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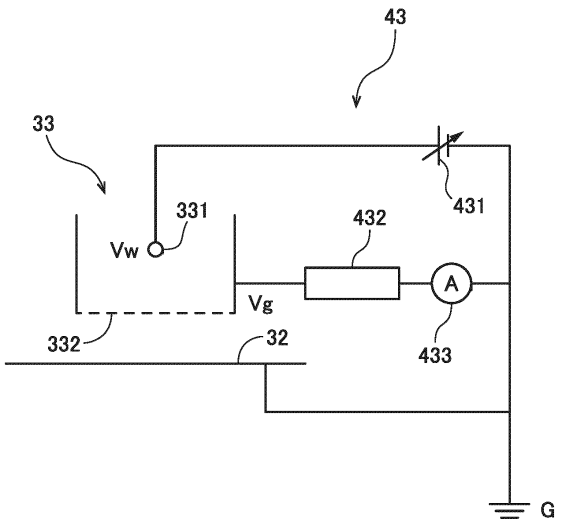
(54) DETERMINATION METHOD AND DETERMINATION DEVICE DETERMINING WHETHER OR NOT A CHARGER IS RECYCLABLE

(57) It is provided a determination method and a determination device capable of determining whether or not a charger is recyclable without disassembling an image forming apparatus (1) or a drum unit (30). The determination device executes a voltage changing step and a voltage determining step. In the voltage changing step, a voltage is applied to the wire (331) so that the grid voltage (Vg) changes between a plurality of preset voltage values. In the voltage determination step, whether or not the charger (33) is recyclable is determined based on a change in the wire voltage (Vw) with respect to a change in the grid voltage (Vg) in the voltage change step. Thus, the recyclability of the charger (33) can be judged without disassembling the image forming apparatus (1) or the drum unit (30).

【FIG.3】



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Description

[Technical Field]

[0001] The present disclosure relates to a determination method and a determination device.

[Background Art]

[0002] Conventionally, an electrophotographic image forming apparatus such as an LED printer is known. An electrophotographic image forming apparatus includes a photosensitive drum and a charger that charges the photosensitive drum. The photosensitive drum and the charger may be mounted on a drum unit that is detachable from the image forming apparatus.

[0003] Conventionally, in this type of image forming apparatus, when determining whether or not the charger is recyclable, it is necessary to disassemble the image forming apparatus or the drum unit and check the charger. Therefore, the determination of whether or not the charger is recyclable is a work requiring many man-hours.

[0004] In view of this, an image forming apparatus that determines whether or not a charger is recyclable by using a drum memory is known. In the related art, the image forming apparatus reads the number of times of cleaning of the wire cleaned by the cleaner from the drum memory, and determines whether the wire is reusable.

[Prior Art Document]

[Patent Document]

[0005] [Patent Document 1] Japanese Patent Application Laid-Open No. 2022 - 157975

SUMMARY OF THE INVENTION

[Problems to be Solved by the Invention]

[0006] In the scorotron charger disclosed in Patent Document 1, when a foreign substance adheres to the wire, abnormal discharge such as spark discharge or arc discharge is likely to occur. The charger which is liable to generate such discharge is not suitable for recycling.

[0007] An object of the present disclosure is to provide a determination method and a determination device capable of determining whether or not a charger is recyclable without disassembling an image forming apparatus or a drum unit by a method different from the conventional method.

[Means for Solving the Problems]

[0008] In a first embodiment, it is provided a determination method of determining whether a scorotron charger is recyclable, the scorotron charger being used in an electrophotographic image forming apparatus and the scorotron charger including a wire and a grid, wherein a grid voltage of the grid changes according to a wire voltage applied to the wire. The determination method according to the first embodiment comprises steps of: (a) changing a voltage applied to the wire by the determination device so that the grid voltage changes between a plurality of preset voltage values; and (b) determining, by the determination device, whether the charger is recyclable based on a change in the wire voltage with respect to a change in the step (a).

[0009] A second embodiment is the determination method according to the first embodiment, wherein the determination device increases the grid voltage in the step (a).

[0010] A third embodiment is the determination method according to the first or second embodiment, wherein the determination device determines that the charger is not recyclable when the wire voltage is smaller than a predetermined threshold value corresponding to the grid voltage in the step (b).

[0011] A fourth embodiment is the determination method according to the third embodiment, wherein the threshold value is set based on a proportional relationship between the grid voltage and the wire voltage when the grid voltage is smaller than a predetermined value.

[0012] A fifth embodiment is the determination method according to any one of the first to fourth embodiments, wherein the charger is used in a drum unit detachably attached to a main body frame of the image forming apparatus.

[0013] A sixth embodiment is the determination method according to the fifth embodiment, further comprising steps of: (c) reading, by the determination device, a number of printed sheets by the drum unit from a memory included in the drum unit; and (d) determining, by the determination device, whether the number of printed sheets read in the step (c) is less than a predetermined value, wherein the determination device executes the steps (a) and (b) when the determination device determines that the number of printed sheets is less than the predetermined value in the step (d), and wherein the determination device does not execute the steps (a) and (b) when the determination device determines that the number of printed sheets is equal to or greater than the predetermined value in the step (d).

[0014] A seventh embodiment is the determination method according to any one of the first to sixth embodiments, further comprising steps of: (e) applying a voltage to the wire by the determination device so that the grid voltage is higher than that during use of the charger; and (f) determining, by the determination device that the charger is not recyclable when a spark discharge occurs in the step (e).

[0015] An eighth embodiment is the determination method of the seventh embodiment, wherein the determination device executes the steps (a) and step (b) after the step (e) and the step (f).

[0016] In a ninth embodiment, it is provided a method of determining whether a scorotron charger is recyclable, the scorotron charger being used in an electrophotographic image forming apparatus, and the scorotron charger including a wire and a grid, wherein a grid voltage of the grid changes according to a wire voltage applied to the wire. The determination method comprises steps of: (g) applying a voltage to the wire by the determination device so that the grid voltage is higher than that during use of the charger; and (h) determining, by the determination device, that the charger is not recycable when spark discharge occurs in the step (g).

[0017] A tenth embodiment is the determination method according to the ninth embodiment, wherein the charger is used in a drum unit detachably attached to a main body frame of the image forming apparatus.

[0018] An eleventh embodiment is the determination method according to the tenth embodiment, further comprising steps of: (i) reading, by the determination device, a number of sheets printed by the drum unit from a memory provided in the drum unit; and (j) determining, by the determination device, whether the number of sheets read in the step (i) is less than a predetermined value, and wherein the determination device executes the steps (g) and (h) when the determination device determines that the number of printed sheets is less than the predetermined value in the step (j), and wherein the determination device does not execute the steps (g) and (h) when the determination device determines that the number of printed sheets is equal to or greater than the predetermined value in the step (j).

[0019] In a twelfth embodiment it is provided a determination device for determining whether or not a scorotron charger is recyclable, the scorotron charger used in an electrophotographic image forming apparatus, and the scorotron charger including a wire and a grid, wherein a grid voltage of the grid changes according to a wire voltage applied to the wire. The determination device comprises: a voltage application circuit configured to apply a voltage to the charger and a controller electrically connected to the voltage application circuit; and wherein the controller executes steps of: changing the grid voltage between a plurality of preset voltage values by the voltage application circuit; and determining whether or not the charger is recyclable based on a change in the wire voltage with respect to a change in the grid voltage in the step of changing.

[0020] In a thirteenth embodiment it is provided a determination device for determining whether or not a scorotron charger is recyclable, the scorotron charger used in an electrophotographic image forming apparatus, the scorotron charger including a wire and a grid, wherein a grid voltage of the grid changes according to a wire voltage applied to the wire. The determination device comprises: a voltage application circuit configured to apply a voltage to the charger; a spark discharge detection circuit electrically connected to the voltage application circuit, the spark charge detection circuit configured to detect occurrence of spark discharge in the charger; and a controller electrically connected to the voltage application circuit and the spark discharge detection circuit, wherein the controller is configured to execute steps of: applying a voltage to the wire by the voltage application circuit so that the grid voltage is higher than that during use of the charger; and determining, by the spark discharge detection circuit, that the charger is not recyclable when the spark discharge occurs in the step of applying.

[Effects of the Invention]

[0021] According to the first to thirteenth embodiments, it is possible to determine whether or not the charger is recyclable without disassembling the image forming apparatus or the drum unit.

Brief Description of the Drawings

[0022]

FIG. 1 is a schematic view of an image forming apparatus.
FIG. 2 is a control block diagram of the image forming apparatus.
FIG. 3 is a circuit diagram of a voltage application circuit.
FIG. 4 is a flowchart showing a flow of processing for determining whether or not a charger is recyclable.
FIG. 5 is a graph showing the relationship between the grid voltage and the wire voltage.

[Detailed Description of the Invention]

[0023] Hereinafter, detailed embodiments will be described with reference to the drawings.

<1. **Configuration of Image Forming Apparatus>**

[0024] FIG. 1 is a schematic view of the image forming apparatus 1. The image forming apparatus 1 is an electrophotographic printer. Specifically, the image forming apparatus 1 is a laser printer or an LED printer. As shown in FIG. 1, the image forming apparatus 1 includes a casing 10, four toner cartridges 20, a drum unit 30, a controller 40, and a display 50.

[0025] The casing 10 includes a box-shaped main body frame 11 and a cover 12. The four toner cartridges 20, the drum unit 30, and the controller 40 are accommodated in the body frame 11.

[0026] The main body frame 11 has an opening 13. The cover 12 is rotatable between a closed position indicated by a two dot chain line in FIG. 1 and an open position indicated by a solid line in FIG. 1. When the cover 12 is disposed at the closed position, the opening 13 of the main body frame 11 is covered by the cover 12. When the cover 12 is disposed at the open position, the opening 13

of the main body frame 11 is opened.

[0027] The four toner cartridges 20 are detachably attached to the drum unit 30. The toner cartridge 20 contains toner as a developer. The four toner cartridges 20 contain toners of different colors (for example, cyan, magenta, yellow, and black). Each toner cartridge 20 includes a developing roller 21. The developing roller 21 is a cylindrical member extending along a developing axis. The developing roller 21 is rotatable about the developing shaft. The toner accommodated in the toner cartridge 20 is carried on the outer surface of the developing roller 21.

[0028] The drum unit 30 is detachably attached to the main body frame 11. More specifically, the drum unit 30 can be mounted to the main body frame 11 in a state where the four toner cartridges 20 are mounted. That is, the drum unit 30 is used together with the four toner cartridges 20. As shown in FIG. 1, the drum unit 30 includes a drum frame 31, four photosensitive drums 32, four chargers 33, and a drum memory 34.

[0029] The drum frame 31 has four slots 311 corresponding to the four toner cartridges 20. One toner cartridge 20 is mounted in one slot 311.

[0030] One of the photosensitive drums 32 is provided for each slot 311. Each photosensitive drum 32 is a cylindrical member extending along a drum axis. Each photosensitive drum 32 is rotatable about a drum shaft. The outer surface of each photosensitive drum 32 is covered with a photosensitive material.

[0031] When the toner cartridge 20 is mounted in the slot 311, the outer surface of the developing roller 21 contacts the outer surface of the photosensitive drum 32. The toner in the toner cartridge 20 is supplied to the outer surface of the photosensitive drum 32 via the outer surface of the developing roller 21. Then, the toner carried on the outer surface of the photosensitive drum 32 is transferred onto the printing paper.

[0032] One of the chargers 33 is provided for each slot 311. Each charger 33 is a device that charges the outer surface of the photosensitive drum 32. Each charger 33 of the present embodiment is a scorotron charger having a wire and a grid. Each charger 33 charges the outer surface of the respective photosensitive drum 32 by corona discharge generated by a voltage applied to the wire.

[0033] The drum memory 34 is a storage medium from and to which information can be read and written. The drum memory 34 is, for example, a flash ROM or an EEPROM. The drum memory 34 is attached to the drum frame 31. The drum memory 34 stores information relating to the drum unit 30. Specifically, the drum memory 34 stores identification information for identifying the drum unit 30. The identification information is, for example, a serial number.

[0034] FIG. 2 is a control block diagram of the image forming apparatus 1. As shown in FIG. 2, the drum memory 34 stores the number of sheets N printed by the drum unit 30. The number of printed sheets N represents the number of times the image forming apparatus 1 has performed printing using one drum unit 30 specified by the identification information. The image forming apparatus 1 increments the number of printed sheets N stored in the drum memory 34 every time one printing is performed.

[0035] The controller 40 controls a printing process using the drum unit 30. As shown in FIG. 2, the controller 40 includes a processor 41 and a main body memory 42.

[0036] The processor 41 is, for example, a central processing unit (CPU). The main body memory 42 is a storage medium from and to which information can be read and written. The main body memory 42 is, for example, a flash ROM or an EEPROM. The main body memory 42 may be disposed on the same substrate as the processor 41, or may be disposed at another location.

[0037] The main body memory 42 stores a computer program for controlling the operation of the image forming apparatus 1. The processor 41 executes various processes in accordance with a computer program stored in the main body memory 42. Specifically, the processor 41 can execute a printing process and a recycling possibility determination process described later.

[0038] As shown in FIG. 2, in a state where the drum unit 30 is mounted on the main body frame 11, the controller 40 is electrically connected to the drum memory 34. This enables the processor 41 to read information from the drum memory 34 and write information to the drum memory 34.

[0039] As shown in FIG. 2, the image forming apparatus 1 includes a voltage application circuit 43 and a spark discharge detecting circuit 44. The voltage application circuit 43 and the spark discharge detection circuit 44 are electrically connected to the controller 40.

[0040] The voltage application circuit 43 is an electric circuit for applying a voltage to the charger 33. FIG. 3 is a circuit diagram of the voltage application circuit 43. As described above, the charger 33 of the present embodiment includes the wire 331 and the grid 332. The wire 331 and the grid 332 are positioned near the outer surface of the photosensitive drum 32. The grid 332 is positioned between the outer surface of the photosensitive drum 32 and the wire 331.

[0041] The voltage application circuit 43 includes a power supply 431, a resistor 432, and an ammeter 433. The positive pole of the power supply 431 is connected to the wire 331. The negative pole of the power supply 431 is grounded to the ground G. This allows the power supply 431 to apply a voltage to the wire 331. Hereinafter, the voltage (potential with respect to the ground G) applied to the wire 331 by the power supply 431 is referred to as a "wire voltage Vw".

[0042] One end of the resistor 432 is connected to the grid 332. The other end of the resistor 432 is connected to the ground G. The voltage of the grid 332 changes according to the wire voltage Vw. Hereinafter, the voltage of the grid 332 (potential with respect to the ground G) is referred to as a "grid voltage Vg". A current correspond-

ing to the grid voltage Vg flows through the resistor 432. The ammeter 433 measures the value of the current flowing through the resistor 432.

[0043] The grid voltage Vg changes not only with the value of the wire voltage Vw but also with the state of dust, toner, a silica compound derived from an external additive of toner, and the like adhering to the wire 331. Specifically, when dust or toner adheres to the wire 331, the resistance value of the wire 331 increases, and thus the grid voltage Vg decreases.

[0044] Since the resistance value of the resistor 432 is constant, the grid voltage Vg is proportional to the value of the current flowing through the resistor 432. The controller 40 performs feedback control of the wire voltage Vw applied to the wire 331 by the power supply 431 so that the current value measured by the ammeter 433 becomes constant. Thus, the grid voltage Vg is maintained constant.

[0045] The spark discharge detection circuit 44 is an electric circuit for detecting the occurrence of spark discharge in the charger 33. The spark discharge is a discharge accompanied by a spark, which is different from a normal corona discharge. Spark discharge is likely to occur when dust, toner, or the like locally adheres to the inside of the charger 33. The spark discharge detection circuit 44 detects the occurrence of spark discharge based on the value of the current flowing through the voltage application circuit 43. More specifically, the voltage application circuit 43 includes a transformer (not shown). The spark discharge detection circuit 44 detects that spark discharge has occurred when the value of the current flowing through the transformer exceeds a preset allowable range. In the image forming apparatus 1 during printing, when the spark discharge detection circuit 44 detects occurrence of spark discharge, the controller 40 stops printing.

[0046] The display 50 displays various kinds of information related to the operation of the image forming apparatus 1. The display 50 is located on the outer surface of the main body frame 11. For example, a liquid crystal display is used as the display 50. The display 50 is electrically connected to the controller 40. The display 50 displays an operation status, an error, and the like of the image forming apparatus 1 based on information output from the controller 40.

[0047] The controller 40 drives a motor (not shown) when the printing process is executed. The developing roller 21 and the photosensitive drum 32 are rotated by a driving force transmitted from the motor. The controller 40 applies a voltage to the charger 33 by the voltage application circuit 43. As a result, the outer surface of the photosensitive drum 32 is charged.

[0048] Further, the controller 40 causes a light source (not shown) to emit light. The light emitted from the light source is irradiated onto the outer surface of the photosensitive drum 32. As a result, an electrostatic latent image is formed on the outer surface of the photosensitive drum 32. The toner supplied from the toner cartridge 20 is supplied onto the electrostatic latent image on the photosensitive drum 32 via the developing roller 21. As a result, a toner image is formed on the outer surface of the photosensitive drum 32.

[0049] The printing paper is conveyed between the photosensitive drum 32 on which the toner image is formed and a transfer belt (not shown). As a result, the toner image is transferred from the outer surface of the photosensitive drum 32 to the printing paper. Thereafter, the toner image is thermally fixed to the print sheet in a fixing unit in the image forming apparatus 1. As a result, an image is printed on the printing paper.

<2. **Determination of Recyclability of Charger**>

[0050] Next, a method of determining whether or not the charger 33 is recyclable will be described. In the present embodiment, the image forming apparatus 1 has a function as a determination device that determines whether or not the charger 33 is recyclable. FIG. 4 is a flowchart showing a flow of processing for determining whether or not the charger 33 is recyclable by the image forming apparatus 1 as the determination device. The processing in step S2 and subsequent steps in FIG. 4 proceeds as the processor 41 of the controller 40 operates in accordance with the computer program.

[0051] When determining whether or not the charger 33 is recyclable, first, the drum unit 30 is mounted to the image forming apparatus 1 as the determination device (step S1). Specifically, the drum unit 30 is mounted on the main body frame 11 of the image forming apparatus 1. Thus, the controller 40 and the drum memory 34 are electrically connected to each other. The voltage application circuit 43 and the spark discharge detection circuit 44 are electrically connected to the charger 33.

[0052] Next, the controller 40 reads the number of printed sheets N from the drum memory 34 (step S2: reading step). The main body memory 42 stores in advance a predetermined value as a threshold value of the number of printed sheets N. The controller 40 compares the number of printed sheets N read from the drum memory 34 with the predetermined value read from the main body memory 42. Then, the controller 40 determines whether or not the number of printed sheets N is less than a predetermined value (step S3: printed sheet number determination step).

[0053] When the controller 40 determines that the number of printed sheets N is equal to or larger than the predetermined value (No in step S3), the controller 40 displays a message or an image indicating that the disassembly inspection of the charger 33 is necessary on the display 50 (step S4). In this case, the controller 40 does not execute the processing of step S5 and subsequent steps described later.

[0054] On the other hand, when the controller 40 determines that the number of printed sheets N is less than the predetermined value (Yes in step S3), the controller 40 executes the processing of step S5 and the subse-

quent steps. In this case, the controller 40 first applies a high voltage to the charger 33 (step S5: voltage application step). Specifically, the controller 40 applies a voltage to the wire 331 by the voltage application circuit 43 while rotating the photosensitive drum 32. At this time, the voltage application circuit 43 applies a voltage to the wire 331 so that the grid voltage Vg becomes higher than that during normal use of the charger 33. For example, when the maximum value of the grid voltage Vg during printing in the image forming apparatus 1 is 800V, a voltage is applied to the wire 331 so that the grid voltage Vg becomes 900V exceeding the maximum value. The time for applying the voltage may be, for example, 5 to 15 seconds.

[0055] The controller 40 determines whether or not spark discharge has occurred in the charger 33 in the voltage application step (step S6: spark discharge determination step). Specifically, the controller 40 determines whether or not the occurrence of spark discharge has been detected by the spark discharge detection circuit 44.

[0056] More specifically, the spark discharge detection circuit 44 includes a resistor, a capacitor, a transistor, and the like. When the spark discharge occurs, a large current flows instantaneously in the spark discharge detection circuit 44. When the value of the current flowing through the spark discharge detection circuit 44 becomes equal to or greater than a predetermined value, the spark discharge detection circuit 44 outputs a voltage that is different from that when normal discharge, that is, corona discharge, is being performed. The controller 40 determines that spark discharge has occurred when it detects that a voltage different from that at normal times is output from the spark discharge detection circuit 44.

[0057] When the controller 40 determines that the spark discharge has occurred in the voltage application step (Yes in step S6), the controller 40 determines that the charger 33 is not recyclable. In this case, the controller 40 displays a message or an image indicating that the charger 33 is not recyclable on the display 50 (step S7).

[0058] On the other hand, when the controller 40 determines that the spark discharge has not occurred in the voltage application step (No in step S6), the controller 40 then changes the voltage applied to the charger 33 in a stepwise manner (step S8: voltage change step). Specifically, the controller 40 changes the grid voltage Vg in a stepwise manner by changing the voltage applied from the voltage application circuit 43 to the wire 331 in a stepwise manner.

[0059] In the voltage changing step, the voltage application circuit 43 changes the grid voltage Vg between a plurality of preset voltage values. For example, the voltage application circuit 43 increases the grid voltage Vg from 100 to 900V in a stepwise manner at 200V intervals. The controller 40 stores the relationship between the grid voltage Vg and the wire voltage Vw applied to the wire 331 at the grid voltage Vg.

[0060] In the case of the example of increasing the grid voltage Vg stepwise from 100V to 900V at the 200V interval, the controller 40 stores the wire voltage Vw when the grid voltage Vg is 100V, stores the wire voltage Vw when the grid voltage Vg is 300V, stores the wire voltage Vw when the grid voltage Vg is 500V, stores the wire voltage Vw when the grid voltage Vg is 700V, and stores the wire voltage Vw when the grid voltage Vg is 900V.

[0061] FIG. 5 is a graph showing an example of the grid voltage Vg and the wire voltage Vw measured in the voltage changing step. The horizontal axis of FIG. 5 represents the grid voltage Vg. The vertical axis of FIG. 5 represents the wire voltage Vw. When no arc discharge occurs between the wire 331 and the grid 332, the wire voltage Vw changes with a substantially constant slope with respect to the grid voltage Vg, as indicated by the dotted line in FIG. 5. However, when an arc discharge occurs between the wire 331 and the grid 332, the wire voltage Vw decreases as indicated by Vwa in FIG. 5.

[0062] The arc discharge occurs between the wire 331 and the grid 332 when a large amount of dust or toner adheres to the charger 33. When the arc discharge occurs, the wire voltage Vw is stabilized at a value lower than usual. The arc discharge may cause a printing failure due to a charging failure of the photosensitive drum 32. The arc discharge cannot be detected by the spark discharge detection circuit 44.

[0063] The controller 40 sets the thresholds of the wire voltage Vw based on the proportional relationship between the grid voltage Vg and the wire voltage Vw in a region where the grid voltage Vg is lower than a predetermined reference value (hereinafter referred to as a "low voltage region A1"). The predetermined reference value is, for example, 500V. In detail, the controller 40 sets a threshold-value straight line Vw0 having a constant inclination as shown in the graph of FIG. 5. The slope of the threshold-value straight line Vw0 may be the slope of the change in the wire voltage Vw with respect to the grid voltage Vg measured in the low voltage region A1, or may be a fixed value stored in advance. The threshold-value straight line Vw0 is set at a position smaller than the wire voltage Vw measured in the low voltage region A1 by a predetermined offset value Vwd. The offset value Vwd is, for example, 500V.

[0064] The controller 40 determines whether or not the wire voltage Vw is smaller than the threshold-value straight line Vw0 in a region (hereinafter, referred to as a "high voltage region A2") in which the grid voltage Vg is larger than the reference value (step S9: voltage determination step).

[0065] In the high voltage region A2, when the wire voltage Vw is smaller than the threshold-value straight line Vw0, there is a possibility that an arc is generated between the wire 331 and the grid 332. Therefore, when the wire voltage Vw is smaller than the threshold-value straight line Vw0 in the high voltage region A2 (Yes in step S9), the controller 40 determines that the charger 33 is not recyclable. In this case, the controller 40 displays a

message or an image indicating that the charger 33 is not recyclable on the display 50 (step S7).

[0066] On the other hand, when the wire voltage Vw is equal to or higher than the threshold-value straight line Vw0 in the high voltage region A2, it is considered that no arc discharges occur between the wire 331 and the grid 332. Therefore, when the wire voltage Vw is equal to or higher than the threshold-value straight line Vw0 in the high voltage region A2 (No in step S9), the controller 40 determines that the charger 33 is recyclable. In this case, the controller 40 displays a message or an image indicating that the charger 33 is recyclable on the display 50 (step S10).

[0067] As described above, the controller 40 supplies the grid voltage Vg higher than that during the use of the charger 33 to the grid 332 in the steps S5 to S6, and determines whether or not the charger 33 is recyclable based on whether or not the spark discharge has occurred. Therefore, the recyclability of the charger 33 can be determined without disassembling the drum unit 30.

[0068] As described above, the controller 40 changes the grid voltage Vg between a plurality of voltage values, and determines whether the charger 33 is recyclable based on the change in the wire voltage Vw with respect to the change in the grid voltage Vg. Therefore, the recyclability of the charger 33 can be determined without disassembling the drum unit 30.

[0069] In the above description, the process of determining whether or not one charger 33 of the drum unit 30 is recyclable has been described, but whether or not the other chargers 33 of the drum unit 30 are recyclable may be determined in the same manner.

<3. Modifications>

[0070] Although an embodiment of the present disclosure has been described above, the present disclosure is not limited to the above-described embodiment.

[0071] In the above-described embodiment, the image forming apparatus 1 serves as the determination device. However, the determination device may be an apparatus different from the image forming apparatus 1 that performs printing. For example, the determination device may be a device which is dedicated to determining whether or not recycling is possible and which is installed in a factory.

[0072] In the above-described embodiment, the controller 40 executes the printed sheet number determination step S3 before performing the voltage application step S5, the spark discharge determination step S6, the voltage change step S8, and the voltage determination step S9 after step S3. However, the printed sheet number determination step S3 may be omitted. That is, the controller 40 may perform the processing of step S5 and thereafter regardless of the number of printed sheets N.

[0073] In the above-described embodiment, the controller 40 first determines whether or not the recycling is possible in the voltage application step and the spark discharge determination step(steps S5 to S6), and then determines whether or not the recycling is possible in the voltage change step and the voltage determination step(steps S8 to S9). However, the controller 40 may first perform the determination of the recycling possibility by the voltage changing step and the voltage determining step (steps S8 to S9), and then perform the determination of the recycling possibility by the voltage application step and the spark discharge determination step(steps S5 to S6).

[0074] In the above-described embodiment, the controller 40 performs both the determination of whether or not the recycling is possible by the voltage application step and the spark discharge determination step(steps S5 to S6) and the determination of whether or not the recycling is possible by the voltage change step and the voltage determination step(steps S8 to S9). However, the controller 40 may perform only one of the determination of the recycling possibility by the voltage application step and the spark discharge determination step(steps S5 to S6) and the determination of the recycling possibility by the voltage change step and the voltage determination step(steps S8 to S9).

[0075] In the above-described embodiment, the drum unit 30 includes four photosensitive drums 32. However, the number of the photosensitive drums 32 included in the drum unit 30 may be one to three, or may be five or more.

[0076] In the above-described embodiment, the drum unit 30 includes the four chargers 33. However, the number of chargers 33 included in the drum unit 30 may be one to three, or may be five or more.

[0077] In the above-described embodiment, four toner cartridges 20 can be mounted on the drum unit 30. However, the number of toner cartridges 20 that can be mounted on the drum unit 30 may be one to three, or may be five or more.

[0078] For example, the drum unit 30 may include one photosensitive drum 32 and one charger 33. A plurality of drum units 30 each having one toner cartridge 20 mounted thereon may be mountable on the main body frame 11.

[0079] The toner cartridge 20 may not include the developing roller 21. In this case, the drum unit 30 may include the developing roller 21.

[0080] In the above-described embodiment, the drum unit 30 includes the charger 33. However, the main body frame 11 of the image forming apparatus 1 may include the charger 33.

[0081] Further, the elements described in the above embodiment and modifications may be combined as appropriate within a range in which no contradiction arises.

[Description of Symbols]

[0082]

1	image forming apparatus
10	casing
11	main body frame
12	cover
13	opening
20	toner cartridge
21	developing roller
30	drum unit
31	drum frame
32	photosensitive drum
33	charger
34	drum memory
40	controller
41	processor
42	main body memory
43	voltage application circuit
44	spark discharge detection circuit
50	display
311	slot
331	wire
332	grid
431	power supply
432	resistor
433	ammeter
A1	low voltage region
A2	high voltage region
Vg	grid voltage
Vw	wire voltage
Vw0	threshold-value straight line

Claims

1. A determination method comprising:
determining, by a determination device, whether or not a scorotron charger (33) is recyclable, the scorotron charger (33) being used in an electrophotographic image forming apparatus (1), the scorotron charger (33) including a wire (331) and a grid (332), wherein a grid voltage (Vg) of the grid (332) changes in accordance with a wire voltage (Vw) applied to the wire (331), the determination method comprising at least one of (a) and (b) as follows:

(a) steps of:

(a-1) changing (S8) a voltage applied to the wire (331) by the determination device so that the grid voltage (Vg) changes between a plurality of preset voltage values; and
(a-2) determining (S9), by the determination device, whether or not the scorotron charger (33) is recyclable based on a change in the wire voltage (Vw) with respect to a change in the grid voltage (Vg) in the step (a-1);
and

(b) steps of:

(b-1) applying (S5) a voltage to the wire (331) by the determination device so that the grid voltage(Vg) is higher than that during use of the scorotron charger (33); and
(b-2) determining (S6),by the determination device, that the scorotron charger (33) is not recyclable when spark discharge occurs in the step (b-1).

2. The determination method according to claim 1, wherein the determination device increases the grid voltage (Vg) in a stepwise manner in the step (a-1).

3. The determination method according to claim 2, wherein the determination device determines that the scorotron charger (33) is not recyclable when the wire voltage (Vw) is smaller than a predetermined threshold value corresponding to the grid voltage (Vg) in the step (a-2).

4. The determination method according to claim 3, wherein the threshold value is set based on a proportional relationship between the grid voltage (Vg) and the wire voltage (Vw) when the grid voltage (Vg) is smaller than a predetermined value.

5. The determination method according to any one of claims 1 to 4, wherein the scorotron charger (33) is used in a drum unit (30) being detachably attached to a main body frame of the image forming apparatus.

6. The determination method according to claim 5, further comprising steps of:

(c) reading (S2), by the determination device, a number of sheets printed by the drum unit (30) from a memory included in the drum unit (30); and
(d) determining (S3), by the determination device, whether the number of printed sheets read in the step (c) is less than a predetermined value,

wherein the determination device executes the step (a-1) and the step (a-2) when the determination device determines that the number of printed sheets is less than the predetermined value in the step (d), and
wherein the determination device does not execute the step (a-1) and the step (a-2) when the determination device determines that the number of printed sheets is equal to or greater than the predetermined value in the step (d).

7. The determination method according to any one of claims 1 to 6, further comprising steps of:

(e) applying (S5) a voltage to the wire (331) by

the determination device so that the grid voltage (Vg) is higher than that during use of the scorotron charger (33); and
(f) determining (S6), by the determination device, that the scorotron charger (33) is not recyclable when spark discharge occurs in the step (e).

8. The determination method according to claim 7, wherein the determination device executes the step (a-1) and the step (a-2) after the step (e) and the step (f).

9. The determination method according to claim 1, wherein the scorotron charger (33) is used in a drum unit (30) detachably attached to a main body frame (11) of the image forming apparatus (1).

10. The determination method according to claim 9, the determination method further comprising steps of:

(i) reading (S2), by the determination device, a number of sheets printed by the drum unit from a memory provided in the drum unit; and
(j) determining (S3), by the determination device, whether the number of printed sheets read in the step (i) is less than a predetermined value,

wherein the determination device executes the step (b-1) and the step (b-2) when the determination device determines that the number of printed sheets is less than the predetermined value in the step (j), and
wherein the determination device does not execute the step (b-1) and the step (b-2) when the determination device determines that the number of printed sheets is equal to or greater than the predetermined value in the step (j).

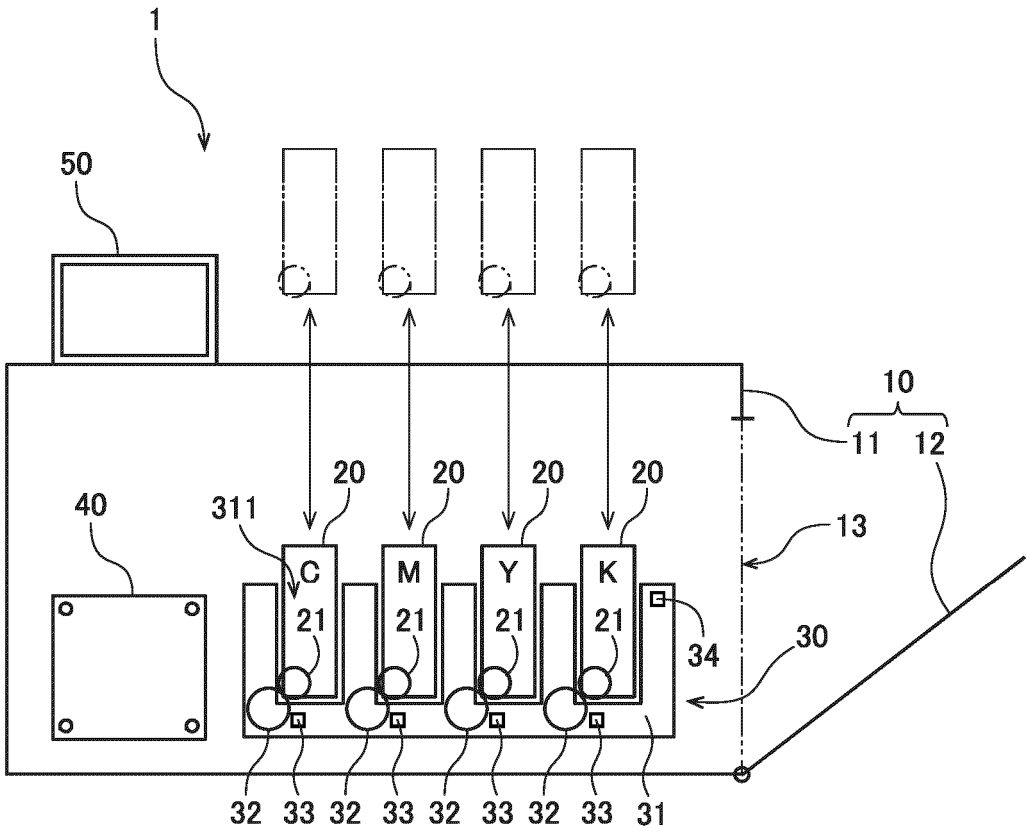
11. A determination device for determining whether or not a scorotron charger is recyclable, the scorotron charger used in an electrophotographic image forming apparatus, the scorotron charger including a wire (331) and a grid (332), wherein a grid voltage (Vg) of the grid (332) changes in accordance with a wire voltage (Vw) applied to the wire (331), is recyclable, the determination device comprising:

a voltage application circuit (43) configured to apply a voltage to the scorotron charger (33); and
a controller (40) electrically connected to the voltage application circuit (43),and
at least one of (a) and (b) as follows:

(a) wherein the controller (40) is configured to execute steps of: changing (S8) the grid voltage (Vg) between a plurality of preset voltage values by the voltage application circuit (43); and determining (S9) whether or not the scorotron charger (33) is recyclable based on a change in the wire voltage (Vw) with respect to a change in the grid voltage (Vg) in the step of changing the grid voltage (Vg); and
(b) wherein the determination device further comprises a spark discharge detection circuit (44) electrically connected to the voltage application circuit (43) and the controller (40), the spark discharge detection circuit (44) being configured to detect occurrence of spark discharge in the scorotron charger (33); and
wherein the controller (40)configured to execute steps of:

applying (S5) a voltage to the wire (331) by the voltage application circuit (43) so that the grid voltage (Vg) is higher than that during use of the scorotron charger (33); and
determining (S6), by the spark discharge detection circuit (44), that the scorotron charger (33) is not recyclable when the spark discharge occurs in the step of applying the voltage to the wire (331).

【FIG.1】


1
50
10
11
12
20
20
20
20
40
311
13
C
M
Y
K
21
21
21
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32
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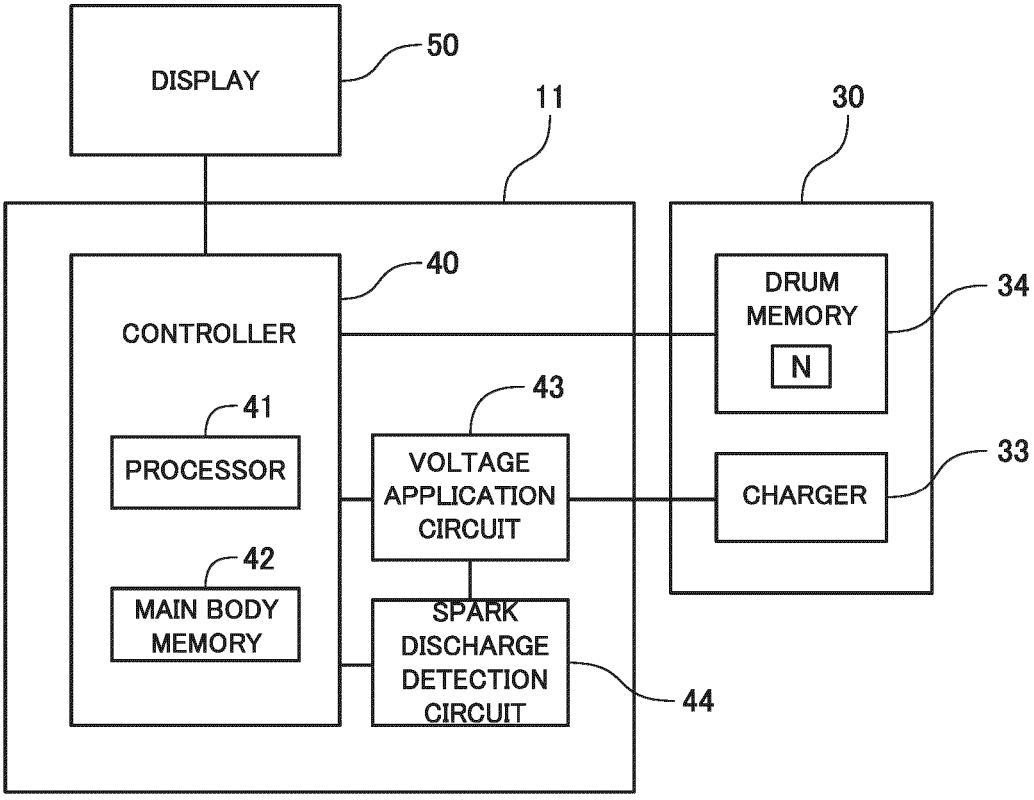
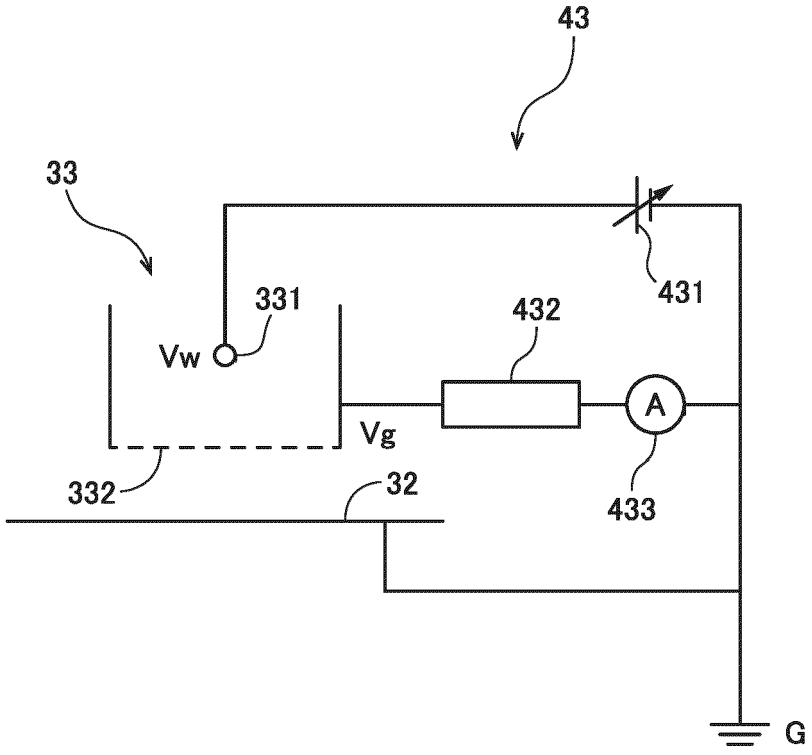
32
33
32
33
32
33
31

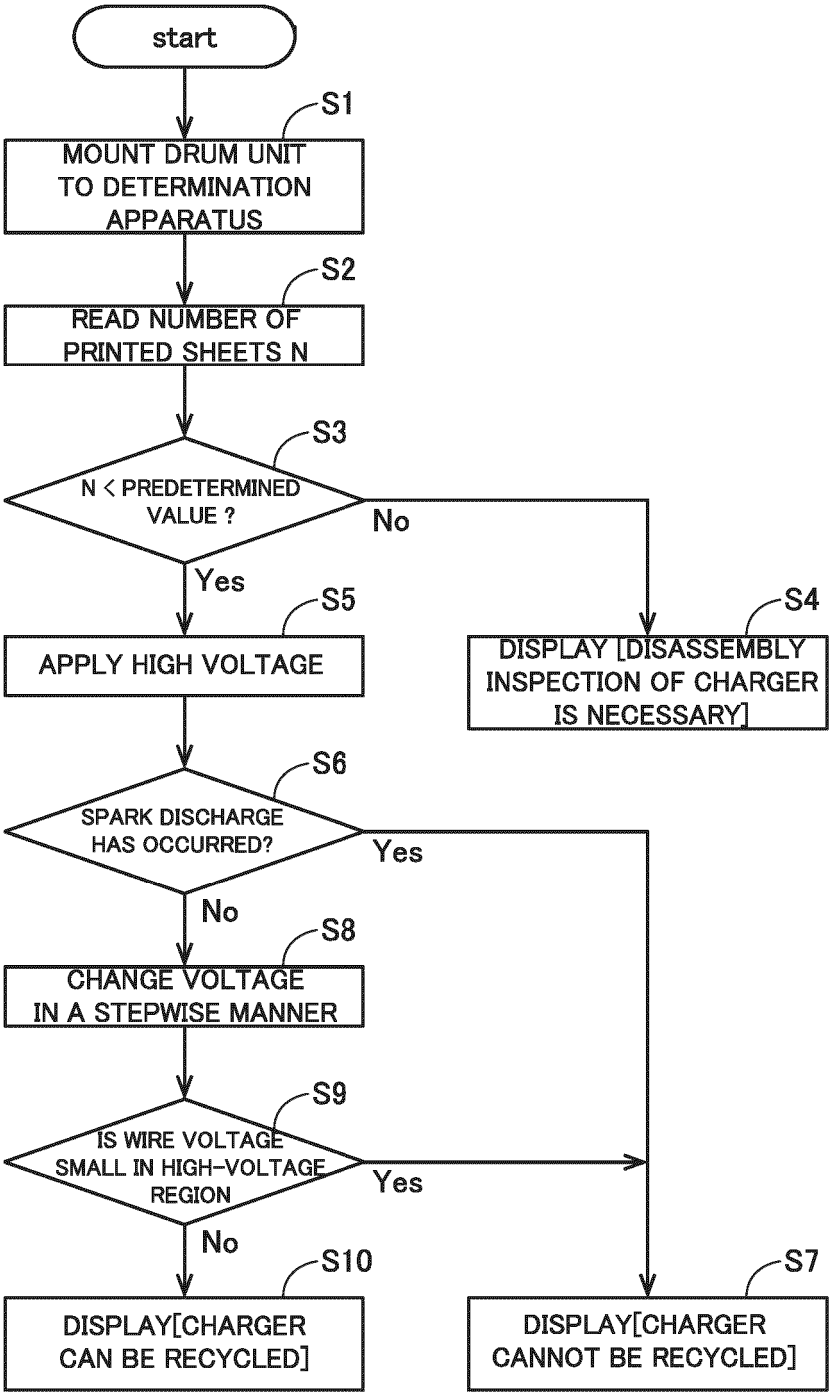
【FIG.2】


DISPLAY
50
11
30
CONTROLLER
40
DRUM MEMORY
N
34
41
PROCESSOR
43
VOLTAGE APPLICATION CIRCUIT
CHARGER
33
42
MAIN BODY MEMORY
SPARK DISCHARGE DETECTION CIRCUIT
44

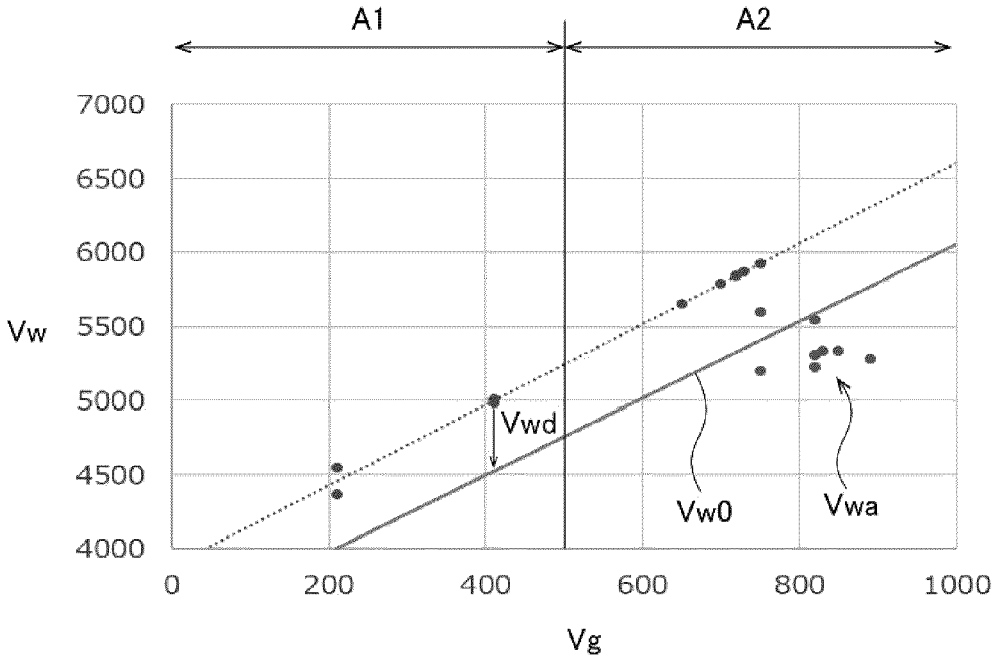
【FIG.3】



【FIG.4】


start
S1
MOUNT DRUM UNIT TO DETERMINATION APPARATUS
S2
READ NUMBER OF PRINTED SHEETS N
S3
N < PREDETERMINED VALUE ?
No
Yes
S4
DISPLAY [DISASSEMBLY INSPECTION OF CHARGER IS NECESSARY]
S5
APPLY HIGH VOLTAGE
S6
SPARK DISCHARGE HAS OCCURRED?
Yes
No
S8
CHANGE VOLTAGE IN A STEPWISE MANNER
S9
IS WIRE VOLTAGE SMALL IN HIGH-VOLTAGE REGION
Yes
No
S10
DISPLAY[CHARGER CAN BE RECYCLED]
S7
DISPLAY[CHARGER CANNOT BE RECYCLED]

【FIG.5】


A1
A2
7000
6500
6000
5500
5000
4500
4000
Vw
0
200
400
600
800
1000
Vg
Vwd
Vw0
Vwa

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EUROPEAN SEARCH REPORT

Application Number
EP 24 19 6560

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2022 125936 A (BROTHER IND LTD) 29 August 2022 (2022-08-29) * abstract; figures *	11	INV. G03G15/02
A		1-10	G03G15/00
A	JP H01 179179 A (CANON KK) 17 July 1989 (1989-07-17) * abstract; figures *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)

G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 January 2025	Urbaniec, Tomasz

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14-01-2025

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JP 2022125936 A	29-08-2022	NONE	
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