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(54) WASTE TONER SOLIDIFICATION AND DISCHARGE

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(57) ABSTRACT

An image forming apparatus includes a body a printing engine to perform an image forming operation, a waste toner withdrawal device to obtain waste toners generated during the image forming operation, and a waste toner treatment device to treat the waste toners obtained by the waste toner withdrawal device and introduced to the waste toner treatment device from the waste toner withdrawal device. The waste toner treatment device includes a waste toner discharging member, a heating portion to heat the waste toners within the heating portion, and a driving portion to move the heating portion along a longitudinal direction of the waste toner discharging member so as to form a waste toner solidified within the heating portion from the waste toners heated by the heating portion. The waste toner discharging member discharges the waste toner solidified within the heating portion outside of the heating portion.

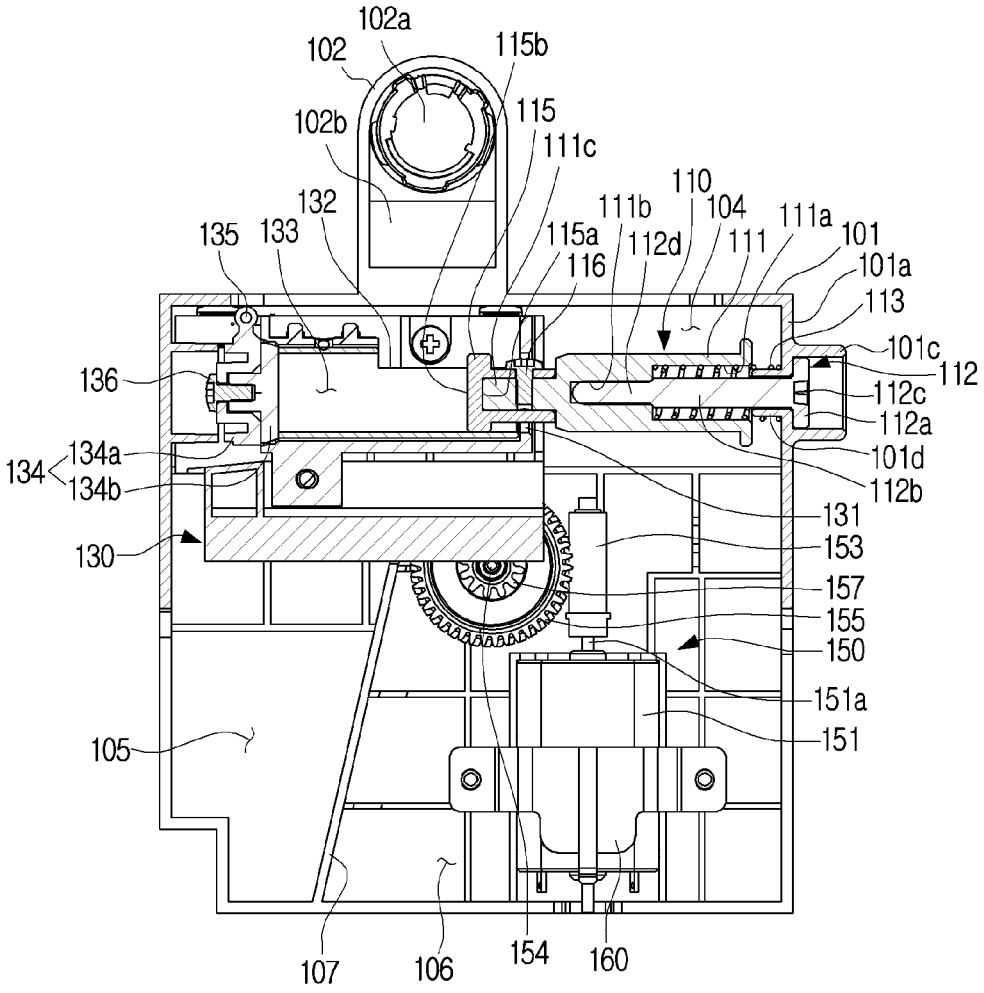

FIG. 1

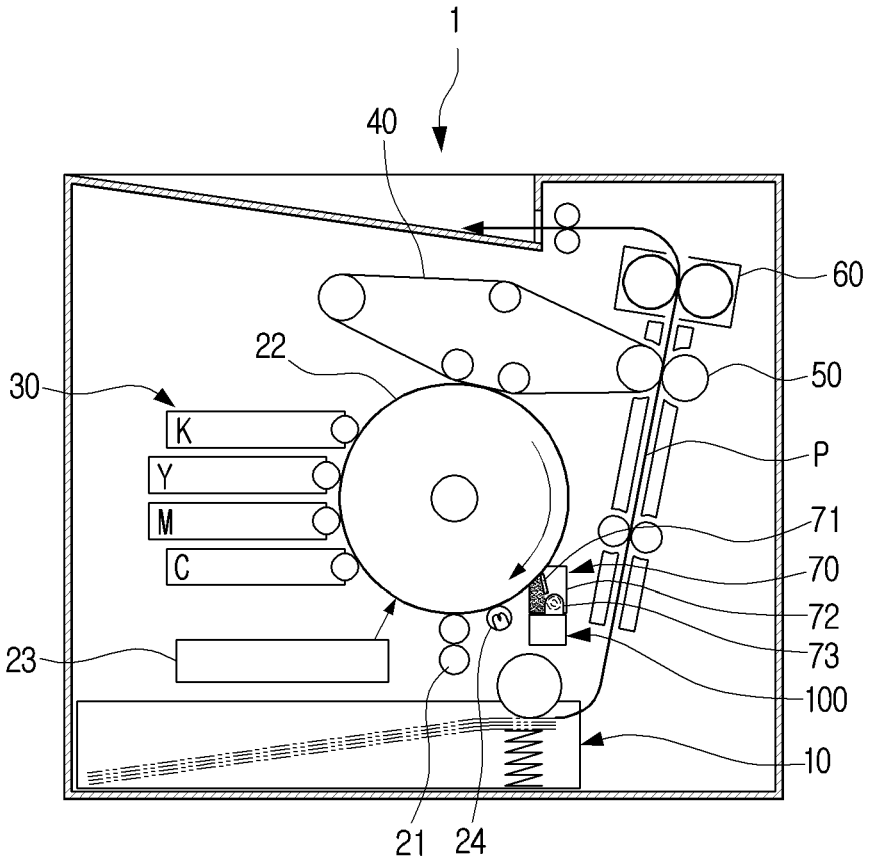

FIG. 2

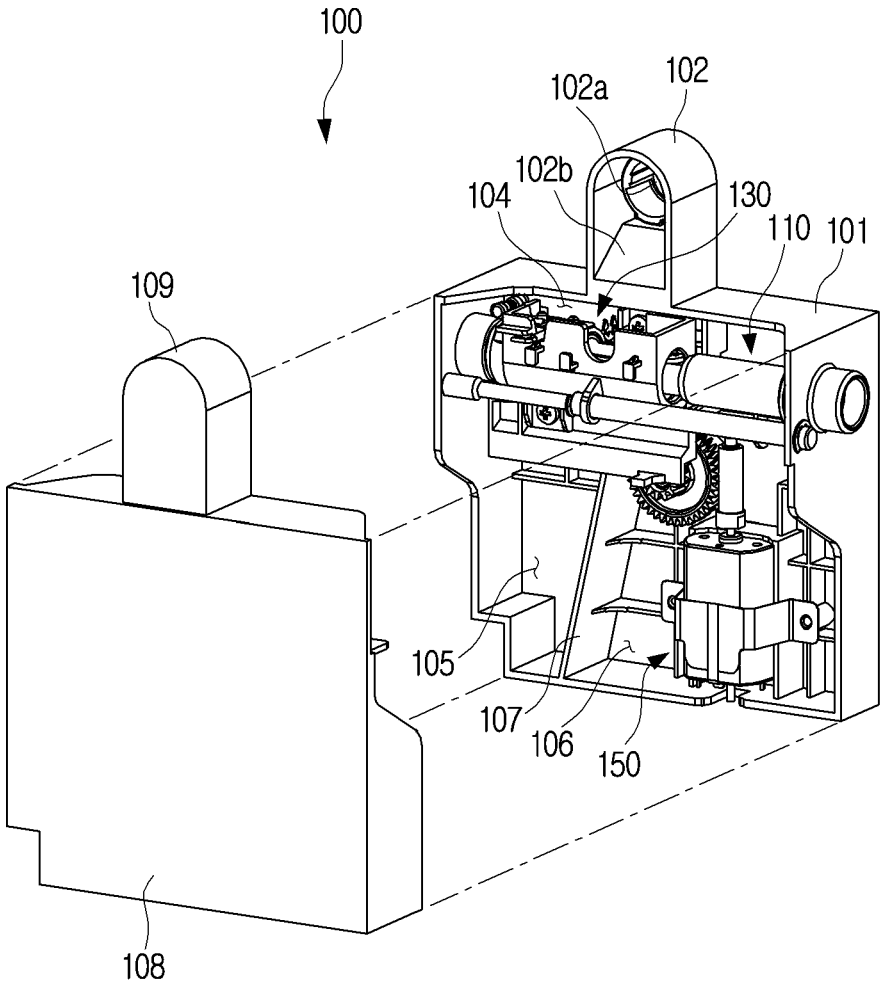

FIG. 3

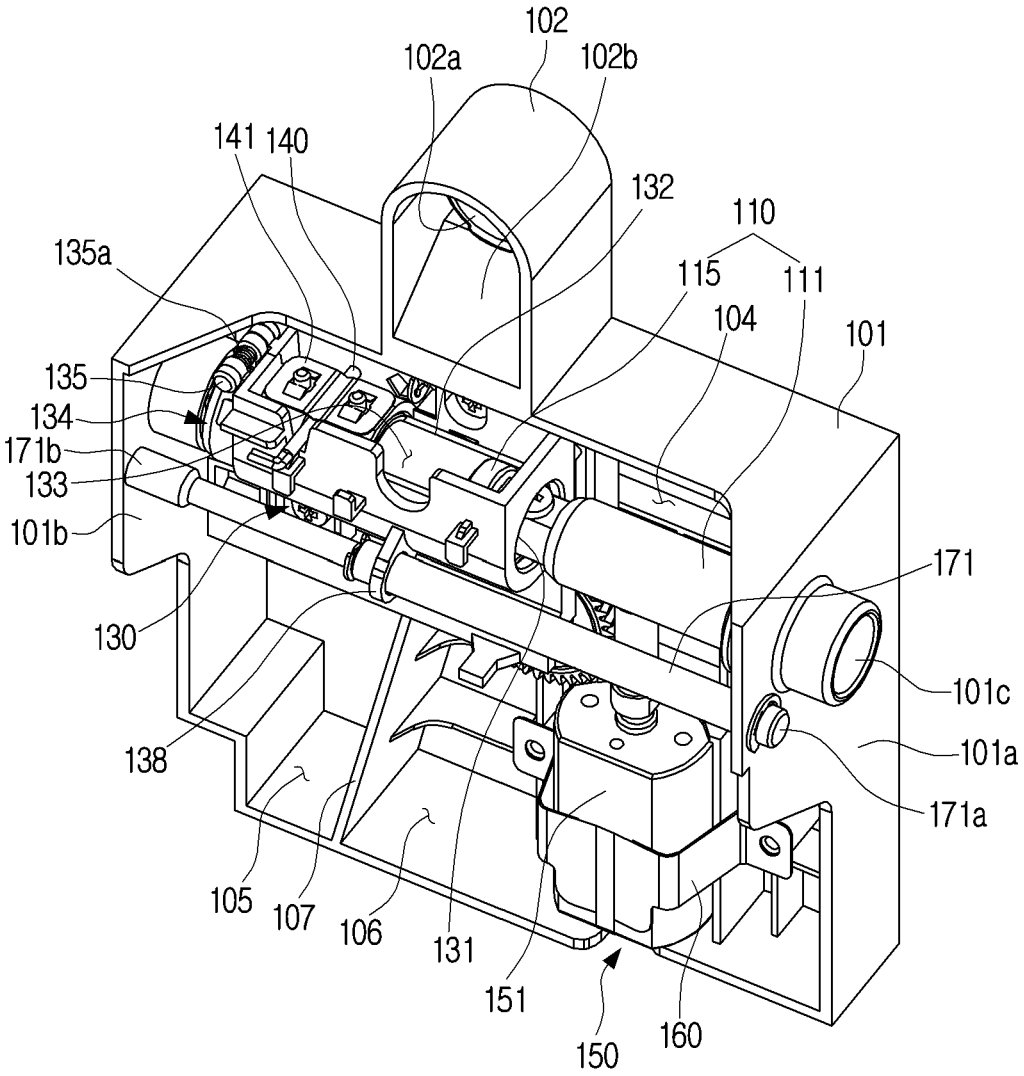
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FIG. 4

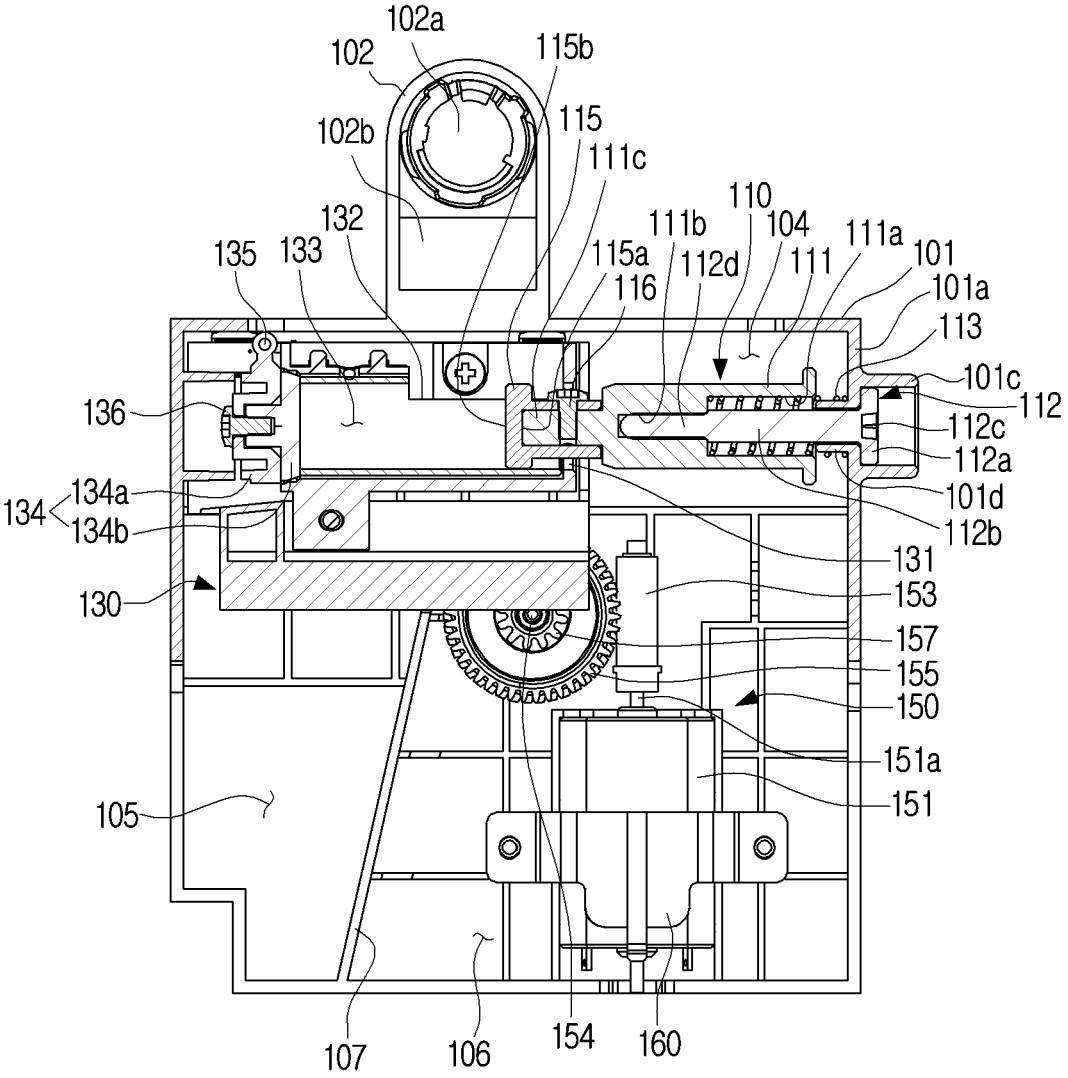
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FIG. 5

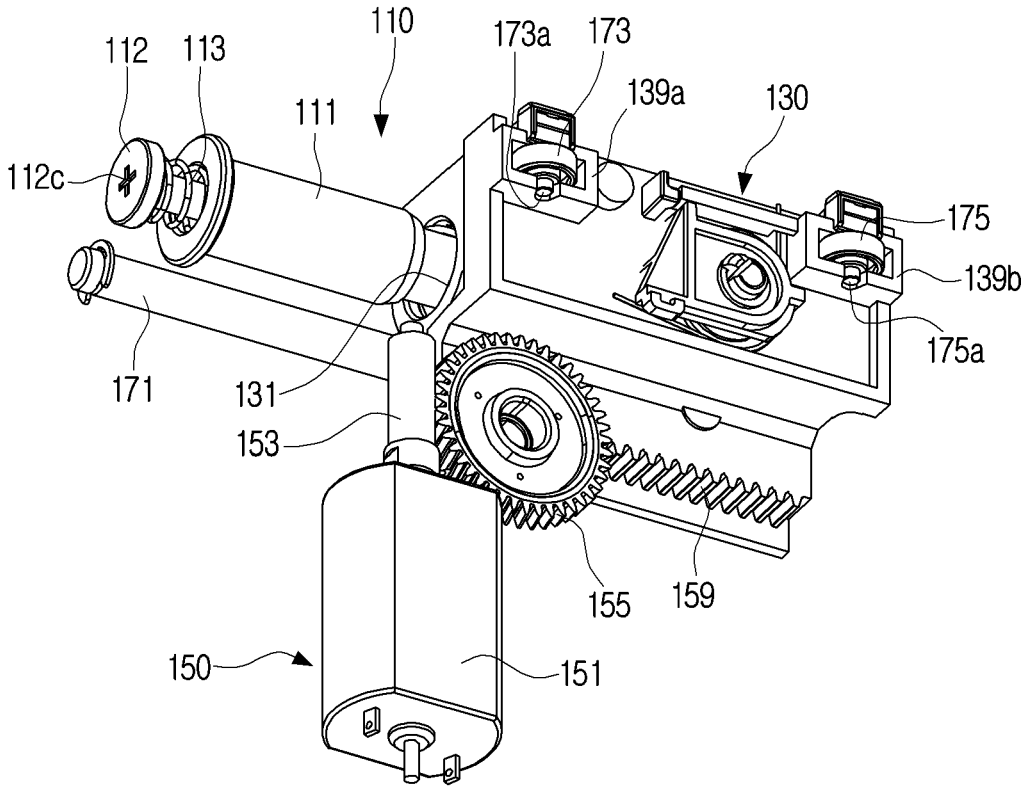
110
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FIG. 6

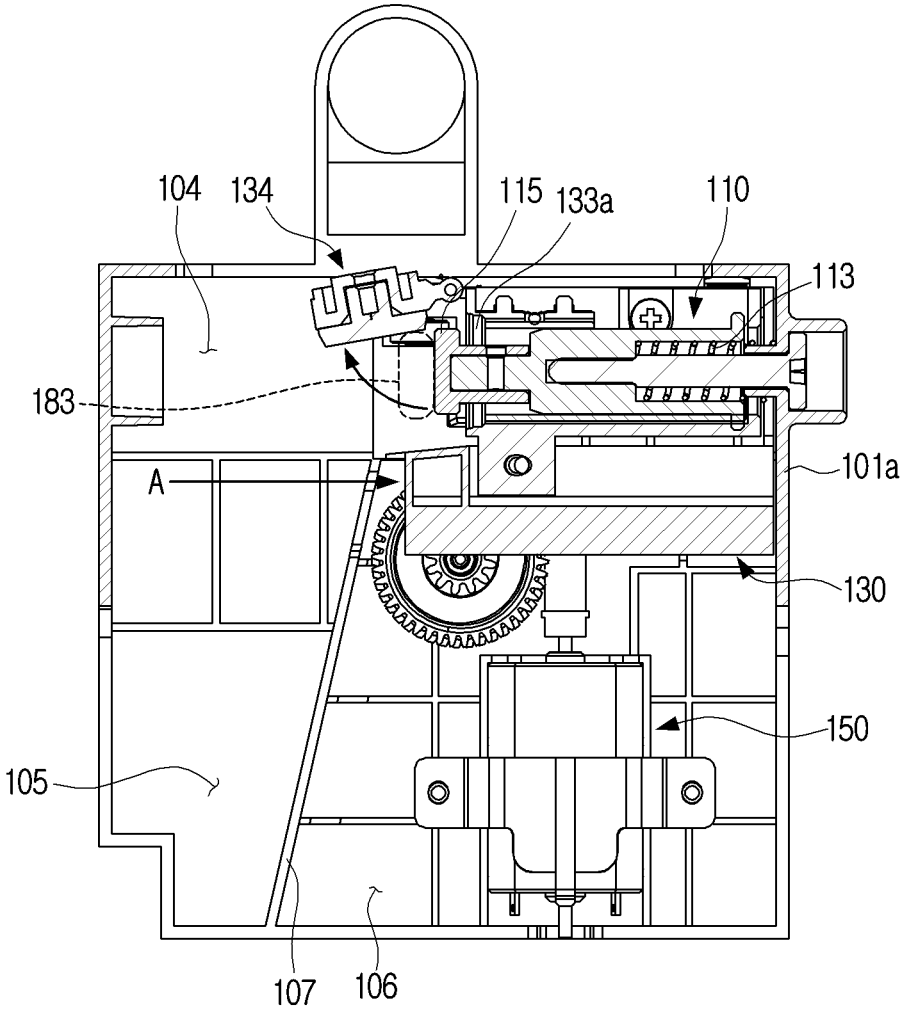

FIG. 7A

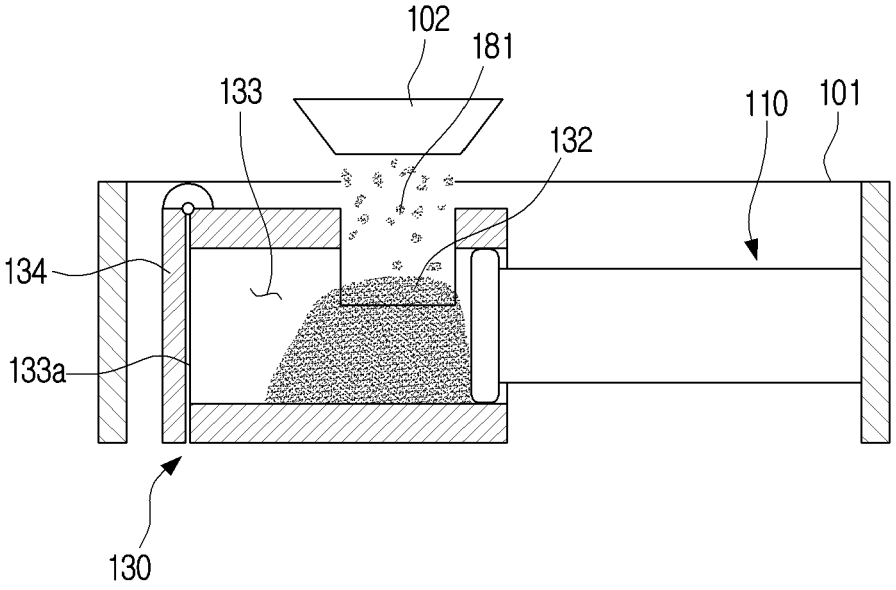

FIG. 7B

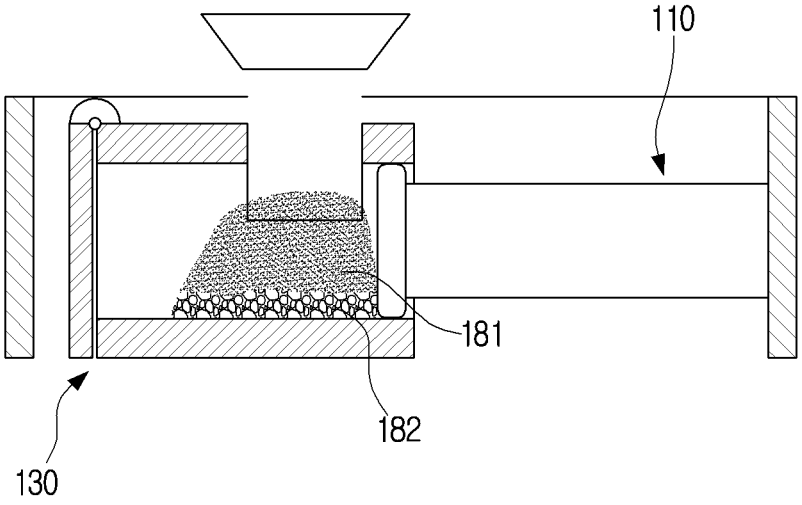

FIG. 7C

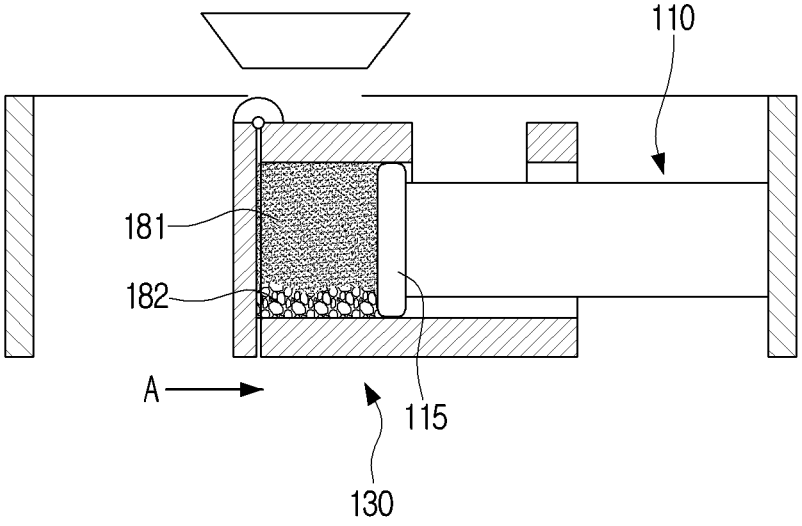

FIG. 7D

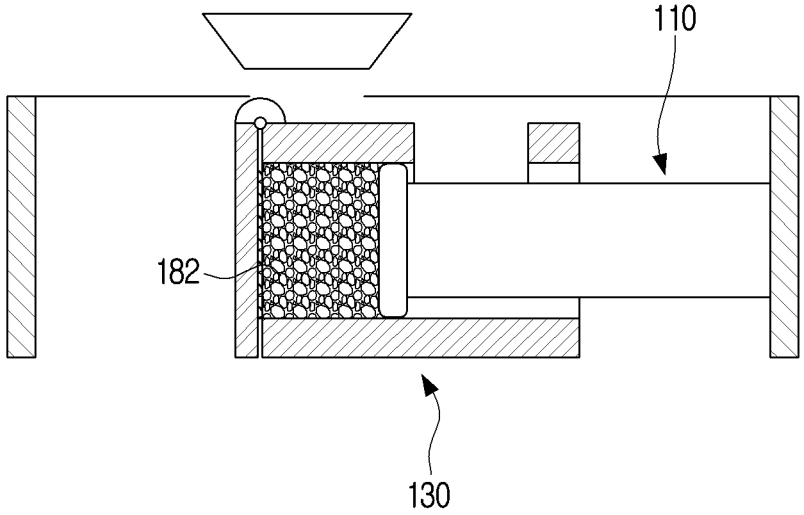

FIG. 7E

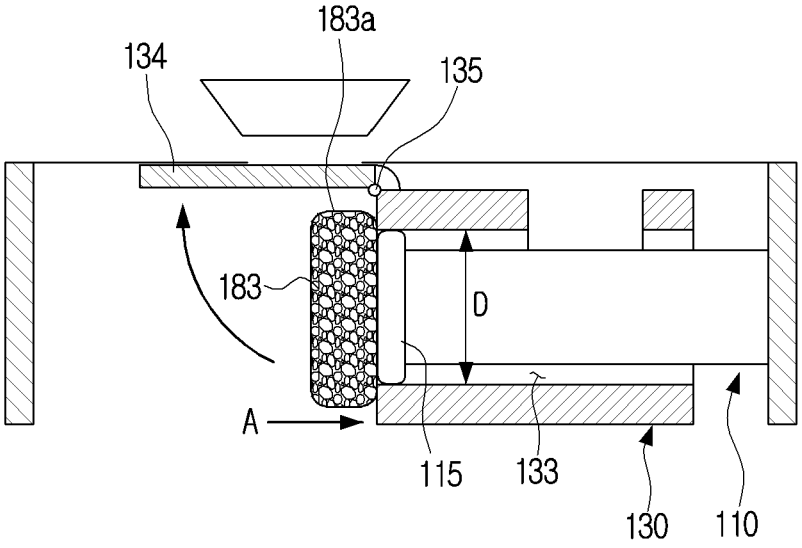

FIG. 7F

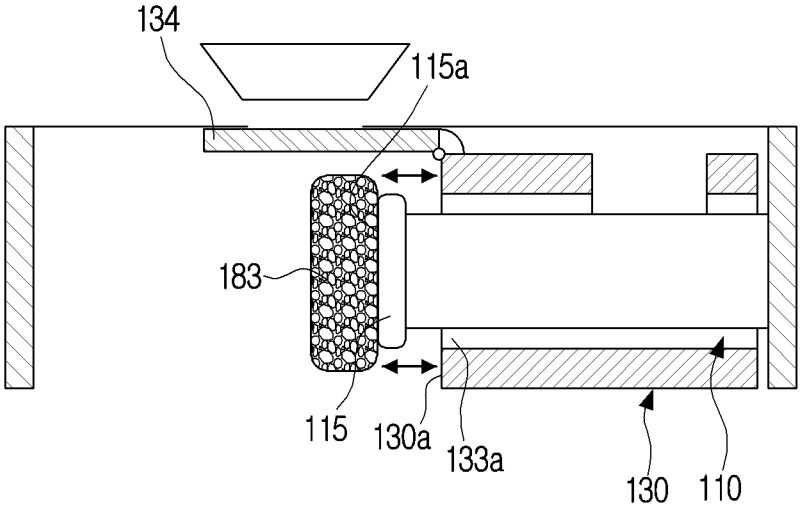

FIG. 7G

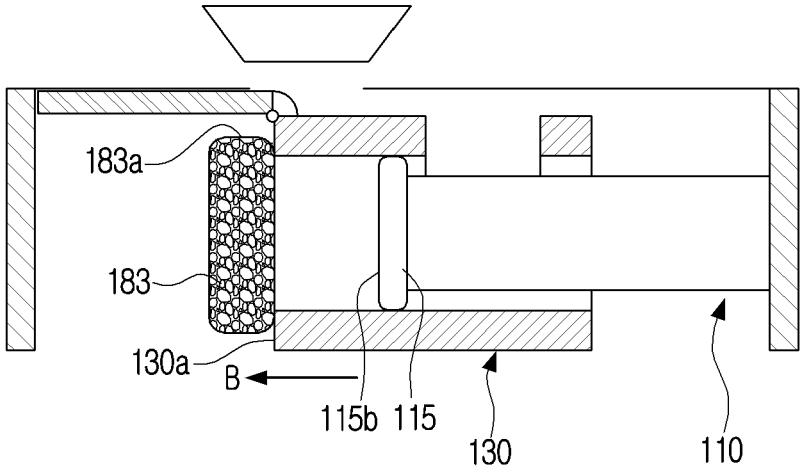

FIG. 7H

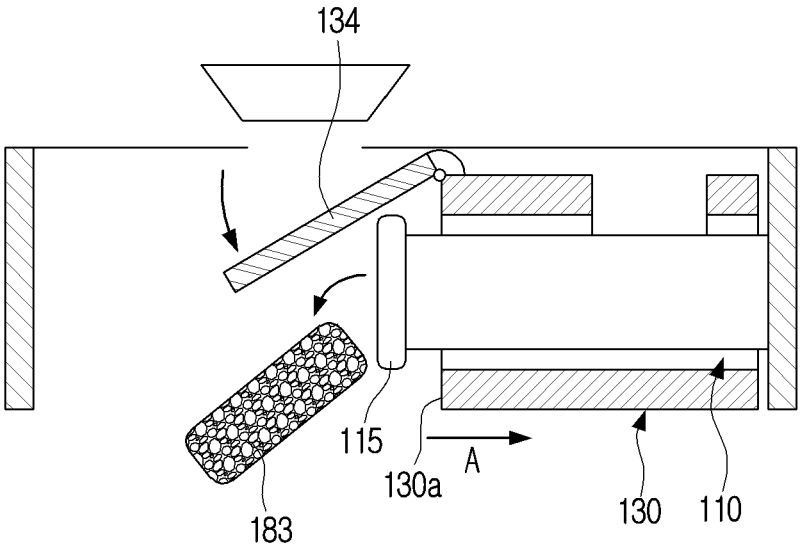

FIG. 8

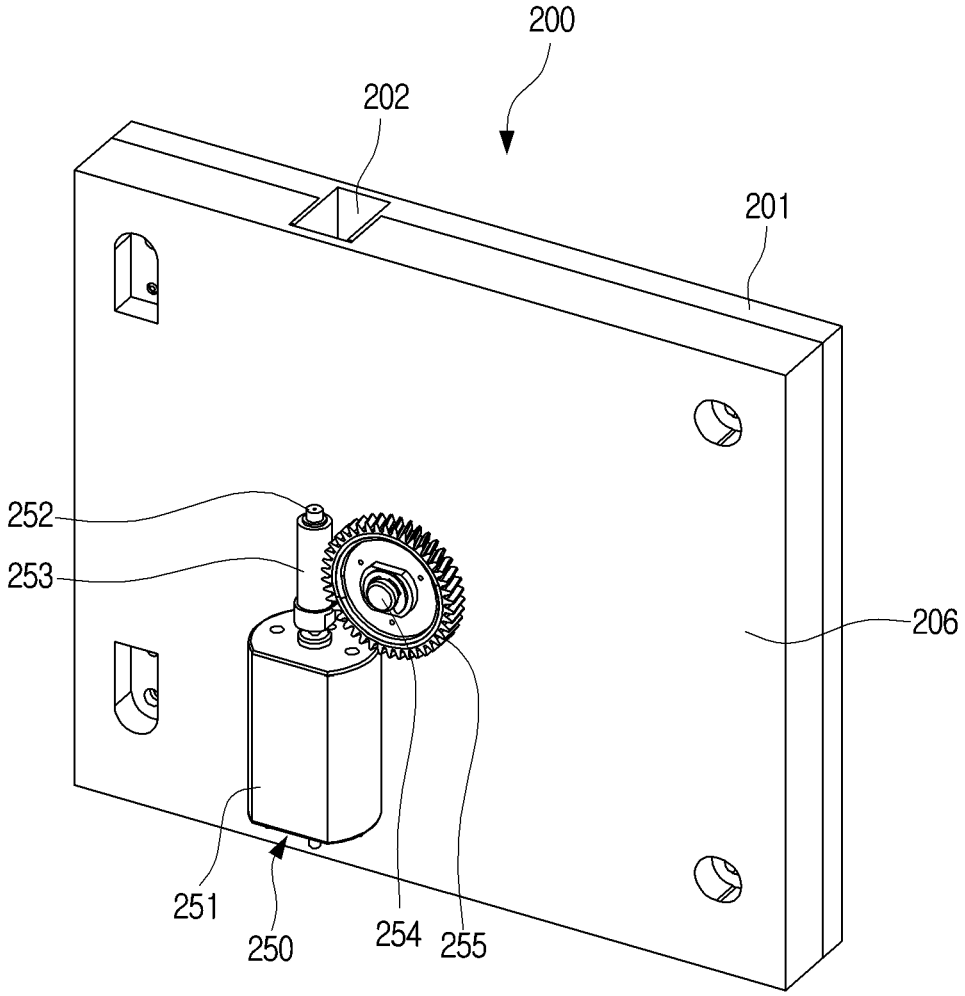

FIG. 9

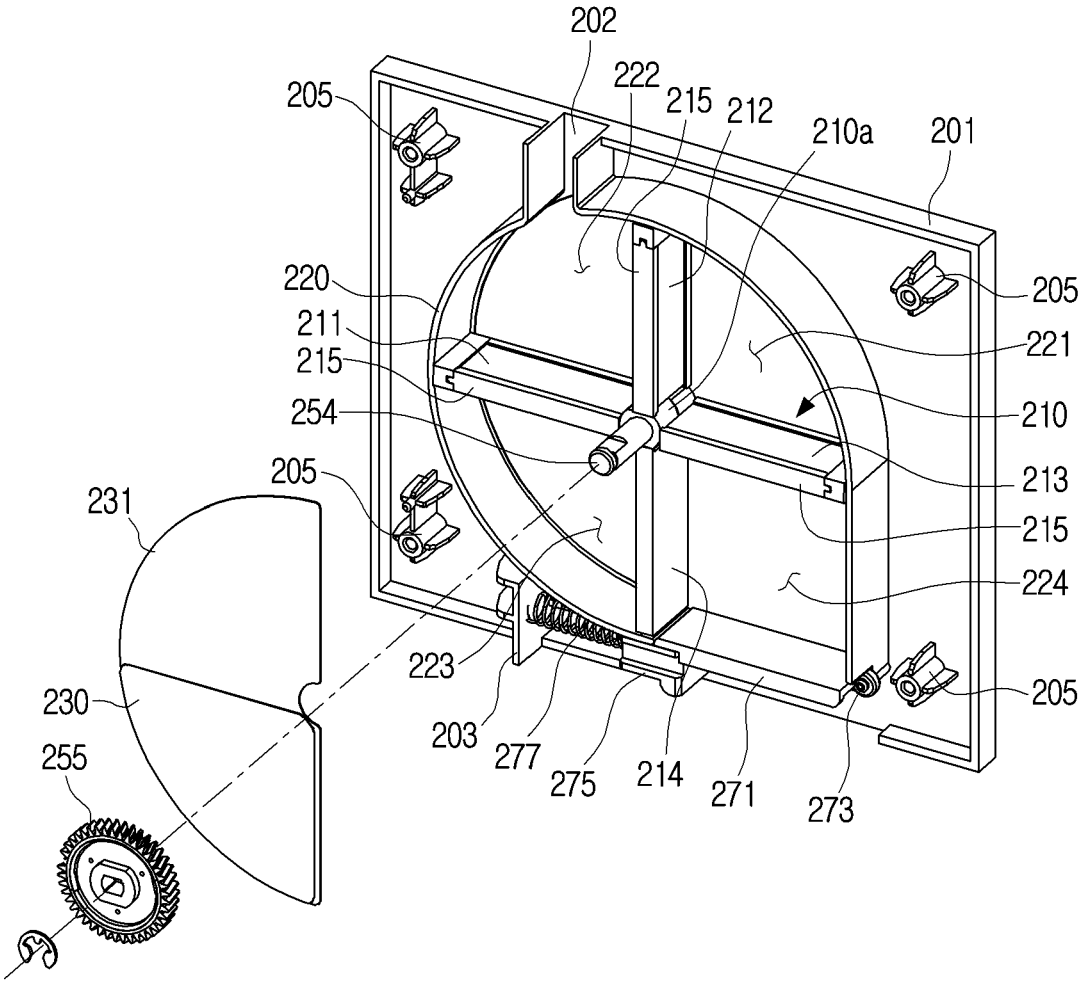
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FIG. 10A

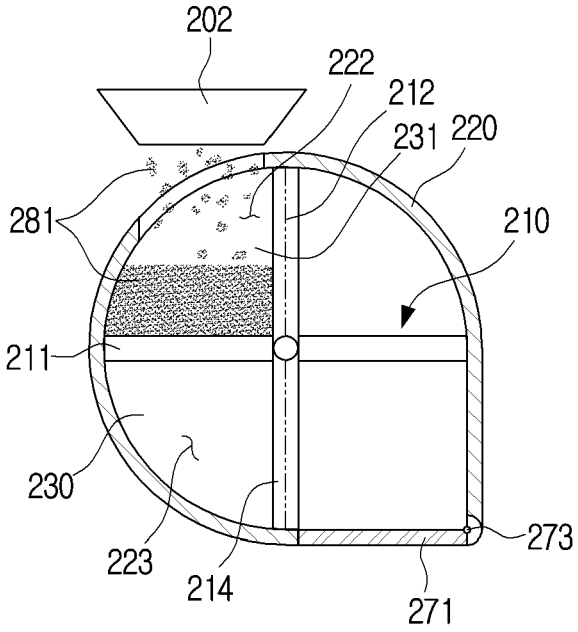


FIG. 10B

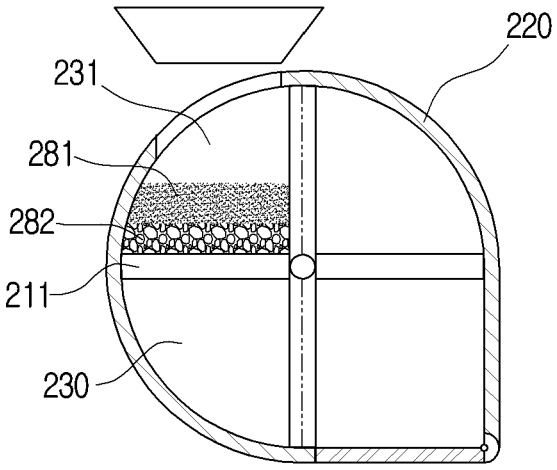


FIG. 10C

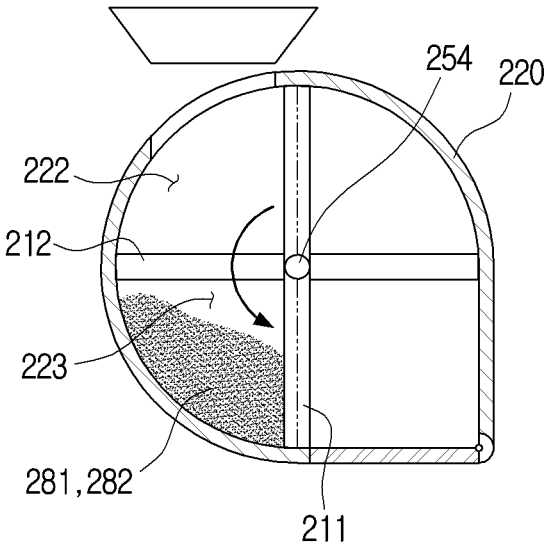


FIG. 10D

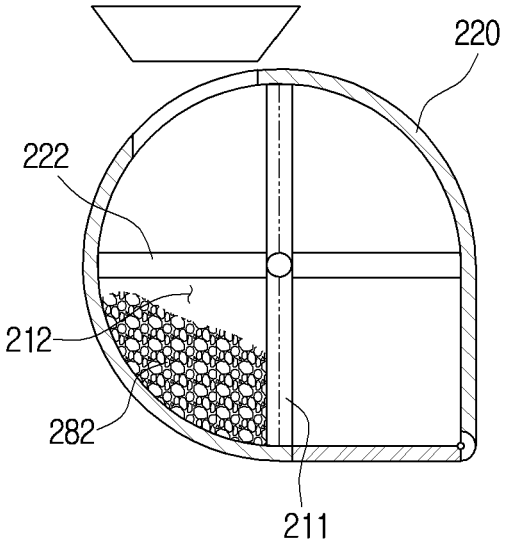


FIG. 10E

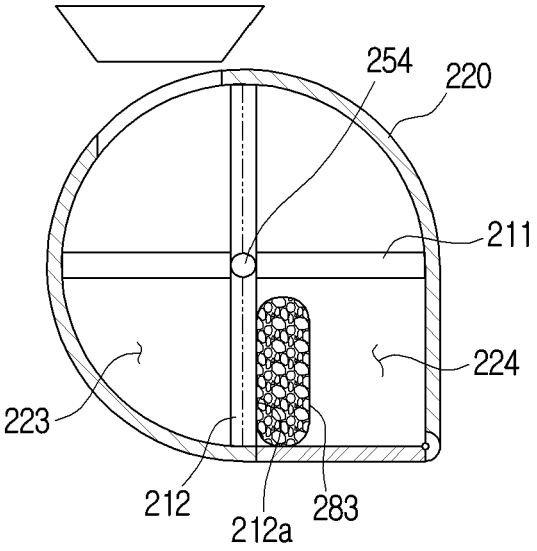


FIG. 10F

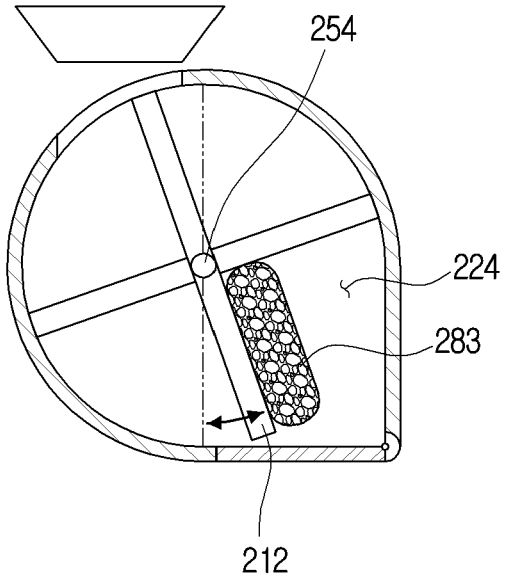


FIG. 10G

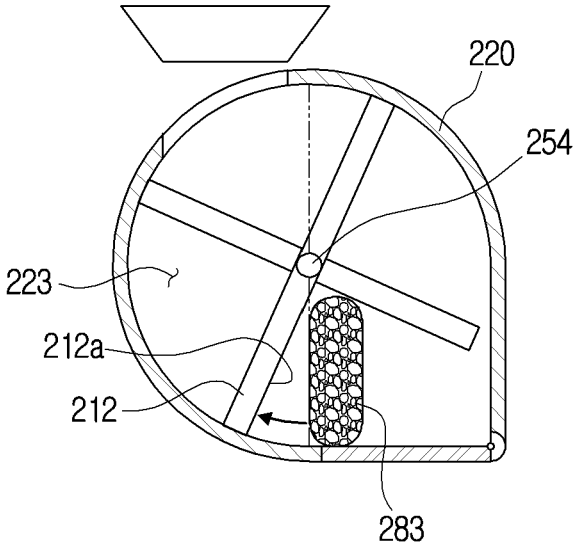
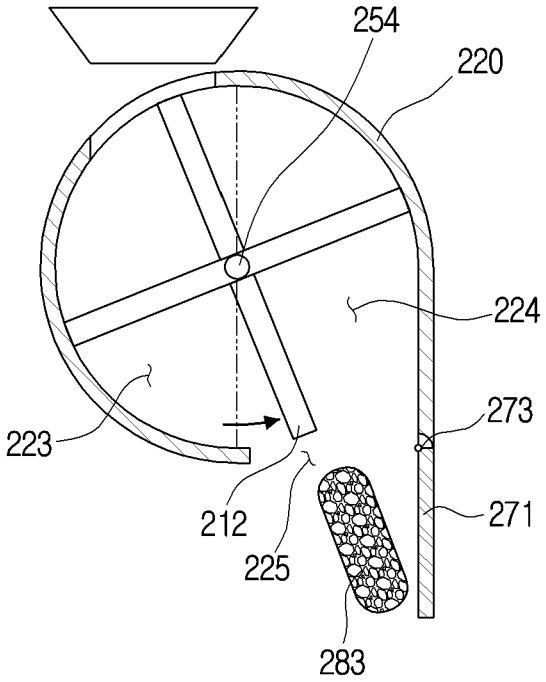


FIG. 10H



WASTE TONER SOLIDIFICATION AND DISCHARGE

BACKGROUND

[0001] An image forming apparatus such as a printer and a copier using an electrophotographic manner includes a photoconductor on which a toner image is formed, a cleaning blade scraping off the remaining waste toners from the photoconductor after transferring the toner image onto a printing medium such as paper or an intermediate transfer body, and a waste toner withdrawal device receiving the waste toners removed by the cleaning blade and sending the waste toners to a waste toner collection container.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] FIG. **1** is a schematic view illustrating an image forming apparatus having a waste toner treatment device, according to an example;

[0003] FIG. **2** is an exploded perspective view illustrating the waste toner treatment device according to an example;

[0004] FIG. **3** is a perspective view illustrating an inner side of the waste toner treatment device according to an example;

[0005] FIG. **4** is a cross-sectional view of the waste toner treatment device according to an example, illustrating a case where a heating portion is at a first position;

[0006] FIG. **5** is a perspective view illustrating a gear connection structure of a driving portion of the waste toner treatment device according to an example;

[0007] FIG. **6** is a cross-sectional view of the waste toner treatment device according to an example;

[0008] FIGS. **7**A to **7**H are schematic views sequentially illustrating processes of solidifying and discharging waste toners collected through the waste toner treatment device, according to an example;

[0009] FIG. **8** is a perspective view illustrating a waste toner treatment device according to an example;

[0010] FIG. **9** is an exploded perspective view illustrating an inner side of the waste toner treatment device according to an example; and

[0011] FIGS. **10**A to **10**H are schematic views sequentially illustrating processes of solidifying and discharging waste toners collected through the waste toner treatment device, according to an example.

DETAILED DESCRIPTION

[0012] Hereinafter, various examples will be described with reference to the drawings. Examples described below may be modified into several different forms. In order to more clearly describe features of examples, a detailed description for contents known to those skilled in the art to which the following examples belong will be omitted.

[0013] When any component is referred to as being "connected to" another component in the disclosure, it means that any component and another component are "directly connected to" each other or are "connected to" each other with the other component interposed therebetween. In addition, when any component is referred to as "including" another component, it means the inclusion of other components rather than the exclusion of other components, unless explicitly described to the contrary.

[0014] In the disclosure, an "image forming job" may refer to various jobs (for example, printing, scanning, or faxing) related to an image, such as forming of the image, creating/storing/transmitting of an image file, or the like, and a "job" may refer to the image forming job, as well as include a series of processes for performing the image forming job.

[0015] In addition, an "image forming apparatus" may refer to an apparatus that prints printing data created in a terminal apparatus such as a computer on a printing medium. An example of such an image forming apparatus may include a copier, a printer, a facsimile, a multi-function printer (MFP) in which functions of the copier, the printer, and the facsimile are complexly implemented through one apparatus, or the like.

[0016] The waste toner collection container of an image forming apparatus may have a limit to its capacity to collect waste toners, and thus may need to be regularly replaced. In general, it is difficult to avoid leakage of the waste toners to the outside in a process of replacing the waste toner collection container. The waste toners leaked to the outside may contaminate an interior of the image forming apparatus, as well as contaminate indoor air.

[0017] As an example device for replacing the waste toner collection container, a waste toner treatment device capable of increasing eco-friendliness and user convenience has been demanded.

[0018] FIG. **1** is a schematic view illustrating an image forming apparatus having a waste toner treatment device, according to an example.

[0019] In FIG. **1**, a bold solid line indicated by reference sign P denotes a progress path of a printing medium. In FIG. **1**, a body of an image forming apparatus **1** is not given a reference numeral, but may be a portion forming an outer shape of the image forming apparatus **1**.

[0020] A paper feeding device **10** may store a printing medium such as paper. The printing medium may be transported along the progress path P by a plurality of transport rollers (not illustrated).

[0021] A charging device **21** may charge the photoconductor **22** with a predetermined potential. The photoconductor **22** may be manufactured by forming a photosensitive material layer on an outer periphery of a metal drum. The photoconductor **22** may be formed in a belt shape instead of a drum shape. A light scanning device **23** may scan the photoconductor **22** with light to form an electrostatic latent image corresponding to printing data on the photoconductor **22**. The charging device **21**, the photoconductor **22**, and the light scanning device **23** may configure a printing engine forming an image on a printing medium.

[0022] An electric charge removing device **24** may be disposed adjacent to the photoconductor **22** to remove an electric charge remaining on the photoconductor **22** after toner images are transferred onto a transfer belt **40**.

[0023] Four developing devices **30** store toners in a solid powder state having four colors, that is, cyan (C), magenta (M), yellow (Y), and black (K), respectively. The four developing devices **30** form the toner images by supplying a toner to the latent electrostatic image formed on the photoconductor **22**.

[0024] The transfer belt **40** may be an example of an intermediate transfer medium accommodating the toner images from the photoconductor **22** and transferring the toner images to the printing medium. The toner images having four colors, that is, cyan (C), magenta (M), yellow

(Y), and black (K), sequentially formed on the photoconductor **22** are sequentially transferred and superposed onto the transfer belt **40**.

[0025] A transfer roller **50** may be installed on an opposite side of the transfer belt **40**, and when the printing medium passes between the transfer belt **40** and the transfer roller **50**, a color toner image may be transferred to the printing medium.

[0026] A fixing device **60** may fix the toner image transferred to the printing medium through heat and pressure. The printing medium on which the toner image may be fixed is discharged to the outside of the image forming apparatus **1** by a plurality of transport rollers (not illustrated), such that a printing process is completed.

[0027] A waste toner withdrawal device **70** includes a blade **71** in contact with the photoconductor **22** in order to scrape off waste toners remaining on a surface of the photoconductor **22**. The waste toners removed from the photoconductor **22** using the blade **71** are temporarily maintained in a case **72**. The waste toners removed from the photoconductor **22** by the waste toner withdrawal device **70** are transported to a waste toner treatment device **100** by a transport screw **73** disposed in the case **72**. In the waste toner treatment device **100**, a waste toner inlet **102***a* (see FIG. **2**) provided in a housing **101** (see FIG. **2**) to be described later may be connected directly to a waste toner outlet (not illustrated) of the waste toner withdrawal device **70** or be connected indirectly to the waste toner outlet (not illustrated) of the waste toner withdrawal device through a separate passage (not illustrated).

[0028] The waste toner treatment device **100** collects the waste toners in a particle form, solidifies the waste toners in a pellet form through heating, pressing, and cooling operations, and then discharges the solidified waste toner. An example reason for solidifying and then discharging the waste toner as described above is as follows. Particles of the toner used in the printing medium have a size of about 4 μm to 7 μm, and correspond to a harmful substance having a particulate size such as fine dust (PM10 and PM2.5). The waste toners in the particle form are suspended in the air in a case where they are leaked to the outside of the image forming apparatus **1**. When the waste toners suspended in the air are inhaled into a human body, the waste toners may cause several diseases. The waste toner treatment device **100** may fundamentally block the waste toners in a particulate form such as fine dust from being suspended in the air to prevent a user from being exposed to the waste toners in the particulate form.

[0029] The image forming apparatus may use a waste toner bottle (WTB) in order to treat the waste toners. The WTB, which is a component performing a function of collecting waste toners generated after performing printing, needs a space for the WTB, and may thus may have less cost than the waste toner treatment device **100** according to the disclosure. However, a size of a space to be provided in the image forming apparatus for installing the WTB is determined by a size, a printing amount, and the like of the image forming apparatus. Therefore, WTBs of various sizes and shapes are used according to models of image forming apparatuses, and it is thus difficult to apply one WTB to several models of the image forming apparatuses through modularization.

[0030] The waste toner treatment device **100** solidifies and discharges the waste toners in the particle form generated after performing the printing in the image forming apparatus **1**, and a space storing the waste toners in the pellet form may be a space relatively smaller than the space for the WTB. Therefore, a size of the waste toner treatment device **100** does not need to be changed according to the size and the printing amount of the image forming apparatus unlike the WTB, and the waste toner treatment device **100** modularized at a predetermined size may thus be applied to various models of the image forming apparatuses.

[0031] In addition, in the waste toner treatment device **100**, components compressing the waste toners are disposed coaxially with each other and overlap each other in a waste toner compressing process, such that a space needed to treat the waste toners may be minimized. In addition, a driving portion providing a driving force in order to compress the waste toners may be disposed in a direction perpendicular to the components compressing the waste toners, such that an increase in a size in the waste toner treatment device **100** in a longitudinal direction may be limited. As described above, in the waste toner treatment device **100** according to the disclosure, a waste toner treatment space may be minimized, and an applicable range of the waste toner treatment device **100** may thus be widened from an office multi-function printer to a small printer for an individual user.

[0032] Hereinafter, a structure of the waste toner treatment device **100** according to an example will be described in detail with reference to the drawings.

[0033] FIG. **2** is an exploded perspective view illustrating the waste toner treatment device according to an example, FIG. **3** is a perspective view illustrating an inner side of the waste toner treatment device according to an example, FIG. **4** is a cross-sectional view of the waste toner treatment device according to an example, illustrating a case where a heating portion is at a first position, FIG. **5** is a perspective view illustrating a gear connection structure of a driving portion of the waste toner treatment device according to an example, and FIG. **6** is a cross-sectional view of the waste toner treatment device according to an example, illustrating a case where the heating portion is at a second position.

[0034] Referring to FIG. **2**, the waste toner treatment device **100** includes a housing **101** disposed inside the image forming apparatus **1**, a waste toner discharging member **110**, a heating portion **130** storing and heating the waste toners, and a driving portion **150** moving the heating portion **130** forward and backward along the waste toner discharging member **110**.

[0035] One side of the housing **101** is opened, and a cover **108** may be detachably coupled to the opened portion. The housing **101** may be provided with an accommodation space in which the waste toner discharging member **110**, the heating portion **130**, and the driving portion **150** are disposed. The accommodation space includes a first region **104** and second and third regions **105** and **106** partitioned laterally by a partition wall **107** below the first region **104**.

[0036] The waste toner discharging member **110** and the heating portion **130** disposed coaxially with each other may be accommodated in the first region **104**. A solidified waste toner **183** (see FIG. **7**) discharged from the inside of the heating portion **130** may be collected in the second region **105**. The driving portion **150** may be disposed in the third region **106** through a gear connection with the heating portion **130**. In this case, the driving portion **150** may be disposed in a direction substantially perpendicular to a moving direction of the heating portion **130** as a whole. Such

a disposition of the driving portion **150** may limit an increase in a size of the waste toner treatment device **100** in a horizontal direction. An entire size of the waste toner treatment device **100** may be minimized by limiting an increase in a size of the waste toner treatment device **100** in a specific direction as described above. Therefore, the waste toner treatment device **100** may be easily installed in various models of image forming apparatuses having different sizes.

[0037] In addition, a passage portion **102** through which the waste toners are introduced may extend from an upper portion of the housing **101**. The passage portion **102** has the same contour as that of an extending portion **109** formed at the cover **108**, and may form a single passage that may guide the waste toners in a gravity direction in a case where the passage portion **102** is coupled to the extending portion **109**.

[0038] A waste toner inlet **102***a* into which the waste toners in the particle form discharged from the waste toner outlet (not illustrated) of the waste toner withdrawal device **70** are introduced may be formed in the passage portion **102**. An inclined surface **102***b* for guiding the waste toners introduced into the passage portion **102** through the waste toner inlet **102***a* in the gravity direction may be formed inside the passage portion **102**.

[0039] Referring to FIG. **3**, the waste toners introduced into the passage portion through the waste toner inlet **102***a* flow down along the inclined surface **102***b* and are collected in a collection space **133** through an opening **132** of the heating portion **130**.

[0040] Referring to FIG. **4**, the waste toner discharging member **110** discharges the waste toners existing in the collection space **133** of the heating portion **130** to the outside of the heating portion **130**. One side of the waste toner discharging member **110** may be connected to one side wall **101***a* of the housing **101**, such that forward and backward movement of the waste toner discharging member **110** is limited. Therefore, the waste toners are discharged from the heating portion **130** through the following process. That is, as the heating portion **130** at a first position (initial position) moves toward one side wall **101***a* of the housing **101**, the collection space **133** of the heating portion **130** becomes gradually narrow by the other side of the waste toner discharging member **110**. The waste toners are compressed while being pushed toward the left (toward a door **134**) of the collection space **133**. When the collection space **133** becomes smaller than a volume of the compressed waste toners according to continuous movement of the heating portion **130**, the waste toners are naturally discharged to the outside of the heating portion **130** through an outlet **133***a* of the heating portion **130** in a state where they are in close contact with the other side of the waste toner discharging member **110**.

[0041] The waste toner discharging member **110** includes an adjusting member **112** penetrating through one side wall **101***a* of the housing **101**, a connecting member **111** screwed to the adjusting member **112**, and a pressing member **115** detachably coupled to a tip of the connecting member **111**.

[0042] A female screw portion **111***b* of an inner side of the connecting member **111** may be screwed to a male screw portion **112***d* formed at a tip of the adjusting member **112**. The connecting member **111** may be elastically supported with respect to one side wall **101***a* of the housing **101** by a coil spring **113**. The coil spring **113** has one end supported on one side wall **101***a* of the housing **101** and the other end supported on a tip of an insertion space **111***a* of the connecting member **111**. The coil spring **113** provides a buffer function so that the waste toner discharging member **110** may move in a case where an excessive pressure is applied to the waste toner discharging member **110** when the waste toner discharging member **110** compresses the waste toners collected in the collection space **133** of the heating portion **130**.

[0043] The adjusting member **112** may increase or decrease a size of the collection space **133** of the heating portion **130** by changing a position of the pressing member **115**. The pressing member **115** may be coupled to the tip of the connecting member **111** to move together with the connecting member **111**. Since the adjusting member **112** is fastened to the connecting member **111** in a screw manner, a position of the pressing member **115** may be changed by adjusting a position of the connecting member **111**.

[0044] The adjusting member **112** may be formed in a substantially bolt shape. The adjusting member **112** penetrates through one side wall **101***a* of the housing **101**, and is then disposed in the first region **104** of the housing **101**. In this case, a head portion **112***a* of the adjusting member **112** may be disposed within a first guide protrusion **101***c* protruding outward of one side wall **101***a* of the housing **101**, and a body portion **112***b* of the adjusting member **112** adjacent to the head portion **112***a* may be slidably guided by a second guide protrusion **101***d* protruding inward of one side wall **101***a* of the housing **101**.

[0045] The adjusting member **112** may be rotated in one direction or in a reverse direction using a tool (for example, a screw driver) (not illustrated). To this end, the head portion **112***a* is provided with a groove **112***c* into which a tip of the tool may be inserted.

[0046] When the adjusting member **112** is rotated in one direction using the tool in a state where the connecting member **111** is elastically supported by the coil spring **113**, the connecting member **111** may move in a direction adjacent to one side wall **101***a* of the housing **101**. As the pressing member **115** moves together with the connecting member **111**, the collection space **133** of the heating portion **130** may become wide. In addition, when the adjusting member **112** is rotated in the reverse direction, the connecting member **111** moves in a direction distant from the one side wall **101***a* of the housing **101**. As the pressing member **115** moves together with the connecting member **111**, the collection space **133** of the heating portion **130** may become narrow. The size of the collection space **133** of the heating portion **130** may be varied by rotating the adjusting member **112** in one direction or the reverse direction depending on an amount of the waste toners collected in the collection space **133** of the heating portion **130** as described above.

[0047] The pressing member **115** may be a member in contact with the waste toners collected in the collection space **133**, and be coupled to the connecting member **111**. For example, a tip **111***c* of the connecting member **111** may be detachably coupled to the pressing member **115** by a fastening bolt **116** with being inserted into a coupling hole **115***a* of the pressing member **115**. Due to such a coupling structure, the pressing member **115** moves together with the connecting member **111**.

[0048] The pressing member **115** may press the waste toners at a predetermined pressure, and may be formed of a material having heat resistance. For example, the pressing

member **115** may be formed of a high strength metal material, a mold, or a high heat resistance material having elasticity.

[0049] In a case where the pressing member **115** may be formed of the high-strength metal material, a releasing layer (not illustrated) formed of a releasing agent such as perfluoro alkoxy (PFA), poly tetra fluoro ethylene (PTFE) may be coated on a contact surface **115***b* of the pressing member **115** so as to facilitate separation of the solidified waste toner at the time of discharging the solidified waste toner.

[0050] In addition, in a case where the pressing member **115** may be formed of a rigid material that does not have elasticity, an inner circumferential surface of the collection space **133** and the pressing member **115** in contact with the inner circumferential surface are not completely in close contact with each other, and some of the waste toners may thus leak between the inner circumferential surface of the collection space **133** and the pressing member **115**. In order to prevent such leakage of the waste toners, the pressing member **115** may use an elastic ring (not illustrated) coupled along an outer circumferential surface thereof in contact with the inner circumferential surface of the collection space **133**. Since the elastic ring also comes into contact with the waste toner subjected to a solidification process, the elastic ring may be formed of a releasing agent.

[0051] In addition, the pressing member **115** may be formed of a material having high elasticity, heat resistance, and releasability, for example, PTFE, which is a releasing agent. In this case, the elastic ring may not be used.

[0052] The heating portion **130** collects the waste toners in the particle form introduced into the passage portion **102**, and heats and compresses the waste toners in the particle form to solidify the waste toners in the pellet form. The solidified waste toner **183** (see FIG. **6**) may be discharged from the heating portion **130** by the waste toner discharging member **110** together with the forward and backward movement of the heating portion **130** to be dropped and collected into the second region **105** of the housing **101**. A process of solidifying the waste toners in the particle form will be described later.

[0053] Referring to FIGS. **3** and **4**, the heating portion **130** may be disposed in a substantially horizontal direction in the first region **104** of the housing **101** together with the waste toner discharging member **110**. The heating portion **130** may be disposed coaxially with the waste toner discharging member **110**, and may be moved forward and backward in the first region **104** along the waste toner discharging member **110** by power provided from the driving portion **150**. In the disclosure, a forward movement direction of the heating portion **130** is defined as a direction adjacent to one side wall **101***a* of the housing **101**, and a backward movement direction of the heating portion **130** is defined as a direction distant from one side wall **101***a* of the housing **101**.

[0054] The heating portion **130** may be formed to have a length equal to that of the waste toner discharging member **110** or somewhat longer than that of the waste toner discharging member **110**. When the heating portion **130** moves forward from a first position (which is an initial position of the heating portion **130** and may be a position where the heating portion **130** is disposed farthest from one side wall **101***a* of the housing **101**), a region occupied by the waste toner discharging member **110** in the collection space **133** of the heating portion **130** increases, and the collection space **133** becomes thus narrow. When the collection space **133** becomes narrow according to the forward movement of the heating portion **130** as described above, the waste toners present in the collection space **133** may be compressed by the pressing member **115**. When the waste toners are compressed, the heating portion **130** itself generates heat at a predetermined temperature so that the waste toners in the particle form may be melted to some degree to be aggregated into a lump of a predetermined size.

[0055] The heating portion **130** may include a body in which a heating element (not illustrated) is buried, a heating layer surrounding the body, a molding layer surrounding the heating layer, and a releasing layer coated on an inner circumferential surface of the body. The body may be formed of a metal material having high thermal conductivity in order to facilitate transfer of heat generated from the heating element. A flexible heat source or a coil-type heat source may be used as the heating layer so as to surround the body. The molding layer may be formed of a heat insulating material in order to minimize heat loss. The releasing layer may be formed of a releasing agent such as PFA or PTFE so that the waste toners adhered to each other while being solidified in the collection space **133** are easily discharged from the collection space **133**.

[0056] A heat generating temperature of the heating portion **130** may be measured through a temperature sensor **140** fixed to the heating portion **130** by a bracket **141**. A controller (not illustrated) may control heat generation of the heating portion **130** by determining the heat generating temperature of the heating portion **130** measured by the temperature sensor **140**.

[0057] The opening **132** for collecting the waste toners in the particle form flowing down along the inclined surface **102***b* of the passage portion **102** in the collection space **133** at the first position of the heating portion **130** may be formed at a position of the heating portion **130** corresponding to the passage portion **102**.

[0058] An insertion hole **131** into which the pressing member **115** may be inserted may be formed at one side of the heating portion **130**, and the outlet **133***a* (see FIG. **6**) through which the solidified waste toner is discharged from the collection space **133** may be formed at the other side of the heating portion **130**.

[0059] In the heating portion **130**, a door **134** capable of opening and closing the outlet **133***a* is hinge-connected through a hinge shaft **135**. The door **134** may prevent the waste toners in the particle form from being leaked through the outlet **133***a* during a process of solidifying the waste toners in the collection space **133**. The door **134** may be elastically supported in a direction in which it closes the outlet **133***a* by a torsion spring **135***a* disposed on the hinge shaft **135**.

[0060] The door **134** includes an external door **134***a* and an internal door **134***b* coupled to an inner side of the external door **134***a* by a fastening bolt **136**. The external door **134***a* may be formed of a heat insulating material so as to minimize loss of the heat generated in the heating portion **130**, and the internal door **134***b* may be formed of a releasing agent such as PFA or PTFE since it is in contact with the waste toners.

[0061] Referring to FIGS. **4** and **5**, in the driving portion **150**, a driving motor **151** for generating power may be fixedly disposed in the third region **106** of the housing **101** by a bracket **160**. The driving motor **151** may be a motor capable of forward rotation and reverse rotation.

[0062] The driving portion **150** may include a power transmission structure in which a worm gear structure and a rack and pinion structure are combined with each other in order to transmit the power generated from the driving motor **151** to the heating portion **130**.

[0063] The worm gear structure may include a worm **153** (fourth gear) coupled to a driving shaft **151***a* of the driving motor **151** and a worm gear **155** (third gear) rotatably coupled to the housing **101** through a rotation shaft **154** disposed in the housing **101** and gear-coupled to the worm **153**.

[0064] The rack and pinion structure may include a pinion **157** (first gear) concentrically coupled to the worm gear **155** to rotate together with the worm gear **155** and having a diameter smaller than that of the worm gear **155** and a rack **159** (second gear) coupled to a lower portion of the heating portion **130** along a longitudinal direction of the heating portion **130** and gear-coupled to the pinion **157**. In this case, the rack **159** may be formed integrally with the heating portion **130**.

[0065] The driving portion **150** may move the heating portion **130** forward and backward between the first position (see FIG. **4**) and the second position (see FIG. **6**). In a case where a gear structure may be adopted as the power transmission structure, when the heating portion **130** moves, if a direction of a force generated between respective gears and a moving direction of the heating portion **130** are different from each other, a step-out phenomenon of the gears may appear. In order to prevent such a phenomenon, in the disclosure, a linear guide portion guiding the heating portion **130** so that the heating portion **130** may move in a constant linear direction is provided.

[0066] Referring to FIG. **3**, the linear guide portion may include a guide rod **171** disposed in parallel with the heating portion **130** along the longitudinal direction of the heating portion **130**. One side **171***a* of the guide rod **171** may be fixed to one side wall **101***a* of the housing **101**, and the other side **171***b* of the guide rod **171** may be fixed to the other side wall **101***b* of the housing **101**.

[0067] The heating portion **130** may be provided with a coupling ring **138** protruding toward the guide rod **171**. The guide rod **171** may be slidably coupled to the coupling ring **138**. Therefore, the heating portion **130** may be linearly guided by the guide rod **171** when moving between the first position and the second position by the power transmitted from the driving portion **150**, and may thus move smoothly without the step-out phenomenon of the gears.

[0068] Referring to FIG. **5**, the linear guide portion may include a plurality of guide rollers **173** and **175** in order to guide smoother linear movement of the heating portion **130**. The plurality of guide rollers **173** and **175** may be rotatably disposed on the heating portion **130** and may be disposed on an opposite side to a side on which the coupling ring **138** is formed. The guide rollers **173** and **175** may be rotatably coupled to grooves **139***a* and **139***b* formed in the heating portion **130** at predetermined intervals, through rotation shafts **173***a* and **175***a*, respectively.

[0069] The number of guide rollers **173** and **175** is not limited, and may be one or three or more.

[0070] In addition, in the waste toner treatment device **100**, a position sensor (not illustrated) capable of detecting a moving position of the heating portion **130** may be disposed inside the housing **101** or the cover **108**. Therefore, the controller may more accurately control the moving position of the heating portion **130** by determining a position value sensed by the position sensor during the process of solidifying the waste toners.

[0071] Hereinafter, processes of solidifying the waste toners in the particle form using the waste toner treatment device **100** according to an example disclosure will be sequentially described with reference to the drawings.

[0072] FIGS. **7**A to **7**H are schematic views sequentially illustrating processes of solidifying and discharging waste toners collected through the waste toner treatment device according to an example. The forward and backward movement of the heating portion **130** may be performed by the driving portion **150** described above, and a description for a detailed operation of the driving portion **150** will hereinafter be omitted.

[0073] Referring to FIG. **7**A, the heating portion **130** moves to the first position so that the waste toners may be collected through the passage portion **102**. At the first position, the opening **132** of the heating portion **130** is positioned so as to correspond to the passage portion **102**. Waste toners **181** in a particle form supplied through the passage portion **102** are dropped in a gravity direction and are introduced into the collection space **133** through the opening **132** of the heating portion **130**.

[0074] Referring to FIG. **7**B, when the introduction of the waste toners **181** in the particle form is completed, the heating portion **130** may be pre-heated to a temperature of T_L or more before being moved to a heating position (see FIG. **7**C). Here, T_L is a temperature higher than a glass transition temperature (T_G) of the waste toner. During a period in which the heating portion **130** is pre-heated, some of the waste toners **181** in the particle form introduced into the collection space **133** are transformed into waste toners **182** in a small lump form while being aggregated with adjacent particles by heat.

[0075] In a case where the heating portion **130** may be moved to the heating position without being pre-heated, there is a risk that fine waste toner particles similar to fine dust will be leaked into a fine gap that may be formed due to a manufacturing tolerance or the like of the waste toner treatment device **100**. A process of pre-heating the heating portion **130** may prevent such leaking of the fine waste toner particles.

[0076] Referring to FIG. **7**C, the heating portion **130** for which pre-heating is completed is moved to the heating position along a direction of arrow A.

[0077] Referring to FIG. **7**D, the waste toners **181** and **182** of the collection space **133** of the heating portion **130** at the heating position are heated and solidified in an appropriate temperature range. In this case, the appropriate temperature range may be limited to a temperature range of T_O larger than T_G and smaller than T_H ($T_G<T_O<T_H$). Here, T_H is a heat-resistant limit temperature of the heating portion **130**.

[0078] Most of the waste toners **181** in the particle form are entangled with each other while being melted during a period in which the waste toners are heated within the appropriate temperature range as described above, such that most of the waste toners **181** in the particle form may be transformed into the waste toners **182** in the small lump form.

[0079] Referring to FIG. **7**E, when the solidification of the waste toners in the collection space **133** of the heating portion **130** is completed, the heating may be stopped and the heating portion **130** may be moved by a predetermined

distance in the direction of arrow A. In this process, the waste toners in the collection space **133** may be compressed in an opposite direction to the moving direction of the heating portion **130** by the pressing member **115**.

[0080] Next, when the heating portion **130** moves in the direction of arrow A, a waste toner **183** aggregated and solidified in one lump form is pushed out of the collection space **133** in a state where it is attached to the pressing member **115**. In this case, a volume of the waste toner **183** is slightly increased due to elasticity of the waste toner **183** itself while a compressed state of the waste toner **183** is released, such that the volume of the waste toner **183** becomes larger than a diameter of the collection space **133**.

[0081] When the solidified waste toner **183** is completely discharged from the collection space **133** of the heating portion **130**, the movement of the heating portion **130** may be stopped, and the waste toner **183** is cooled. The waste toner **183** may be maintained in a state where it is attached to the pressing member **115** while being cooled.

[0082] In a case where the waste toner is cooled in the collection space **133**, the waste toner is still in a high temperature state, and it thus takes a long time to cool the waste toner, and if the waste toner is stiffly solidified in the collection space **133**, the waste toner is strongly stuck to the inner circumferential surface of the collection space **133**, and a large force may thus be needed to discharge the waste toner to the outside of the heating portion **130**. Therefore, for example the cooling of the solidified waste toner **183** may be performed after the solidified waste toner **183** is discharged to the outside of the heating portion **130** immediately after the heating ends.

[0083] Referring to FIG. **7**F, the waste toner **183** for which the cooling is completed remains attached to an end portion **130***a* of the heating portion **130** and the pressing member **115**.

[0084] In this state, the heating portion **130** may be repeatedly moved forward and backward by a predetermined distance to remove the solidified waste toner **183** from the end portion **130***a* of the heating portion **130**.

[0085] Referring to FIG. **7**G, the heating portion **130** may be moved in a direction of arrow B in order to remove the waste toner **183** from the pressing member **115**.

[0086] Therefore, the pressing member **115** may be relatively drawn into the collection space **133** of the heating portion **130**. On the other hand, the stiffly solidified waste toner **183** may be naturally separated from the contact surface **115***b* of the pressing member **115** since the stiffly solidified waste toner **183** may not enter the collection space **133** due to a contour portion **183***a* thereof caught by the end portion **130***a* of the heating portion **130**.

[0087] The waste toner treatment device **100** according to the disclosure does not need a separate waste toner separation device for separating the waste toner **183** from the heating portion **130** and the pressing member **115**.

[0088] In this state, the solidified waste toner **183** may be dropped by its own weight and be collected in the second region **105** of the housing **101**.

[0089] When the waste toner **183** may be again attached to the end portion **130***a* of the heating portion **130** in an operation illustrated in FIG. **7**G, if the heat portion **130** is again moved in the direction of arrow A as illustrated in FIG. **7**H, the waste toner **183** may be easily separated from the heating portion **130** by the pressing member **115**.

[0090] Hereinafter, a configuration of a waste toner treatment device according to another example will be described with reference to the drawings. The waste toner treatment device **100** according to the example described above solidifies the waste toner while transporting the waste toner in the linear direction, while a waste toner treatment device **200** according to another example described later has a structure in which a waste toner is solidified by rotational movement.

[0091] FIG. **8** is a perspective view illustrating a waste toner treatment device according to another example, and FIG. **9** is an exploded perspective view illustrating an inner side of the waste toner treatment device according to another example.

[0092] Referring to FIG. **8**, a waste toner treatment device **200** according to another example may include a housing **201** and a cover **206** capable of closing an opened one side of the housing **201**. The housing **201** and the cover **206** are portions forming an outer shape of the waste toner treatment device **200**, and may be formed of a mold material having low heat conductivity in order to minimize heat loss.

[0093] A case where the housing **201** and the cover **206** may be formed in a rectangular shape has been illustrated in the disclosure, but the housing **201** and the cover **206** may also be formed in a circular shape since transport of waste toners is performed in a rotational direction. A plurality of bosses **205** (see FIG. **9**) to which fastening screws (not illustrated) are coupled may be formed so that the housing **201** and the cover **206** may be coupled to each other through the fastening screws may be formed in the housing **201**.

[0094] A passage portion **202** for introducing the waste toners in a particle form transported from the waste toner withdrawal device **70** (see FIG. **1**) and introduced into the housing **201** may be formed in the housing **201**.

[0095] In the waste toner treatment device **200**, a driving portion **250** may be disposed outside the housing **201** and the cover **206** unlike the waste toner treatment device **100** described above. Therefore, the housing **201** may be formed to have a slim width, such that an assembling operation of the waste toner treatment device **200** at the time of installing the waste toner treatment device **200** in the image forming apparatus **1** may be more easily performed.

[0096] Referring to FIG. **9**, a region in which solidification of the waste toners is performed by a partition member **220** provided inside the housing **201** may be secured in the housing **201**. The partition member **220** may be partitioned into first to fourth quadrant regions **221**, **222**, **223**, and **224** by a waste toner discharging member **210**.

[0097] The waste toner discharging member **210** may include first to fourth blades **211**, **212**, **213**, and **214** disposed at intervals of 90° around a hub **210***a*. However, the waste toner discharging member **210** does not need to necessarily include four blades, and solidifying the waste toners may be carried out even though the waste toner discharging member **210** includes less than four blades, for example, three blades disposed adjacent to each other at intervals of 90°. When the number of blades of the waste toner discharging member **210** is three, the number of regions divided within the partition member **220** may also be three and a separation interval may be varied, for example at intervals of 120°.

[0098] For example, the releasing layers are coated on surfaces of the respective blades **211**, **212**, **213**, and **214** in contact with the waste toners. In addition, sealing members **215** formed of a material having releasability and elasticity may be coupled, respectively, to contours of the blades **211**,

212, **213**, and **214** in contact with a metal plate **231** so that the waste toners in the particle form are not leaked. In the disclosure, the sealing members **215** may also be coupled to and used for contours of the three blades **211**, **212**, and **213**. This is to consider that regions where the leakage of the waste toners in particle form may occur are limited to the second and third quadrant regions **222** and **223**.

[0099] Portions of the partition member **220** corresponding to the first to third quadrant regions **221**, **222**, and **223** may be formed as curved lines, and a portion of the partition member **220** corresponding to the fourth quadrant region **224** may be formed as a straight line.

[0100] The second quadrant region **222** may be connected to the passage portion **202** to be used as a space collecting the waste toners in the particle form. A detection sensor (not illustrated) capable of detecting whether or not a predetermined amount of waste toners in the particle form are introduced into the second quadrant region **222** may be disposed at a predetermined position of the second quadrant region **222**.

[0101] The third quadrant region **223** may be used as a region heating the waste toners, and a heating portion **230** formed of a plate-shaped heater may be disposed before and after the third quadrant region **223**, respectively.

[0102] In addition, the metal plate **231** may be disposed before and after the second and third quadrant regions **222** and **223**, respectively, to cover the second and third quadrant regions **222** and **223**. In this case, the waste toners come into contact with an inner surface of the metal plate **231**. Therefore, a coating layer may formed on the inner surface of the metal plate **231** using a releasing agent such as PFA or PTFE so that the solidified waste toner is easily separated.

[0103] When the waste toner discharging member **210** rotates, the respective blades **211**, **212**, **213**, and **214** continuously come into contact with and rub against the inner surface of the metal plate **231**. When the heating portion **230** is located on the inner surface of the metal plate **231**, the respective blades **211**, **212**, **213**, and **214** may rub against the heating portion **230** to cause a decrease in a lifespan of the heating portion **230**. For example, the heating portion **230** may be disposed on an outer surface of the metal plate **231** at a position corresponding to the third quadrant region **223** to avoid or prevent the decrease in lifespan of the heating portion **230** due to the blades **211**, **212**, **213**, and **214** rubbing against the heating portion **230**. However, in a case the heating portion **230** is treated to have high surface strength, the metal plate **231** may be omitted and the heating portion **230** may be manufactured in a semi-circle shape to cover the second and third quadrant regions **222** and **223** or may be manufactured in a quarter-circle shape to cover the third quadrant region **223**.

[0104] In the disclosure, the metal plate **231** is formed in the semi-circle shape so as to correspond to the second and third quadrant regions **222** and **223**. However, the metal plate **231** is not limited thereto, and may also be manufactured in a quarter shape of a circle plate so as to correspond to the third quadrant region **223**.

[0105] A side surface of the fourth quadrant region **224** is surrounded by the partition member **220**, but an opening **225** (see FIG. **10**H) opened and closed by a door **271** is formed at a lower side of the fourth quadrant region **224**.

[0106] The door **271** may be hinge-connected to the housing **201** through a hinge shaft **273**, and be locked and unlocked by a locking member **275** disposed below the partition member **220**. The locking member **275** may be elastically supported by a coil spring **277**. The coil spring **277** may be positioned between a support piece **203** and the locking member **275** and presses the locking member **275** toward the door **271**.

[0107] The door **271** and the locking member **275** may be omitted and the opening **225** (see FIG. **10**H) of the fourth quadrant region **224** may be formed in an always open state.

[0108] Referring to FIGS. **8** and **9**, the driving portion **250** may include a driving motor **251** capable of forward rotation and reverse rotation, a worm **253** coupled to a driving shaft **252** of the driving motor **251**, and a worm gear **255** gear-connected to the worm **253**.

[0109] The worm gear **255** may be coupled to a rotation shaft **254** penetrating through and coupled to the hub **210***a* of the waste toner discharging member **210**. Therefore, when the worm gear **255** rotates, the rotation shaft **254** and the waste toner discharging member **210** rotate together in the same direction.

[0110] The waste toner treatment device **200** may use a sensor (not illustrate) for detecting positions of the blades when the waste toner discharging member **210** rotates. The sensor may be located at any one of boundaries of the respective quadrant regions. For example, the sensor may be disposed at a position not in contact with the heating portion **230**. For example, the sensor may be disposed at a boundary between the first and fourth quadrant regions **221** and **224**.

[0111] Since such a waste toner treatment device **200** does not have an effect that the waste toners are compressed between the pressing member **115** having a piston shape and the door **134**, a size of the solidified waste toner may be somewhat larger than that in the waste toner treatment device **100** described above. However, the waste toner treatment device **200** has a structure simpler than that of the waste toner treatment device **100** described above, and all components for treating the waste toners may be disposed inside the slim housing **201** and the cover **206**, and the waste toner treatment device **200** may thus may have a more compact size than the waste toner treatment device **100** described above.

[0112] Hereinafter, processes of solidifying the waste toners in the particle form through the waste toner treatment device **200** according to another example will be sequentially described with reference to the drawings.

[0113] FIGS. **10**A to **10**H are schematic views sequentially illustrating processes of solidifying and discharging waste toners collected through the waste toner treatment device according to another example. The rotation of the waste toner discharging member **210** in one direction and a reverse direction is performed by the driving portion **250** described above, and a description for a detailed operation of the driving portion **250** will hereinafter be omitted.

[0114] Referring to FIG. **10**A, waste toners **281** in a particle form are introduced into the second quadrant region **222** through the passage portion **202**.

[0115] Referring to FIG. **10**B, when the introduction of the waste toners **281** in the particle form is completed, the heating portion **230** is pre-heated to a temperature of T_L or more before being moved to a heating position (see FIG. **100**). Here, T_L is a temperature higher than a glass transition temperature (T_G) of the waste toner. During a period in which the heating portion **230** may be pre-heated, some of the waste toners **281** in the particle form introduced into the

second quadrant region **222** are transformed into waste toners **282** in a small lump form while being aggregated with adjacent particles by heat.

[0116] In a case where the heating portion **230** is moved to the heating position without being pre-heated, there is a risk that fine waste toner particles similar to fine dust will be leaked into a fine gap that may be formed due to a manufacturing tolerance or the like of the waste toner treatment device **200**. A process of pre-heating the heating portion **230** may prevent such leaking of the fine waste toner particles.

[0117] Referring to FIG. **100**, the waste toner discharging member **210** is rotated counterclockwise by 90° in a state where the pre-heating of the heating portion is completed. Therefore, the waste toners **281** and **282** accumulated on the first blade **211** are transported to the third quadrant region **223** by their own weights.

[0118] Referring to FIG. **10**D, the waste toners **281** and **282** of the third quadrant region **223** are heated and solidified in an appropriate temperature range by driving the heating portion **230**. In this case, the appropriate temperature range may be limited to a temperature range of T_O larger than T_G and smaller than T_H ($T_G<T_O<T_H$). Here, T_H is a heat-resistant limit temperature of the heating portion **230**.

[0119] Most of the waste toners **281** in the particle form are entangled with each other while being melted during a period in which the waste toners are heated within the appropriate temperature range as described above, such that most of the waste toners **281** in the particle form may be transformed into the waste toners **282** in the small lump form.

[0120] Referring to FIG. **10**E, when the solidification of the waste toners in the third quadrant region **223** is completed, the heating is stopped and the waste toner discharging member **210** is rotated counterclockwise by 90°. A waste toner **283** aggregated in one lump form is discharged from the third quadrant region **223** to the fourth quadrant region **224** in a state where it is attached to a side **212***a* the second blade **212**. In this case, a volume of the waste toner **283** is horizontally increased due to elasticity of the waste toner **283** itself. In this state, the waste toner **283** in the lump form is cooled.

[0121] Referring to FIG. **10**F, the waste toner **283** for which the cooling is completed remains attached to the second blade **212**. In this state, the waste toner discharging member **210** is rotated so that the second blade **212** alternately reciprocates clockwise and counterclockwise within the third and fourth quadrant regions **223** and **224**.

[0122] In this case, both sides of the waste toner **283** solidified in a state where the volume of the waste toner **283** is increased are caught by end portions of the metal plate **231** present in the third quadrant region **223**, and at the same time, the waste toner **283** rubs against inner surfaces of the housing **201** and the cover **206** corresponding to the fourth quadrant region **224**. When this process is repeatedly performed, the waste toner **283** may be separated from the second blade **212**.

[0123] Referring to FIG. **10**G, the waste toner discharging member **210** is rotated clockwise by a predetermined angle so that the second blade **212** moves to the third quadrant region **223** in order to completely separate the waste toner **283** from the second blade **212**.

[0124] Therefore, a contour portion of the stiffly solidified waste toner **283** is caught by the fourth quadrant region **224**, such that the solidified waste toner **283** may be naturally separated from the second blade **212**.

[0125] Referring to FIG. **10**H, after the opening **225** is opened by rotating the door **271** counterclockwise around the hinge axis **273**, when the second blade **212** is moved from the third quadrant region **223** to the fourth quadrant region **224**, the second blade **212** pushes out the waste toner **183**. Therefore, the waste toner may be discharged to the outside of the fourth quadrant region **224** through the opening **225**.

[0126] Although various examples have been illustrated and described hereinabove, the disclosure is not limited to the examples described above, but may be variously modified without departing from the spirit and scope of the disclosure or as claimed in the claims. These modifications are to fall within the scope of the disclosure.

1. A waste toner treatment device, comprising:
- a waste toner discharging member;
- a heating portion to heat waste toners within the heating portion; and
- a driving portion to move the heating portion along a longitudinal direction of the waste toner discharging member so as to form a waste toner solidified within the heating portion from the waste toners heated by the heating portion, and
- the waste toner discharging member is to discharge the waste toner solidified within the heating portion outside of the heating portion.

2. The waste toner treatment device as claimed in claim **1**, wherein the heating portion includes:
- an inlet through which the waste toners are introduced into the heating portion, and
- an outlet through which the waste toner solidified within the heating portion is discharged outside of the heating portion.

3. The waste toner treatment device as claimed in claim **2**, wherein the waste toner discharging member includes a pressing member formed at a tip of the waste toner discharging member and in close contact with an inner circumferential surface of the heating portion.

4. The waste toner treatment device as claimed in claim **3**, wherein the pressing member is formed of a synthetic resin having elasticity.

5. The waste toner treatment device as claimed in claim **3**, wherein the pressing member includes:
- a metal member coupled to the tip of the waste toner discharging member, and
- an elastic ring coupled to an outer periphery of the metal member.

6. The waste toner treatment device as claimed in claim **2**, wherein the heating portion includes a door to elastically open and close the outlet.

7. The waste toner treatment device as claimed in claim **1**, wherein the driving portion includes:
- a driving motor to perform forward and reverse rotation,
- a first gear to receive power from the driving motor, and
- a second gear coupled to the heating portion and gear-connected to the first gear.

8. The waste toner treatment device as claimed in claim **7**, wherein the driving portion includes:
- a third gear concentrically fixed to the first gear, and
- a fourth gear coupled to a driving shaft of the driving motor and gear-connected to the third gear, and

the driving motor is disposed perpendicular to the waste toner discharging member.

9. The waste toner treatment device as claimed in claim **1**, comprising a housing, formed of a heat insulating material, in which the waste toner discharging member, the heating portion, and the driving portion are provided.

10. The waste toner treatment device as claimed in claim **9**, wherein the housing includes:

a first space in which the heating portion and the waste toner discharging member are disposed,

a second space to collect the solidified waste toner below the heating portion, and

a third space partitioned from the second space by a partition wall and in which the driving portion is disposed.

11. The waste toner treatment device as claimed in claim **1**, comprising a linear guide portion to guide movement of the heating portion in the longitudinal direction.

12. The waste toner treatment device as claimed in claim **11**, wherein

the linear guide portion includes a guide rod which is disposed in parallel to the heating portion along the longitudinal direction,

the guide rod is slidably connected to one side of the heating portion.

13. The waste toner treatment device as claimed in claim **12**, wherein the linear guide portion includes at least one guide roller rotatably connected to another side of the heating portion.

14. The waste toner treatment device as claimed in claim **1**, further comprising a position sensor to sense a position of the heating portion.

15. An image forming apparatus, comprising:

a body;

a printing engine, disposed in the body, to perform an image forming operation;

a waste toner withdrawal device to obtain waste toners generated during the image forming operation; and

a waste toner treatment device to treat the waste toners obtained by the waste toner withdrawal device and introduced to the waste toner treatment device from the waste toner withdrawal device, the waste toner treatment device including:

a waste toner discharging member,

a heating portion to heat the waste toners within the heating portion, and

a driving portion to move the heating portion along a longitudinal direction of the waste toner discharging member so as to form a waste toner solidified within the heating portion from the waste toners heated by the heating portion, and

the waste toner discharging member is to discharge the waste toner solidified within the heating portion outside of the heating portion.

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