

TITLE OF INVENTION

TONER CARTRIDGE

Field of the Invention

This invention relates to a toner cartridge to be applied to a developing device in an image forming machine such as an electrostatic copying apparatus or a laser printer.

Description of the Prior Art

As is well known, an image forming machine such as an electrostatic copying apparatus or a laser printer forms a latent electrostatic image on an electrostatic photosensitive member, and develops this image to a toner image by a developing device. With a developing device which applies a toner to a latent electrostatic image to develop it to a toner image, a toner cartridge is mounted thereon, and its toner discharge opening is unsealed to feed the toner. A typical example of a toner cartridge, as disclosed in Japanese Laid-Open Utility Model Publication No. Sho 57-136953, comprises a container body having a tubular wall and opposite end walls closing the longitudinally opposite end portions of the tubular wall. The container body is usually composed of a tubular member and a pair of end wall members mounted on the opposite end portions of the tubular member. The tubular member which may be in the form of a cylinder or a polygonal prism defines the tubular wall. The end wall member has a flat wall portion circular or polygonal in cross section, and a short tubular wall portion protruding from the peripheral edge of the flat wall portion. The end wall member is mounted on each end of the tubular member by inserting its short tubular wall portion into the tubular member, or inserting an end portion of the tubular member into its short tubular wall

portion. The flat wall portions of the pair of end wall members define the opposite end walls of the container body. The container body accommodates a toner. The tubular wall of the container body has a longitudinally extending toner discharge opening, which is sealed with a sealing member such that it can be unsealed. The sealing member may be formed of a film or sheet member to be strippably welded or bonded to the tubular wall.

With the above-described toner cartridge, the sealing member is released at least partly from the container body, whereby the toner discharge opening of the container body is unsealed. The unsealed toner discharge opening is directed downwards and positioned at a required position of the developing device. Thus, the toner accommodated in the container body is caused to fall through the toner discharge opening.

In a conventional toner cartridge as stated above, the longitudinally opposite ends of the toner discharge opening formed in the tubular wall defined by the tubular member are aligned with, or situated inwardly of, the inner ends of the short tubular wall portions of the end wall members. Thus, cylindrical or polygonal-prismatic end spaces situated outwardly of the longitudinally opposite edges of the toner discharge opening are present in the container body. The toner cartridge mounted on the developing device is generally disposed such that the central axis of the tubular wall extends substantially horizontally. Thus, the toner present in a lower part of each of the above-mentioned end spaces in the container body tends to stagnate without being discharged from the toner discharge opening. This toner stagnant in the container body is not consumed properly, but

discarded wastefully. When the toner cartridge is released from the developing device, moreover, the toner remaining in the container body is highly likely to scatter from within the container body owing to the inclination or swing of the container body, staining the image forming machine, its surroundings and/or the operator's clothing.

To avoid the stagnation of the toner in the container body, it can be attempted to adopt a constitution in which the short tubular wall portion to be formed in the end wall member for mounting the end wall member to the tubular member is caused to protrude longitudinally outwardly, instead of longitudinally inwardly, from the flat wall portion, and the toner discharge opening formed in the tubular member is caused to extend as far as the flat wall portion of the end wall member. If such a constitution is adopted, however, the longitudinally opposite end portions of the container body, i.e., those portions of the end wall members which extend longitudinally outwardly from the flat wall portions will be present as spaces accommodating no toner, thus considerably decreasing the volume of toner accommodation relative to the entire length of the toner cartridge.

Summary of the Invention

The object of the present invention is to improve the shape of the toner cartridge, thereby minimizing the stagnation of the toner at the opposite end portions of the container body while maximizing its discharge from the toner discharge opening, without excessively decreasing the volume of the toner accommodated.

According to an aspect of the present invention, in order to attain this object, the inner

surface of at least one of the opposite end walls of the container body is caused to extend, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body, longitudinally outwardly from the edge substantially coinciding with one longitudinal edge of the toner discharge opening.

That is, in order to attain the above-mentioned object, an aspect of the present invention is to provide a toner cartridge comprising a container body having a tubular wall having a longitudinally extending toner discharge opening formed therein, and opposite end walls closing the longitudinally opposite end portions of the tubular wall; a toner accommodated in the container body; and a sealing member unsealably sealing the toner discharge opening of the container body; wherein

the inner surface of at least one of the opposite end walls of the container body extends, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body, longitudinally outwardly from the edge substantially coinciding with one longitudinal edge of the toner discharge opening.

Preferably, the inner surfaces of both of the opposite end walls of the container body extend, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body, longitudinally outwardly from the edges substantially coinciding with the longitudinally opposite edges of the toner discharge opening. The angle of inclination α is preferably 70 to 80 degrees. The inner surface of one of the opposite end walls of the container body is preferably an inclined flat surface. According to a

preferred embodiment, in a sectional view taken perpendicularly to the longitudinal direction of the container body, the inner surface of the tubular wall extends, at the angle of inclination β which is larger than the angle of repose of the toner accommodated in the container body, from the opposite side edges of the toner discharge opening. The tubular wall is cylindrical in shape, and the peripheral dimension of the toner discharge opening is substantially constant in the entire longitudinal direction.

According to another aspect of the present invention, in order to attain the aforementioned object, the inner surface of at least one of the opposite end walls of the container body is caused to extend inwardly and longitudinally outwardly, at the angle of inclination γ which is larger than the angle of repose of the toner accommodated in the container body, from the outer peripheral edge thereof, and one longitudinal edge of the toner discharge opening is substantially conformed to the outer peripheral edge of the inner surface of that one of the opposite end walls of the container body.

That is, in order to attain the aforementioned object, another aspect of the present invention is to provide a toner cartridge comprising a container body having a tubular wall having a longitudinally extending toner discharge opening formed therein, and opposite end walls closing the longitudinally opposite end portions of the tubular wall; a toner accommodated in the container body; and a sealing member unsealably sealing the toner discharge opening of the container body; wherein the inner surface of at least one of the opposite end walls of the container body extends

inwardly and longitudinally outwardly, at the angle of inclination γ which is larger than the angle of repose of the toner accommodated in the container body, from the outer peripheral edge thereof, and one longitudinal edge of the toner discharge opening is substantially conformed to the outer peripheral edge of the inner surface of that one of the opposite end walls of the container body.

Preferably, the inner surfaces of both of the opposite end walls of the container body extend inwardly and longitudinally outwardly, at the angle of inclination γ which is larger than the angle of repose of the toner accommodated in the container body, from the outer peripheral edges thereof, and the longitudinally opposite edges of the toner discharge opening are substantially confirmed to the outer peripheral edges of the inner surfaces of the opposite end walls of the container body. The angle of inclination γ is preferably 70 to 80 degrees. The inner surface of one of the opposite end walls of the container body is preferably substantially conical, substantially truncated-conical, or substantially concave. According to a preferred embodiment, in a sectional view taken perpendicularly to the longitudinal direction of the container body, the inner surface of the tubular wall extends, at the angle of inclination β which is larger than the angle of repose of the toner accommodated in the container body, from the opposite side edges of the toner discharge opening. The tubular wall is cylindrical in shape, and the peripheral dimension of the toner discharge opening is substantially constant in the entire longitudinal direction.

According to the toner cartridge of the present invention, in at least one of the opposite

end walls of the container body, a part of its edge is caused to coincide with the edge of the toner discharge opening. Thus, some space accommodating no toner is necessarily produced longitudinally outwardly of the end wall. By inclining the end wall, however, the resulting space accommodating no toner can be made sufficiently small. Since the end wall extends longitudinally inwardly, at the angle of inclination α or γ which is larger than the angle of repose of the toner, toward the edge of the toner discharge opening formed in the tubular wall, the toner is discharged fully smoothly through the toner discharge opening without stagnating on the end wall.

Brief Description of the Drawings

Fig. 1 is a perspective view showing a preferred embodiment of a toner cartridge constituted in accordance with the present invention, along with a developing device which it is applied to;

Fig. 2 is a longitudinal sectional view of the toner cartridge shown in Fig. 1;

Fig. 3 is a transverse sectional view of the toner cartridge shown in Fig. 1;

Fig. 4 is a transverse sectional view of the toner cartridge shown in Fig. 1, similar to Fig. 3, illustrating a state in which the container body is turned through 90 degrees relative to the outer case;

Fig. 5 is a transverse sectional view of the toner cartridge shown in Fig. 1, similar to Fig. 3, illustrating a state in which the container body is turned through 180 degrees relative to the outer case;

Fig. 6 is a longitudinal sectional view, similar to Fig. 2, illustrating another embodiment of a toner cartridge constituted in accordance with the

present invention;

Fig. 7 is a longitudinal sectional view, similar to Fig. 2, illustrating still another embodiment of a toner cartridge constituted in accordance with the present invention;

Fig. 8 is a longitudinal sectional view, similar to Fig. 2, illustrating a further embodiment of a toner cartridge constituted in accordance with the present invention;

Fig. 9 is a partial longitudinal sectional view showing a modified shape of the end wall; and

Fig. 10 is a partial longitudinal sectional view showing another modified shape of the end wall.

Detailed Description of the Preferred Embodiments

Preferred embodiments of the toner cartridge constituted in accordance with the present invention will be described in detail with reference to the accompanying drawings.

With reference to Figs. 1, 2 and 3, the illustrated toner cartridge, entirely indicated at the numeral 2, is composed of a container body 4, a sealing member 6, and an outer case 8. The container body 4 is formed from three members, a tubular member 10 and end wall members 12 and 14. Inside the container body 4, a toner accommodation space 24 is defined by a tubular wall 16 and end walls 20 and 22 closing the opposite end portions of the tubular wall 16. The tubular wall 16 is defined by the tubular member 10, while the end walls 20 and 22 are defined by the end wall members 12 and 14.

The tubular member 10 is preferably a slenderly extending cylindrical member. As is well known to those skilled in the art, such tubular member 10 can be formed advantageously from a boxboard having an aluminum foil laminated on the

inner peripheral surface, and having a suitable plastic film, such as a nylon film, coated on the outer peripheral surface. If desired, the tubular member 10 may be molded from a suitable plastic material. A longitudinally extending toner discharge opening 26 is formed in the tubular member 10. The toner discharge opening 26, in the state illustrated in Figs. 1, 2 and 3, is situated in an upper end portion of the tubular member 10. The opposite end edges of the toner discharge opening 26 are positioned slightly longitudinally inwardly of the opposite end edges of the tubular member 10. At the longitudinally opposite end portions of the tubular member 10 are retained unopen portions 28 and 30 situated outwardly of the toner discharge opening 26. The width of the toner discharge opening 26, i.e., its peripheral dimension, may be substantially constant in the entire longitudinal direction. In Fig. 3, a transverse sectional view of the tubular member 10 (accordingly, a sectional view taken perpendicularly to the longitudinal direction of the container body 4), the angle of inclination β of the tubular wall 16 extending from the opposite side edges of the toner discharge opening 26 is preferably set to be larger than the angle of repose of the toner (not shown) accommodated in the container body 4. In other words, the angle of inclination β_{min} formed by a tangent to the inner surface of the tubular wall 16 at the opposite side edges of the toner discharge opening 26, which is the minimum angle of inclination of the tubular wall 16 extending arcuately from the opposite side edges of the toner discharge opening 26, is preferably set to be larger than the angle of repose of the toner accommodated in the container body 4. The reasons will be offered

later. The angle of repose of the toner in customary use is about 60 degrees, and thus the above-described angle of inclination $\beta_{\min}$ can be set at about 70 to 80 degrees.

With reference to Figs. 1 and 2, the end wall member 12 optionally molded from a suitable plastic material has a flat end wall portion defining the end wall 20 of the container body 4, and a short tubular wall portion 32 protruding longitudinally outwardly from the peripheral edge of the end wall portion. Importantly, the inner surface of the end wall 20 defined by the flat end wall portion of the end wall member 12 extends in an inclined manner, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body 4, longitudinally outwardly from its edge (upper edge in Fig. 2) substantially conformed to one longitudinal edge (left edge in Fig. 2) of the toner discharge opening 26. The reasons will be offered later. As described above, the angle of repose of the toner is usually about 60 degrees, so that the angle of inclination α is preferably about 70 to 80 degrees. Since the end wall 20 is inclined at the angle of inclination α , the end wall 20 is not circular, but elliptic. The short tubular wall portion 32 of the end wall member 12 is cylindrical, and its outside diameter is substantially the same as the inside diameter of the tubular member 10. The end wall member 12 further has an annular wall portion 34 extending radially outwardly from the outer end of the short tubular wall portion 32, a short cylindrical wall portion 36 protruding longitudinally inwardly from the radially outer edge of the annular wall portion 34, and a plate-like gripping piece 38 extending longitudinally outwardly

from the outer surface of the end wall portion defining the end wall 20. The annular wall portion 34 is substantially perpendicular to the longitudinal axis of the container body 4. Such end wall member 12 is fixed to one end portion of the tubular member 10 by securing the outer peripheral surface of the short tubular wall portion 32 to the inner peripheral surface of one end portion (left end portion in Fig. 2) of the tubular member 10 with a suitable adhesive.

With further reference to Figs. 1 and 2, the end wall member 14 may also be molded from a suitable plastic material, as be the end wall member 12. The end wall member 14 is substantially the same as the end wall member 12, except that it lacks the plate-like gripping piece 38. That is, the end wall member 14 also has a flat end wall portion defining the end wall 22 of the container body 4, and a short tubular wall portion 40 protruding longitudinally outwardly from the peripheral edge of the end wall portion. Importantly, the inner surface of the end wall 22 defined by the flat end wall portion of the end wall member 14 extends in an inclined manner, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body 4 and which is preferably about 70 to 80 degrees, longitudinally outwardly from its edge (upper edge in Fig. 2) substantially conformed to one longitudinal edge (right edge in Fig. 2) of the toner discharge opening 26, as does the inner surface of the end wall 20. The reasons will be offered later. Since the end wall 22 is inclined at the angle of inclination α , the end wall 22 is not circular, but elliptic. The short tubular wall portion 40 of the end wall member 14 is cylindrical, and its outside diameter is substantially the same as the inside

diameter of the tubular member 10. The end wall member 14 further has an annular wall portion 42 extending radially outwardly from the outer end of the short tubular wall portion 40, and a short cylindrical wall portion 44 protruding longitudinally inwardly from the radially outer edge of the annular wall portion 42. The annular wall portion 42 is substantially perpendicular to the longitudinal axis of the container body 4. Such end wall member 14 is fixed to one end portion of the tubular member 10 by securing the outer peripheral surface of the short tubular wall portion 40 to the inner peripheral surface of one end portion (right end portion in Fig. 2) of the tubular member 10 with a suitable adhesive.

With reference to Figs. 1, 2 and 3, the outer case 8 is a cylindrical one having a larger inside diameter than the outside diameter of the cylindrical member 10. The length of the case 8 is substantially the same as that of the tubular member 10. Such case 8 can be formed advantageously from a boxboard having its outer peripheral surface coated with a suitable plastic film such as a nylon film. If desired, the case 8 may be molded from a suitable plastic material. As clearly shown in Figs. 2 and 3, a longitudinally extending toner passage opening 46 is formed in the case 8. The toner passage opening 46, in the state illustrated in Figs. 1, 2 and 3, is situated in a lower end portion of the case 8. The length of the toner passage opening 46 formed in the case 8, i.e., its longitudinal dimension, is somewhat larger than the length of the toner discharge opening 26 formed in the tubular member 10, i.e., its longitudinal dimension. The longitudinally opposite end portions of the toner passage opening 46 are situated somewhat longitudinally outwardly of the

longitudinally opposite end portions of the toner discharge opening 26. The width of the toner passage opening 46, i.e., its peripheral dimension, is advantageously substantially the same as or somewhat larger than the width of the toner discharge opening 26, i.e., its peripheral dimension. As shown in Figs. 1 and 3, an engagement ridge 48 extending longitudinally at a middle portion of the case 8 is provided at a predetermined angular position of the outer peripheral surface of the case 8. Such an engagement ridge 48 may be formed separately from the cylindrical body of the case 8, and fixed at its required position with an adhesive. As clearly shown in Fig. 2, the outside diameter of the case 8 is substantially the same as or slightly smaller than the inside diameter of the short cylindrical wall portion 36 of the end wall member 12 and the inside diameter of the short cylindrical wall portion 44 of the end wall member 14. The case 8 is relatively rotatably assembled with the container body 4 (i.e., the tubular member 110 and the end wall members 12 and 14) by positioning the opposite end portions of the case 8 inside the short cylindrical wall portion 36 of the end wall member 12 and the short cylindrical wall portion 44 of the end wall member 14. In greater detail, according to an example of production of the toner cartridge 2, the tubular member 10, the end wall member 12, the sealing member 6 (the sealing member 6 will be described later), and the case 8 are combined as required. Then, a toner is charged into the tubular member 10 from an open end (right end in Fig. 2) of the tubular member 10. Thereafter, the end wall member 14 is fixed to one end portion of the tubular member 10 with an adhesive, and assembled with one end portion of the

case 8 such that the case 8 may be rotatable. As clearly understood from Fig. 3, the engagement ridge 48 provided on the outer peripheral surface of the case 8 protrudes radially outwardly beyond the outer peripheral surfaces of the end wall members 12 and 14.

With further reference to Figs. 2 and 3, the sealing member 6 may be formed advantageously from a suitable plastic film such as a nylon film. Such sealing member 6 has a sealing portion 50 covering the toner discharge opening 26 formed in the tubular member 10, and an extension 52 extending from the sealing portion 50. The sealing portion 50 is situated on the outer peripheral surface of the tubular member 10 to cover the toner discharge opening 26. The marginal region of the sealing portion 50 that surrounds the toner discharge opening 26 is welded strippably to the outer peripheral surface of the tubular member 10. The extension 52 extending from one side edge (left side edge in Fig. 3) of the sealing portion 50 extends over the sealing portion 50 after being folded back at one side edge of the sealing portion 50. Then, the extension 52 further extends clockwise in Fig. 3 along the outer peripheral surface of the tubular member 10, passing through the toner passage opening 46 formed in the case 8. Then, it is folded back at one side edge (right side edge in Fig. 3) of the toner passage opening 46, and further extends along the outer peripheral surface of the case 8. Finally, a front end portion of the extension 52 is welded to the outer peripheral surface of the case 8. If desired, the sealing portion 50 of the sealing member 6 may be bonded with an adhesive, instead of being welded, to the outer peripheral surface of the tubular member

10, and the front end portion of the extension 52 of the sealing member 6 may be bonded with an adhesive, instead of being welded, to the outer peripheral surface of the case 8. Advantageously, the longitudinal dimension of the sealing member 6, i.e., its dimension in the right-and-left direction in Fig. 2, is somewhat larger than the longitudinal dimension of the toner discharge opening 26, and substantially the same or slightly smaller than the longitudinal dimension of the toner passage opening 44.

Fig. 1 also briefly shows a developing device 54 which the toner cartridge 2 is to be mounted on. At an upper part of the developing device 54 is disposed a toner cartridge receiving portion 56. The toner cartridge receiving portion 56 defines a receiving space 60 extending substantially horizontally from an insertion opening 58 formed in one surface thereof. The insertion opening 58 is a circular one having an inside diameter consistent with the outside diameters of the end wall members 12 and 14 of the toner cartridge 2, and the cross section of the receiving space 60 is a circle consistent with the shape of the insertion opening 58. At a predetermined angular position of the inner peripheral surface of the cylindrical wall defining the receiving space 60 is formed an engagement groove 62 which extends substantially horizontally.

The procedure for mounting the toner cartridge 2 into the toner cartridge receiving portion 56 of the developing device 54 and feeding the developing device 54 with the toner is as follows: First, the toner cartridge 2 is inserted into the receiving space 60 through the insertion opening 58 of the toner cartridge receiving portion 56, with the end wall member 14 (accordingly, the

right end in Fig. 2) being placed foremost. On this occasion, the angular position of the engagement ridge 48 formed on the outer peripheral surface of the case 8 is aligned with the angular position of the engagement groove 62 of the toner cartridge receiving portion 56, and the engagement ridge 48 is inserted into the engagement groove 62. Thus, the toner cartridge 2 is inserted into the receiving space 60 until the main part of the end wall member 12 is situated in the insertion opening 58, and only the gripping piece 38 formed in the end wall member 12 projects from the receiving space 60 toward you. At this time, as shown in Figs. 2 and 3, the toner passage opening 46 formed in the case 8 is situated at the lower end portion and left open downwards, whereas the toner discharge opening 26 formed in the container body 4 is situated at the upper end portion. Then, the gripping piece 38 formed in the end wall member 12 is gripped to turn the container body 4 counterclockwise through 180 degrees in Figs. 3 to 5. Fig. 4 illustrates a state in which the container body 4 is turned counterclockwise through 90 degrees from the state shown in Fig. 3, and Fig. 5 illustrates a state in which the container body 4 is turned counterclockwise through 180 degrees from the state shown in Fig. 3. Since the engagement ridge 48 is engaged with the engagement groove 62 of the toner cartridge receiving portion 56, the case 8 is not rotated attendant on the container body 4, but is kept in the state shown in Fig. 3. As will be readily understood by reference to Figs. 3 to 5, when the container body 4 is rotated with the case 8 stationary, the extension 52 of the sealing member 6 is relatively pulled. Hence, the sealing portion 50 of the sealing member 6 is stripped sequentially from

the outer peripheral surface of the tubular member 10, starting at the left side edge in Fig. 3. When the container body 4 is rotated to the state shown in Fig. 5, the sealing portion 50 of the sealing member 6 has been stripped from the outer peripheral surface of the tubular member 10, with only one side edge portion thereof being left intact. As a result, the toner discharge opening 26 of the container body 4 is situated at the lower end portion, and rendered open downwards. The toner (not shown) accommodated in the container body 4 is allowed to fall into the developing device 54 from the toner discharge opening 26 through the toner passage opening 46 formed in the case 8. In regard to the discharge of the toner from the container body 4, the following facts should be given attention: As will be clearly seen by reference to Fig. 2 viewed upside-down, where the toner discharge opening 26 of the container body 4 is situated at the lower end portion and rendered open downwards, the end walls 20 and 22 of the container body 4 extend upwardly and longitudinally outwardly in an inclined manner from the lower ends substantially conformed to the longitudinally opposite ends of the toner discharge opening 26. The angle of inclination α of the end walls 20 and 22 relative to the horizontal is greater than the angle of repose of the toner. Thus, the toner flows downwards sufficiently satisfactorily without stagnating on the end walls 20 and 22, and discharges from the toner discharge opening 26. As will be understood by reference to Fig. 5, the tubular wall 16 of the container body 4 also extends upwardly and arcuately, at the angle of inclination β relative to the horizontal which is greater than the angle of repose of the toner, from the opposite side edges of

the toner discharge opening 26. Thus, the toner does not stagnate on the tubular wall 16. Consequently, substantially all of the toner accommodated in the container body 4 is discharged fully smoothly from the container body 4 into the developing device 54 through the toner discharge opening 26 and the toner passage opening 46.

As shown by two-dot chain lines in Fig. 2, if the end walls 20 and 22 of the container body 4 were caused to extend substantially vertically from the opposite ends of the toner discharge opening, the toner in the container body 4 would be discharged sufficiently satisfactorily from the toner discharge opening 26 without becoming stagnant on the end walls 20 and 22. However, if the end walls 20 and 22 were constituted as shown by the two-dot chain lines, the volume of the toner accommodated in the container body 4 would be decreased compared with the constitution shown by the solid lines.

To release the toner cartridge 2 from the developing device 54 after discharge of substantially all of the toner accommodated in the container body 4, the gripping piece 38 is gripped, and the container body 4 is rotated clockwise in Figs. 5 and 3 from the state shown in Fig. 5 until the state shown in Fig. 3. Thus, the toner discharge opening 26 of the container body 4 is situated at the upper end portion again, thereby reliably preventing some toner stagnating in the container body 4 from falling through the toner discharge opening 26. Then, the toner cartridge 2 is pulled from the toner cartridge receiving portion 56 toward you.

Fig. 6 illustrates another embodiment of a toner cartridge constituted in accordance with the present invention. A toner cartridge, entirely

indicated at the numeral 102, is composed of a container body 104 and a sealing member 106. The toner cartridge 102 has no outer case.

The container body 104 of the toner cartridge 102 is formed from three members, a tubular member 110 and end wall members 112 and 114. The tubular member 110 is substantially identical with the tubular member 10 of the container body 4 in the toner cartridge 2 shown in Figs. 1 to 5. The end wall member 112 is substantially the same as the end wall member 12 of the container body 4 in the toner cartridge 2 shown in Figs. 1 to 5, except that the radial dimension of its annular wall portion 134 is relatively small, and that the distance between the outer peripheral surface of its short tubular wall portion 132 and the inner peripheral surface of its short cylindrical wall portion 136 is substantially the same as the wall thickness of the tubular member 110. The end wall member 114 is also substantially the same as the end wall member 14 of the container body 4 in the toner cartridge 2 shown in Figs. 1 to 5, except that the radial dimension of its annular wall portion 142 is relatively small, and that the distance between the outer peripheral surface of its short tubular wall portion 140 and the inner peripheral surface of its short cylindrical wall portion 144 is substantially the same as the wall thickness of the tubular member 110. The end wall member 112 is fixed to one end portion of the tubular member 110 by inserting the one end portion of the tubular member 110 between the short tubular wall portion 132 and the short cylindrical wall portion 136, and bonding them together with an adhesive. The end wall member 114 is fixed to the other end portion of the tubular member 110 by inserting the other end

portion of the tubular member 110 between the short tubular wall portion 140 and the short cylindrical wall portion 144, and bonding them together with an adhesive.

The sealing member 106 in the toner cartridge 102 may also be formed advantageously from a suitable plastic film such as a nylon film. Such sealing member 106 also has a sealing portion 150, and an extension 152. The sealing portion 150 is situated on the outer peripheral surface of the tubular member 110 to cover a toner discharge opening 126. The marginal region of the sealing portion 150 that surrounds the toner discharge opening 126 is welded strippably to the outer peripheral surface of the tubular member 110. The extension 152 extending from one side edge (right side edge in Fig. 6) of the sealing portion 150 is folded back along the one side edge of the sealing portion 150, and extends leftward in Fig. 6 over the sealing portion 150. Then, the extension 152 further extends along the outer peripheral surface of the short cylindrical wall portion 136 of the end wall member 112. A front end portion of the extension 152 is welded strippably to the outer peripheral surface of the short cylindrical wall portion 136 of the end wall member 112.

An example of the manner of using the toner cartridge 102 shown in Fig. 6 will be described. The toner cartridge 102 is inserted into a required position of a developing device (not shown), in the state illustrated in Fig. 6 where the toner discharge opening 126 formed in the tubular member 110 is situated at a lower portion of the toner cartridge 102. Then, a front end portion of the extension 152 of the sealing member 106 is stripped from the outer peripheral surface of the short cylindrical end

portion 136 of the end wall member 112, and the extension 152 is pulled leftward in Fig. 6. Thus, the sealing portion 150 of the sealing member 106 is stripped sequentially from the peripheral surface of the tubular member 110, starting at the right end portion in Fig. 6. As a result, the toner discharge opening 126 is rendered completely open. The sealing member 106 can be completely stripped from the peripheral surface of the tubular member 110, and released from the container body 104. When the toner discharge opening 126 has thus become open, the toner (not shown) accommodated in the container body 104 is allowed to fall downwards from the toner discharge opening 126 for feeding into the developing device. As with the toner cartridge 2 shown in Figs. 1 to 5, the end walls 120 and 122 of the container body 104 extend upwardly and longitudinally outwardly in an inclined manner from the lower ends substantially conformed to the longitudinally opposite ends of the toner discharge opening 126. The angle of inclination α of the end walls 120 and 122 relative to the horizontal is greater than the angle of repose of the toner. Thus, the toner flows downwards sufficiently satisfactorily without stagnating on the end walls 120 and 122, and discharges from the toner discharge opening 126. The tubular wall 116 of the container body 104 also extends upwardly and arcuately, at the angle of inclination β (see Fig. 5) relative to the horizontal which is greater than the angle of repose of the toner, from the opposite side edges of the toner discharge opening 126. Thus, the toner does not stagnate on the tubular wall 116. Consequently, substantially all of the toner accommodated in the container body 104 is discharged fully smoothly from the container body 104 into the

developing device through the toner discharge opening 126. After substantially all of the toner accommodated in the container body 104 is discharged, the container body 104 is rotated through 180 degrees about its longitudinal central axis to bring the toner discharge opening 126 to the upper end portion. Then, the toner cartridge 102 can be withdrawn from the developing device.

Fig. 7 illustrates still another embodiment of a toner cartridge constituted in accordance with the present invention. In a toner cartridge 202 shown in Fig. 7, a container body 204 is composed of two members, a bottomed tubular member 211 and an end wall member 212. The bottomed tubular member 211 defines a tubular wall 216 in the shape of a cylinder, and an end wall 222 which closes one end of the tubular wall 216. The inner surface of the end wall 222, in the state illustrated in Fig. 7, extends upwardly and longitudinally outwardly in an inclined manner from the lower end coinciding with one end edge of a toner discharge opening 226 formed in the tubular wall 216. The angle of inclination α of the inner surface of the end wall 222 relative to the horizontal is set to be larger than the angle of repose of the toner. The end wall member 212 and a sealing member 206 in the toner cartridge 202 shown in Fig. 7 are substantially the same as the end wall member 112 and the sealing member 106 in the toner cartridge 102 shown in Fig. 6. According to an example of production of such toner cartridge 202, a sealing portion 250 of the sealing member 206 is welded strippably to the outer peripheral surface of the bottomed tubular member 211 to seal the toner discharge opening 226. Then, a toner is charged into the bottomed tubular member 211 through the open end

(left end in Fig. 7) of the bottomed tubular member 211. Thereafter, the end wall member 212 is fixed to the open end portion of the bottomed tubular member 211, and a front end portion of an extension 252 of the sealing member 206 is welded strippably to the outer peripheral surface of a short cylindrical wall portion 236 of the end wall member 212.

If, as with a container body 204 in the toner cartridge 202 shown in Fig. 7, one of the end walls 220 and 222 closing the opposite ends of the tubular wall 216, i.e., the end wall 222, is formed integrally with the tubular wall 216, there is no need to fix a separately formed end wall member to one end of the tubular wall 216, i.e., the right end in Fig. 7. Thus, at one end portion of the container body 204, i.e., the right end portion in Fig. 7, it suffices to provide a relatively short unopen portion 230 necessary for strippably welding thereto the sealing portion 250 of the sealing member 206. If the unopen portion 230 may thus be relatively short, it is possible, if desired, to make the end wall 222 extend substantially vertically, and conform one end edge of the toner discharge opening 226 to the lower end of the end wall 222, as shown by a two-dot chain line in Fig. 7. Such a constitution would not excessively decrease the volume of the toner accommodated in the container body 204, nor would it cause the toner to stagnate at the right end portion of the container body 204.

Fig. 8 illustrates a further embodiment of a toner cartridge constituted in accordance with the present invention. In a toner cartridge 302 shown in Fig. 8, an end wall 320 defined by the end wall portion of an end wall member 312 is a conical one extending inwardly (i.e., toward the central axis of

a tubular wall 316) and longitudinally outwardly from the outer peripheral edge thereof at the angle of inclination γ . Importantly, the angle of inclination γ is set to be larger than the angle of repose of the toner accommodated in a container body 304. As described above, the angle of repose of the toner is generally about 60 degrees, so that the angle of inclination γ is preferably about 70 to 80 degrees. An end wall 322 defined by the end wall portion of an end wall member 314, like the end wall 320, is a conical one extending inwardly (i.e., toward the central axis of the tubular wall 316) and longitudinally outwardly from the outer peripheral edge thereof at the angle of inclination γ . The opposite end edges of a toner discharge opening 326 formed in a tubular member 310 are substantially conformed to the outer peripheral edges of the end walls 320 and 322. The constitution of the toner cartridge 302 shown in Fig. 8, except the elements described above with regard to the end walls 320 and 322, is substantially the same as the toner cartridge 202 shown in Fig. 6. In the toner cartridge 302 shown in Fig. 8, too, when the sealing member 306 is released from the container body 304 to render the toner discharge opening 326 of the container body 304 open, the toner accommodated in the container body 304 is discharged sufficiently satisfactorily through the toner discharge opening 326. Since the end walls 320 and 322 extend longitudinally outwardly at the angle of inclination γ which is larger than the angle of repose of the toner, there is no stagnation of the toner on the end walls 320 and 322.

Instead of the conical end walls 320 and 322, it is possible to adopt a truncated conical end wall 420 as shown in Fig. 9, or a concave end wall

520 as shown in Fig. 10. In the case of the truncated conical end wall 420 as well, it is important that the angle of inclination γ is larger than the angle of repose of the toner. For the concave end wall 520 as well, it is important that the minimum angle of inclination $\gamma_{\min}$, i.e., the angle of inclination $\gamma_{\min}$ at the lower end of the end wall 520, is larger than the angle of repose of the toner. Furthermore, the end walls 320 and 322, 420 and 520 shown in Figs. 8, 9 and 10 are shaped such that their longitudinally outermost points are in registry with the central axes of tubular walls 316, 416 and 516. If desired, their longitudinally outermost points may be displaced in arbitrary directions relative to the central axes of the tubular walls 316, 416 and 516.

More additionally, in all of the above-described embodiments, the tubular walls 16, 116, 216, 316, 416 and 516 are cylindrical with their cross sections being circular. If desired, tubular walls in the shapes of polygonal prisms, such as regular hexagonal prisms or regular octagonal prisms, may be used instead of the cylindrical tubular walls 16, 116, 216, 316, 416 and 516.

While some preferred embodiments of the present invention have been described in detail with reference to the accompanying drawings, it is to be understood that the invention is in no way limited to them, but various changes and modifications may be made without departing from the spirit and scope of the invention.



What we claim is:

1. A toner cartridge comprising a container body having a tubular wall having a longitudinally extending toner discharge opening formed therein, and opposite end walls closing the longitudinally opposite end portions of the tubular wall; a toner accommodated in the container body; and a sealing member unsealably sealing the toner discharge opening of the container body; wherein

the inner surface of at least one of the opposite end walls of the container body extends, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body, longitudinally outwardly from the edge substantially coinciding with one longitudinal edge of the toner discharge opening.

2. The toner cartridge of Claim 1 wherein the inner surfaces of both of the opposite end walls of the container body extend, at the angle of inclination α which is larger than the angle of repose of the toner accommodated in the container body, longitudinally outwardly from the edges substantially coinciding with the longitudinally opposite edges of the toner discharge opening.

3. The toner cartridge of Claim 1 wherein the angle of inclination α is 70 to 80 degrees.

4. The toner cartridge of Claim 1 wherein the inner surface of said one of the opposite end walls of the container body is an inclined flat surface.

5. The toner cartridge of Claim 1 wherein in a sectional view taken perpendicularly to the longitudinal direction of the container body, the inner surface of the tubular wall extends, at the angle of inclination β which is larger than the angle of repose of the toner accommodated in the container

body, from the opposite side edges of the toner discharge opening.

6. The toner cartridge of Claim 1 wherein the tubular wall is cylindrical in shape, and the peripheral dimension of the toner discharge opening is substantially constant in the entire longitudinal direction.

7. A toner cartridge comprising a container body having a tubular wall having a longitudinally extending toner discharge opening formed therein, and opposite end walls closing the longitudinally opposite end portions of the tubular wall; a toner accommodated in the container body; and a sealing member unsealably sealing the toner discharge opening of the container body; wherein

the inner surface of at least one of the opposite end walls of the container body extends inwardly and longitudinally outwardly, at the angle of inclination γ which is larger than the angle of repose of the toner accommodated in the container body, from the outer peripheral edge thereof, and one longitudinal edge of the toner discharge opening is substantially conformed to the outer peripheral edge of the inner surface of that one of the opposite end walls of the container body.

8. The toner cartridge of Claim 7 wherein the inner surfaces of both of the opposite end walls of the container body extend inwardly and longitudinally outwardly, at the angle of inclination γ which is larger than the angle of repose of the toner accommodated in the container body, from the outer peripheral edges thereof, and the longitudinally opposite edges of the toner discharge opening are substantially conformed to the outer peripheral edges of the inner surfaces of the opposite end walls of



the container body.

9. The toner cartridge of Claim 7 wherein the angle of inclination γ is 70 to 80 degrees.

10. The toner cartridge of Claim 7 wherein the inner surface of said one of the opposite end walls of the container body is substantially conical.

11. The toner cartridge of Claim 7 wherein the inner surface of said one of the opposite end walls of the container body is substantially truncated-conical.

12. The toner cartridge of Claim 7 wherein the inner surface of said one of the opposite end walls of the container body is substantially concave.

13. The toner cartridge of Claim 7 wherein in a sectional view taken perpendicularly to the longitudinal direction of the container body, the inner surface of the tubular wall extends, at the angle of inclination β which is larger than the angle of repose of the toner accommodated in the container body, from the opposite side edges of the toner discharge opening.

14. The toner cartridge of Claim 7 wherein the tubular wall is cylindrical in shape, and the peripheral dimension of the toner discharge opening is substantially constant in the entire longitudinal direction.

