferably, as a possible embodiment of the invention, once the reading of the code of the waste item has been performed, the device issues a notification to place said waste in the container, in such a way that, in the event that the user should wish to remove the waste item, the motion detector detects the situation of removal and nullifies the insertion of the waste item identified, while in the event that the user inserts the waste item into the container, the volume detector detects the entry of the waste, recording the insertion thereof and validating the recycled waste.

[0065] This mode of operation enables the minimisation of fraudulent use of the waste management system proposed, which is based on the correct identification of the user and the waste, and to ensure the correct insertion thereof into the container for its subsequent management.

[0066] User management comprises, among other data summarising the activity, and other possible uses, the inclusion of gratification/motivation incentives to increase the correct recycling of the waste, whether in the form of municipal discounts or alternatives, or vouchers or cheques, etc.

[0067] In this regard, the installation of this smart device enables interaction with the inhabitants, creating a feedback regarding recycling habits, thanks to the identification of the user and of the waste being recycled, which enables the establishment and implementation of a positive reward system for the user.

[0068] As has been mentioned, this database is able to collect all the information generated during the recycling process: the material, the locations and the time of use by the users, likewise the identification of each user, etc., enabling the creation of an individual environmental file per inhabitant where said incentives will accumulate thanks to his recycling activity.

[0069] Finally, and in accordance with a fourth aspect, the present invention proposes a software characterised in that it comprises the corresponding programme code adapted to the execution of the steps described in the previous method.

[0070] In this way, we have a compact smart device which, thanks to containing in its single body all the basic elements to perform the actions described, and having a damping system at its point of attachment to the container, enables its rapid, simple, secure attachment to existing containers, among others, enabling the renewal of the functionality of the stock of containers without replacing them with containers of a specific design, which would require the replacement of the entirety of the containers, with the associated cost involved.

Brief description of the drawings

[0071] For the better understanding of the description made herein, a set of drawings has been provided wherein, schematically and solely by way of a non-limiting example, a practical case of an embodiment is portrayed.

Figure 1 is a perspective view of a smart device installed at the opening for the entry of waste of a waste container, in accordance with a possible embodiment of the device.

Figure 2 is a frontal elevational view of an arc-shaped smart device for the partial coverage of the opening, in accordance with a possible embodiment of the device.

Figure 3 is a lateral elevational view of an arc-shaped smart device for the partial coverage of the opening, in accordance with a possible embodiment of the device identical to that of figure 2.

Figure 4 is a lateral elevational view of an arc-shaped smart device for the partial coverage of the opening, with transparencies in its external walls, in accordance with a possible embodiment of the device with a configuration similar to that of figure 3.

Figure 5 is a frontal elevational view of a circular smart device for the total coverage of the opening, in accordance with a possible embodiment of the device.

Figure 6 is a partial lateral cross-sectional view of a smart device with a push-button installed on the lateral wall of the container, in a manner not associated with the opening for the entry of waste, in accordance with a possible embodiment of the device.

Figure 7 is a lateral elevational view of a smart device with a push-button, with transparencies in its external walls, in accordance with a possible embodiment of the device.

Figure 8 portrays two views of an embodiment of the invention where the compact device is remote from the opening for the entry of waste into the container, at an area near to the same. In a lateral elevational view (figure 8a) and a frontal elevational view (figure 8b).

Description of a preferred embodiment

[0072] Various embodiments of the smart device for waste containers, of the waste container incorporating the same and of the mode of operation of the waste management system including the same, of the present invention, are described below, with reference to the aforementioned figures.

[0073] In accordance with a preferred embodiment, as may be seen in figure 1, the smart device (10) is installed on a conventional waste container (20), being located at the opening (21) for the entry of waste. The smart device (10) is manufactured from glass fibre or plastic, enabling an optimal resistance to theft, an optimal resistance to inclement weather conditions and an optimal resistance to fire, likewise good thermal insulation properties, protecting the components from the possible high temperatures suffered by the container (20) in the sunlight.

[0074] This smart device (10) is compact, as may be seen in figures 2, 3 and 4, forming a single body once assembled, including all the characteristic elements necessary for its operation. The body of the smart device (10) is formed by an external section (11) which is attached to the opening (21) for the entry of waste, and an internal section (12) which remains within the container (20), said two sections being solidly joined to each other, forming a single body, once the smart device (10) is installed at the opening (21) of the container. The entire assembly is solidly attached to the area of the container (20) where said opening (21) for the entry of waste is located, the corresponding area of the container (20) being grasped between said section (11) and the internal section (12).

[0075] In alternative embodiments, where the smart device (10), from the moment of its initial design, is integrated in a container (20) designed for the integration of the same, a device (10) with a single body is used, part of which remains in the interior and part at the exterior, although preferably it has two sections which join solidly together, forming a single body, in order to facilitate assembly.

[0076] The external section (11) of the smart device (10) partially covers the opening (21), forming an arc. Said external section (11) bears the motion detector (13) which, in the present embodiment acts as a possible start module for the electronic components that are at stand-by. In addition thereto, three code/chart readers (14) are installed along the arc which forms the external section (11) of the smart device (10), pointing toward the axis of the opening (21) for the entry of waste, in order to carry out the reading of the code on the waste, plastic containers and/or glass in this case.

[0077] With regard to this embodiment, there may alternatively be a number of readers (14) between a single one, requiring the user to perform the orientation of the waste to be deposited in the container toward the single reader (14), or more readers (14) enabling coverage of the arc of the external section (11), according to the angle of coverage of the readers (14) installed.

[0078] In the internal section (12) the ultrasonic sensor (15), used as a volume detector, is to be found; this enables the determination of whether the waste item inserted and read by the readers (14) has been inserted completely and deposited within the container (20).

[0079] Also in the internal section (12) of the smart device (10) is the processing and control system, based on a microcontroller, also the battery for electrical power and the connection thereof to the means of generation of electrical power, in this case these being a number of solar panels installed on the container (20) itself; said microcontroller, battery and solar panels are not portrayed.

[0080] Alternatively, the power supply battery may dispense with its connection to its own power generation means, there being openings or ports (302) to said battery for the periodic replacement thereof, as is the case with the embodiment portrayed in figure 8.

[0081] In this embodiment there may alternatively be a different distribution of the elements disposed in the internal section (12) with no significant variances, with the exception of the ultrasonic sensor which, for the correct confirmation of the insertion of the waste item, must be in the internal section (12) of the smart device (10).

[0082] In the present embodiment, the user identification means may be several complementary means, such as the reading of a code associated with the user by the code readers, or wireless communication between a mobile device or RFID card and a communication module of the microprocessor, which preferably will use Bluetooth Low Energy (BLE) to communicate with and to identify the user.

[0083] The microprocessor of the smart device (10) has a communication module of the GSM and/or WiFi type, for its direct connection to a server from which the information on the user and on the stock of containers (20) is managed; likewise the route for the collection/emptying of said containers (20).

[0084] Additionally, the microprocessor uses the connection with the user's mobile device to send information indirectly to the external server via the application with which the mobile device connects to the smart device (10).

[0085] In alternative embodiments, there may be a single communication system with the server, employing alternatively only one of the two mentioned above.

[0086] The attachment of the smart device (10) to the container (20) is carried out by means of conventional attachment elements, disposing a layer of low-density expanded polyethylene material, of 10 kg/m^3 , forming a layer (16) for the absorption of vibrations at the surfaces in contact with the parts of the container (20).

[0087] In addition to this layer (16) of low-density foam, an air space (17) is disposed around the electronic components; that is, the microprocessor of the processing and control system, creating an air space for the thermal insulation of said electronics from the material which forms the body of the smart device (10).

[0088] In normal operation of the container (20) with the smart device (10) installed, the readers (14, 301) and the ultrasonic sensors (15, 303, 304) are at stand-by, with a minimal electricity consumption, approximately 1 to 5 mA. When the user arrives at the container (20), either by means of the connection of the user's mobile device with the smart device (10) for the identification thereof, or alternatively by means of any of the other means of identification available, such as the RFID card, for example, the microprocessor activates said readers (14, 301) and sensors (15, 303, 304) to enable the insertion by the user of the waste into the container (20) and the identification of said waste.

[0089] Alternatively, and/or additionally, the smart device (10) may awaken from its stand-by condition at the moment when the motion detector (13) detects a waste item in the proximity of the opening (21) of the container (20).

[0090] In the present case, an upper arc of readers is disposed, toward which the user must direct the bar code or QR code of the waste item, for the reading thereof. Once read, the information is sent to the microprocessor, which stores said information and links it with the user identified, and sends this to the user management platform, together with the status of the container, should any characteristic of its upkeep be altered.

[0091] Once the reading of the code of the waste item has been performed, an audible signal and a LED indicate that said waste item may be dropped into the container (20). In the event that the user should wish to remove the waste item, the motion detector, in this embodiment an infra-red sensor, detects the situation and nullifies the insertion of the waste item identified. In the event that the user should insert the waste item into the container (20), the ultrasonic sensor (15) detects the entry of the waste item, recording said insertion and validating the waste item recycled.

[0092] As has been mentioned, if the identification of the user has been performed by means of a mobile telephone or device incorporating a connection to a telecommunications network, this will be used to send the information concerning the user's waste management to the external server, together with the data on the status of the container (20). This saving of energy due to the use of BLE when compared with the use of GSM or NB IOT communication is fundamental for the duration of the batteries and therefore for the efficient sizing and reduced cost of this communications module of the smart device (10), as has been contended above in the description of the invention.

[0093] Otherwise, the communication module with GSM, NB IOT or similar is employed for the direct sending of the data.

[0094] Once the waste management operation is completed, the smart device (10) reverts once again to stand-by to save power.

[0095] As a part of user management, in addition to the motivation of the user for his continued correct waste management and the maximisation thereof, there is included a calculation of usage and of the amount of waste managed, it thus being possible to determine a better location for the containers (20) within the area where they are installed. Other types of management, conclusions and calculations may be performed with the data obtained advantageously with the present invention, as the bar code data sent enable the identification of the product managed as waste, with associated data on the type of waste material, its volume, etc.

[0096] Among the parameters which may be sent to the external server is the datum of fullness of the container (20), determined by the products inserted and the type of product, detected by its bar code and directly by means of the ultrasonic sensor (15) itself, which detects a considerable level of fullness, enabling, by the sending of this datum to the server, notification of the container (20) emptying service for its inclusion in the emptying route, and said route is optimised.

[0097] Additionally, thanks to the obtaining of said data corresponding to the waste habitually and/or periodically inserted, its type and physical characteristics (volume and weight), the time of its becoming full may be predicted, to be confirmed by the ultrasonic sensor (15).

[0098] During the emptying operation, which is performed in the traditional way of lifting and upturning the container (20) by the waste collection truck, as this is performed in a manner that produces numerous impacts, shocks and vibrations, at the moment when the container (20) reaches a specific tilt angle, as the smart device (10) includes an accelerometer, not portrayed in the figures, the microprocessor disconnects the electronics in order to prevent damage to the electronic components which may be activated.

[0099] In an alternative manner of this invention, there may be an external section of the smart device (100) where there may be the same or identical configuration in the remainder of the smart device (100), but with three detectors surrounding 360° of the opening (21) of the container, as may be seen in figure 5. This configuration enables the code or chart of the waste item to be read in any position in which it is inserted into said opening (21), it being necessary in the worst case to perform a slight rotation thereof, between 30° and 90° , for said code to be read.

[0100] As part of this 360° configuration, there may alternatively be 5 or more readers (14), covering with their angle of coverage, which in this case is 90° , the entirety of the perimeter of the opening for the waste item bar code or chart to be read.

[0101] Alternatively, an embodiment may be employed, as may be seen in figures 6 and 7, using a smart device (200) not associated with the reading of the waste item code at the opening itself, but said device is installed on one of the lateral or upper walls of the container (20), depending on the geometry thereof, so that the waste item may be presented before the single reader (13) disposed and then deposited in the interior of the container. Entry is confirmed by means of an internal ultrasonic sensor (15), but without the possibility of performing the confirmation which could be carried out in the previous embodiments, in that the waste item inserted is the same as that read by the readers (14).

[0102] This alternative smart device (200) may feature an additional or alternative start-up system for the electronic components at stand-by, such as a push-button switch (210) or a user-interactive touch screen, not portrayed in the figures.

[0103] Similarly to the previous alternative embodiment, and as may be seen in figures 8a and 8b, the compact smart device (300) is also installed on one of the lateral or upper walls of the container (20). This device (300), once assembled on a conventional existing container, is located in such a way that the code reader (301) and a closed housing (302) for changing the battery powering the device (300) are on the external part of the container.

[0104] At the same time, in order to correct the security issue of the correct performance of the operation of inserting the waste item identified into the container (20), two ultrasonic sensors (303, 304) are located therein. One of these sensors (303) is directed toward the opening for the entry of waste into the container (20) for the detection of the entry of the waste item identified and to verify that this is performed a moment subsequent to its identification. The other sensor (304) is directed toward the base of the container (20) for the detection of the degree of fullness.

[0105] Despite the fact that reference has been made to a specific embodiment of the invention, it is evident for a person skilled in the art that the smart device for waste containers, as well as the waste container incorporating the same, and the mode of operation of the waste management system including these, as described, are susceptible to numerous variations and modifications, and that all the aforementioned details can be replaced by other technically equivalent details without detracting from the scope of the protection defined by the attached claims.

Claims

1. A smart device for waste containers, of the type installed in said containers or on their associated external structures, having elements for their attachment to the container, and means for the identification of and/or communication with the users of said container and means for the generation and storage of its own electrical power, **characterised in that** the smart device comprises, at least:

- a start module for the active operation of the device;
- one or more code/chart readers, at least for the waste to be inserted;
- one or more volume detectors for the detection of the entry of the waste into the container;
- a processing and control system with wireless means of communication with an external server for user management and container emptying programming;
- a system for absorbing shocks and vibrations at the joint between the smart device and the waste container on which it is installed;

where the start module executes the activation of the code/chart readers and volume detectors, which start from a mode of operation at stand-by or deactivated, with minimal electricity consumption; and

where the device is constituted compactly in a single body with all of its components, these being the start module, code/chart readers, volume detectors and the processing and control systems, this compact device being attached to the container.

2. A smart device for waste containers, as claimed in claim 1, where the code/chart readers are installed in at least part of the opening for the entry of waste into the container, or around said opening at the area nearest thereto, said readers pointing toward said opening, the device being compactly integrated in said location.

3. A smart device for waste containers, as claimed in claim 1, where the code/chart readers are installed on the exterior of the container, remotely from the opening for the entry of waste into the container, and remotely from the area nearest to said opening.

4. A smart device for waste containers, as claimed in claim 1, where the start module is constituted by at least one of the following elements or systems:

- a manual push-button connected to the processing and control system;

- a system for the detection of the presence of a body in the proximity of the smart device;
- a system for communication with a mobile device such as a mobile telephone, tablet or identification card, by means of wireless technology, WiFi, RFID and/or Bluetooth, which may additionally act as a means for the identification of the user.

- 5 5. A smart device for waste containers, as claimed in claim 1, where the volume detector is located within the container, directed toward the opening for the entry of waste into the container, and also toward the interior of said container.
- 10 6. A smart device for waste containers, as claimed in claim 2, where the smart device has at least three code/chart readers in an arc-shaped component corresponding to the location at the opening for the entry of waste into the container, or surrounding the same.
- 15 7. A smart device for waste containers, as claimed in claim 2, where the smart device has between three and five code/chart readers in a 360° ring corresponding to the location at the opening for the entry of waste into the container, or surrounding the same.
- 20 8. A smart device for waste containers, as claimed in claim 1, where the processing and control system is connected to and governs the electronic components that form the smart device, also performing the capture and storage of data provided by said components, and also having a module for communication with the user and/or the external server.
- 25 9. A smart device for waste containers, as claimed in claim 1, where the impact and vibration absorption system is formed by a chamber fixed to the container, with the points of contact between the device and the container executed by means of one or more layers of impact- and vibration-absorbing material.
- 30 10. A smart device for waste containers, as claimed in claim 1 or 9, where the impact- and vibration-absorbing system features a chamber internal to the smart device wherein the electronic components are located, without said electronic components being in contact with the structure of the smart device itself, creating an air space surrounding these internal electronic components.
- 35 11. A smart device for waste containers, as claimed in claim 1, where the smart device includes an accelerometer connected to the processing and control system in order to deactivate the electronic components in the event that the container surpasses a specific tilt angle, meaning that it is in the process of being emptied, and therefore with a greater probability of impacts and vibrations.
- 40 12. A waste container, **characterised in that** it incorporates a smart device for the identification of the users thereof, and for the detection and identification of waste to be managed, of the type described in claims 1 to 11.
- 45 13. A mode of operation of the waste management system including the smart device for waste containers and said containers, of the types described in claims 1 to 12, **characterised in that** the system includes at least the following steps:
 - a. The smart device installed in each of the containers, which includes code/chart readers and volume detectors at stand-by, is activated by means of a start module.
 - b. The user identifies himself prior to or subsequent to the insertion of the waste into the container, associating the data of the waste items inserted with said user.
 - c. The user inserts the waste through the opening of the container, subsequent to the reading of the codes/charts of the waste item itself by the readers of the device.
 - d. The volume detector confirms the insertion of the waste item into the container, or nullifies it if the falling of the waste item through the opening into the container is not confirmed.
 - e. The data concerning the user and the insertion of waste into the container are stored temporarily for their subsequent sending to an external server, or are sent directly via the connection to said server.
 - f. The volume detector, at each use of the device, detects the volume available in order to send notification for its collection.
 - 55 g. The data are sent to the external server for the management of the user data and the programming of the emptying of the container on the optimised route for the containers, either directly or indirectly via the connection with the mobile device of the user employed for the identification thereof.

14. A mode of operation of the waste management system, as claimed in claim 13, where once the reading of the code of the waste item has been performed, a notification is issued to deposit said waste in the container, in such a way that, in the event that the user should wish to remove the waste item, the motion detector detects the situation of removal and nullifies the insertion of the waste item identified, while in the event that the user inserts the waste item into the container, the volume detector detects the entry of the waste, recording the insertion thereof and validating the recycled waste.

15. A software **characterised in that** it comprises the corresponding program code adapted to execute the steps described in claims 13 and 14.

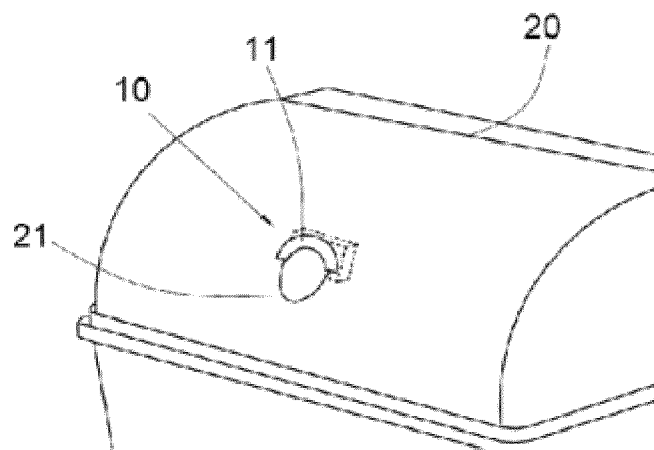


Fig. 1

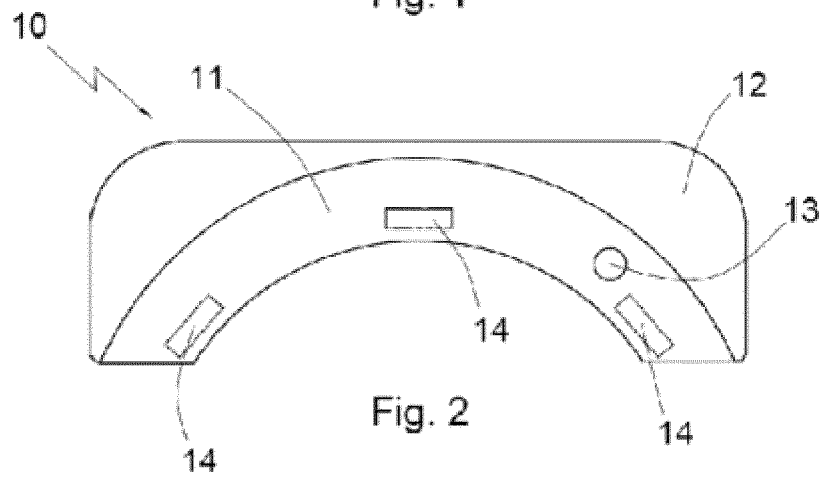


Fig. 2

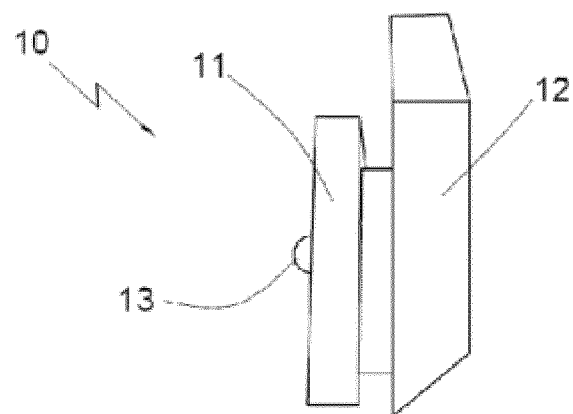


Fig. 3

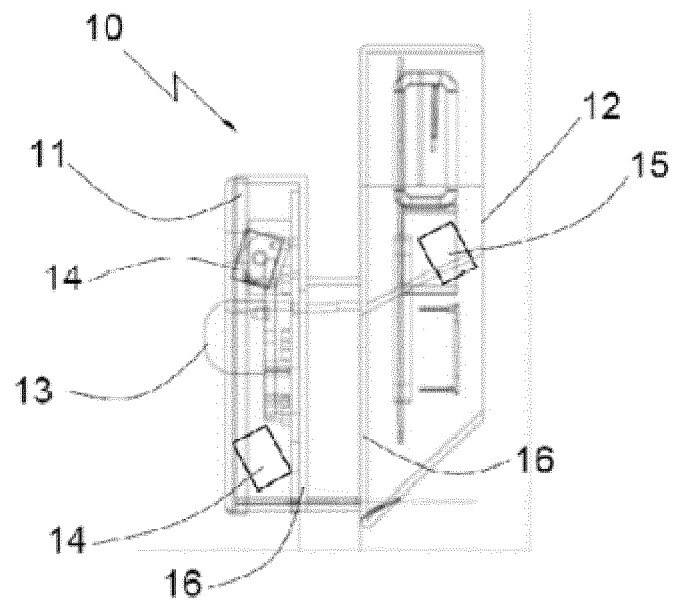


Fig. 4

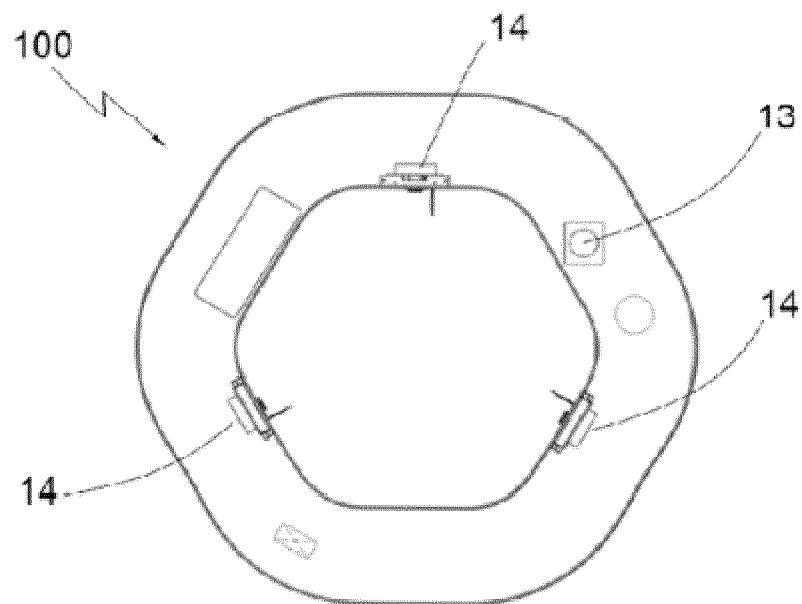


Fig. 5

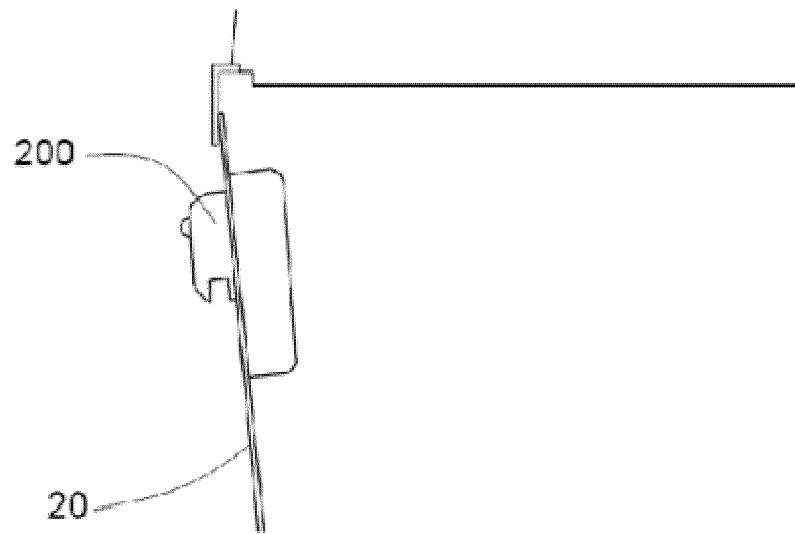


Fig. 6

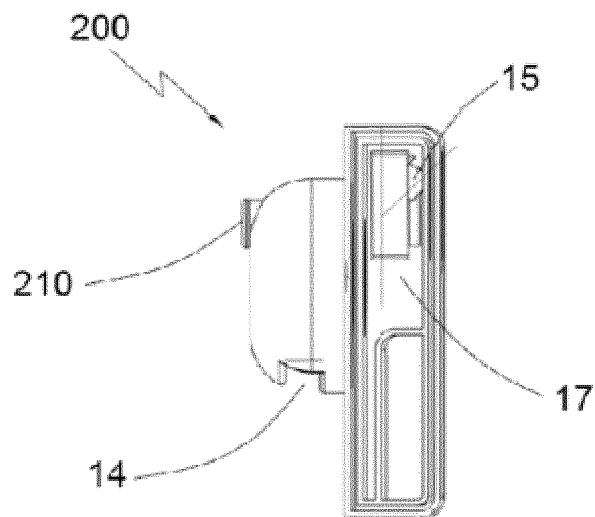


Fig. 7

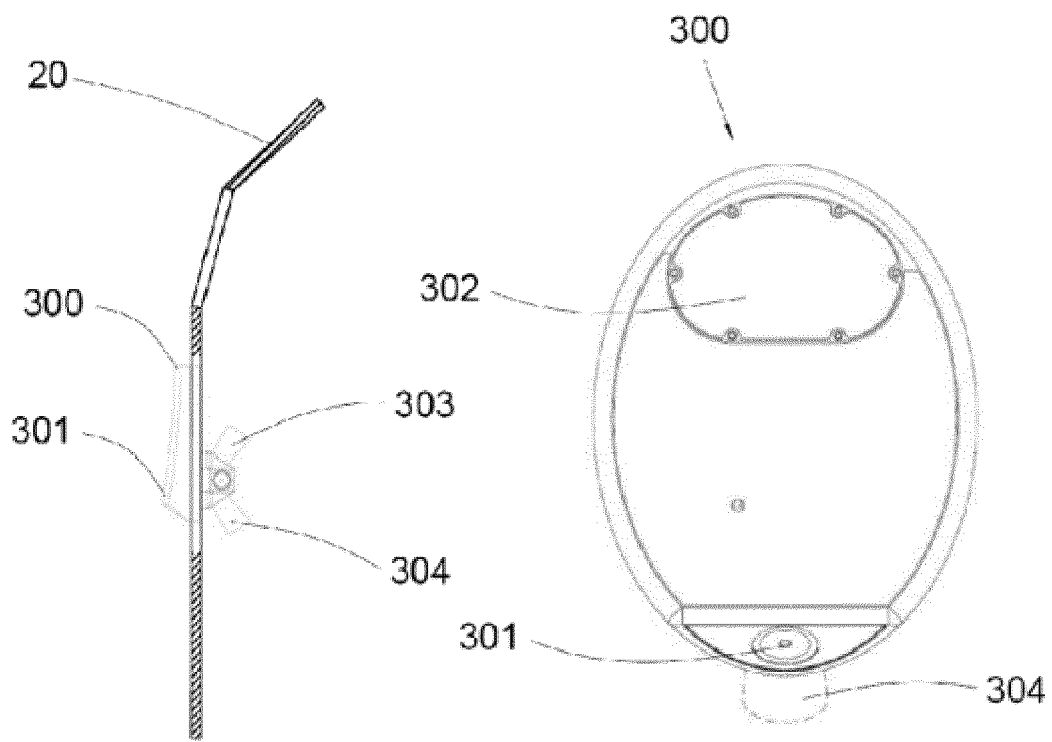


Fig. 8a

Fig. 8b