United States Patent [19]

Fujimoto

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[54] **TONER SUPPLY DEVICE OF ELECTROSTATIC PHOTOCOPYING APPARATUS**

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[30] **Foreign Application Priority Data**

Dec. 29, 1970 Japan ..... 45-138905[U]

[52] **U.S. Cl.** **222/312,** 118/DIG. 1, 118/308, 222/DIG. 1, 222/342

[51] **Int. Cl.** **G01f 11/00**

[58] **Field of Search** ..... 222/247, 248, 312, 342, 222/DIG. 1, 343; 118/308, DIG. 1

[56] **References Cited**

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[57] **ABSTRACT**

An oscillatable rotary feed roller is disposed along an elongated opening formed in the bottom of a toner supply hopper to define a slit-like toner discharge opening between the feed roller surface on which toner mixing bars are mounted and one of the side edges of the elongated opening which is provided with an opening adjusting plate. As the roller is oscillated, the toner mixing bars agitate the toner in the supply hopper to prevent agglomeration and a wire is extended below the toner discharge opening along the toner feed roller in contact or in closely spaced apart relation therewith so that toner attached to the feed roller can be removed by the wire.

7 Claims, 4 Drawing Figures

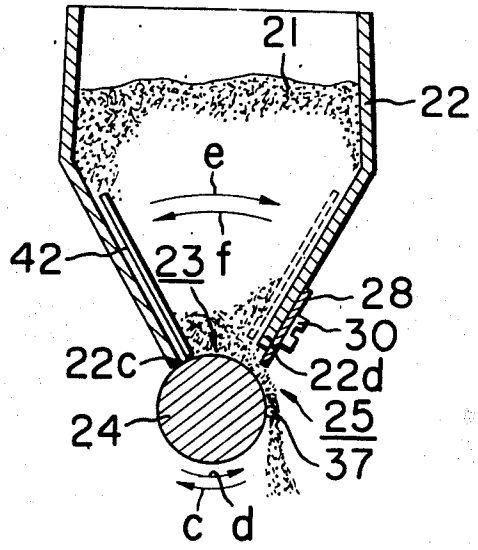


FIG. 1 PRIOR ART

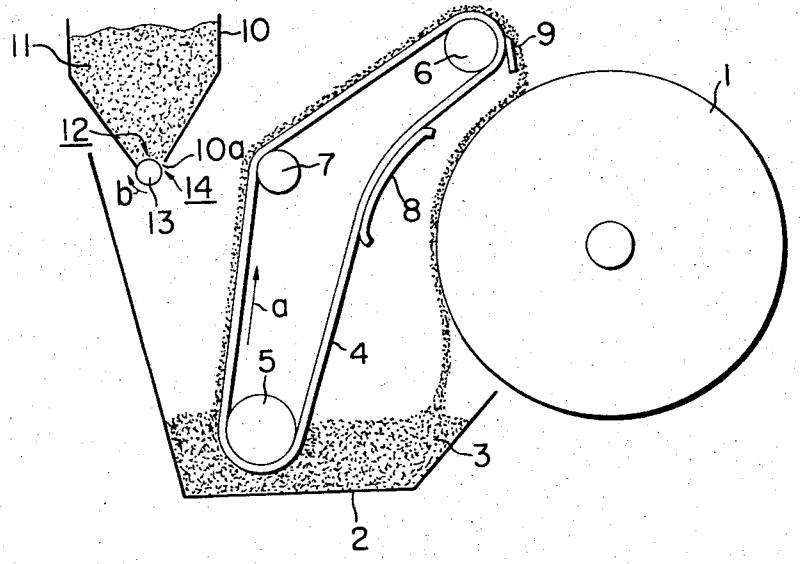
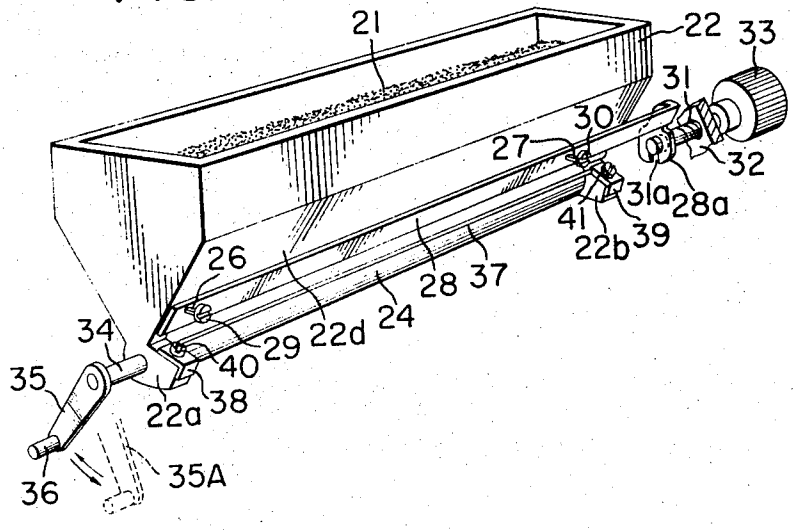


FIG. 2



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FIG. 3

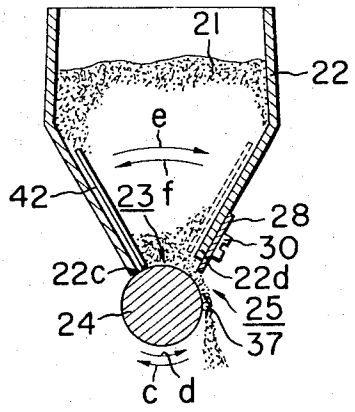
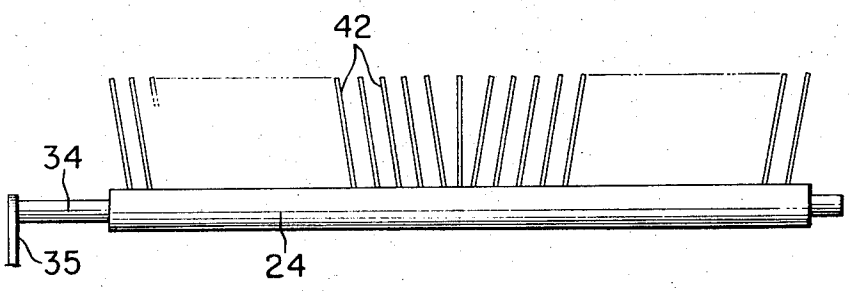


FIG. 4



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TONER SUPPLY DEVICE OF ELECTROSTATIC PHOTOCOPYING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to generally an electrostatic photocopying apparatus, and more particularly a toner supply device of an electrostatic photocopying apparatus.

Developing agents used in dry electrostatic photocopying processes contain toner which consists of thermoplastic resin of a low melting point uniformly mixed with colorant such as dyes, pigments such as carbon black and the like and a dispersing agent, and which is divided into fine particles whose size ranges from one to ten microns. The toner is mixed with a carrier which is, for example, iron powder in the magnetic brush developing process, glass beads in the cascade developing process or the like. In case of the fur brush developing process, toner is attached to a fur brush. In the dry developing process, such resinous pigment toner is disposed in a reservoir or supply device and repetitively used to develop an electrostatic latent image into a toner visible image by attaching toner to the latent image. Therefore, the toner concentration in the reservoir will be gradually decreased, and images of better quality cannot be developed unless, toner is supplied to the reservoir 2 keep the constant toner concentration to provide images of better quality.

In the prior art toner supply devices, toner particles tend to agglomerate or solidify and to firmly attach to a feed roller to form a toner layer therearound. As a consequence, the toner discharge opening in which the feed roller operates, becomes clogged, and the agglomerated toner drops into the developing vessel or chamber.

The present invention was made to overcome these problems encountered in the prior art toner supply devices. Briefly stated, according to the present invention, means is provided which is adapted to remove toner attached to a feed roller in cooperation with the rotation or oscillation thereof.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a diagrammatic side view illustrating one prior art example of a developing device for developing an electrostatic latent image formed upon an electrophotographic sensitive drum;

FIG. **2** is a perspective view of one embodiment of a toner supply device in accordance with the present invention;

FIG. **3** is a sectional view thereof; and

FIG. **4** is a side view of a toner feed roller thereof having toner mixing wires.

DESCRIPTION OF THE INVENTION

Prior Art

In FIG. **1** is illustrated a developing device of the cascade developing process which uses the dry developing agent consisting of toner mixed with carrier, that is iron powder. A photoconductive compound such as selenium is coated upon a drum **1**, and a developing vessel **2** containing the dry developing agent **3** is disposed on the left side of the drum **1**. In the developing vessel **3**, a magnetic belt **4** is wrapped around a belt roller **5**, a belt roller **6** disposed obliquely upwardly of the drum **1**, and a tension roller **7**, and is pressed against a pressure plate **8**. The iron powder carrying toner is attracted by the magnetic belt **4**, and is lifted in the direction indicated by the arrow *a* above the drum **1**. The developing agent thus is dropped upon the drum **1** by a blade **9** in contact with the conveyor belt **4** at the upper end thereof so that the electrostatic latent image formed upon the drum **1** is developed into a visible toner image, which is thereafter transferred upon copying paper. Since the developing agent **3** is repetitively used in the manner described above, the toner concentration is gradually descreased.

A toner supply hopper **10** containing toner **11** is disposed on the upper left side of the developing vessel **2**, and has a toner discharge opening **12** which is perpendicular to the plane of the drawing. A rotary toner feed roller **13** is disposed along the discharge opening **12** in such a manner that one side edge **10***a* of the opening **12** and the peripheral surface of the feed roller **13** define a toner discharge opening **14**. Therefore, upon rotation of the feed roller **13** in the direction of the arrow *b*, the toner **11** is supplied into the developing vessel **2** through the toner discharge opening **14**. The feed roller **13** may be continuously or intermittently rotated as the needs demand.

However, as described hereinbefore, the toner whose particle size ranges from one to ten microns, tends to agglomerate and to firmly adhere to the feed roller **13** forming a layer therearound. Therefore, the toner discharge opening **14** is finally clogged, and the agglomerated toner drops into the developing vessel **2**.

The Invention

Referring to FIGS. **2–4**, the preferred embodiment of a toner supply device in accordance with the present invention will be described. An elongated opening **23** (See FIG. **3**) is formed along the bottom of a toner supply hopper **22** containing toner **21**, and arms **22***a* and **22***b* are formed integral with the side walls of the hopper **22** at both ends of the opening **23**. A toner feed roller **24** supported by the arms **22***a* and **22***b* is rotatably disposed along the opening **23**, and one side edge **22***c* (See FIG. **3**) of the hopper is disposed in closely spaced apart relation with the surface of the toner feed roller **24**, whereas the other side edge **22***d* is disposed in relatively spaced part relation with the feed roller **24** to define a slit-like toner discharge opening **25**. An adjusting plate **28** is slidably fixed to the side edge portion **22***d* with screws **29** and **30** fitted into elongated slots **26** and **27** formed in the plate **28** in parallel to each other at an angle relative to the side edge of the adjusting plate **28**, and fixed to the side edge portion **22***d*. One end of the adjusting plate **28** is bent as shown in FIG. **2** to form a bifurcated projection **28***a* which is fitted into an annular groove **31**a formed at the leading end portion of an adjusting screw **31**. The adjusting screw **31** extends through the casing **32**, and is advanced into or retracted from the casing **32** by rotating a knob **33** fixed to the adjusting screw **31**. That is, when the adjusting screw **31** is retracted or moved outwardly of the casing **32**, the adjusting plate **28** is displaced toward the adjusting screw **31**. Since the elongated guide slots **26** and **27** are slantingly formed as described above, the width of the toner discharge opening **25** is varied.

A crank arm **35** is fixed to one end of a feed roller shaft **34** extending beyond the supporting arm **22***a*, and a conventional drive mechanism (not shown) is operatively coupled to pin **36** fixed to the free end of the crank arm **35** to oscillate it. For example, the oscillation mechanism is a rotary eccentric cam disk or oscil-

lating lever. Therefore, the crank **35** is oscillated between the positions **35** and **35A** indicated by the solid and dotted lines respectively in FIG. **2**, thereby rotating the feed roller **24** through the same angle.

A wire **37** is extended along the surface of the feed roller **24** adjacent to the toner discharge opening **25** between the supporting arms **22***a* and **22***b* of the toner hopper **22**, and has its both ends securely fixed to the supporting arms **22***a* and **22***b* with retaining plates **38** and **39** and screws **40** and **41**.

Next the mode of toner supply operation of the toner supply device with the above construction will be described. When the feed roller **24** is oscillated in the directions indicated by the arrows *c* and *d* in the manner described above, toner **21** in the hopper **22** is supplied into the developing vessel in an amount which is dependent upon the degree of opening of the toner discharge opening **25**. The toner attached to the feed roller **24** can be immediately removed therefrom by the wire **37** so that the toner can be supplied into the developing vessel before it is agglomerated.

A plurality of toner mixing bars **42** extending from the feed roller **24** are disposed in the hopper **22**, so that upon oscillation of the feed roller **24**, they are also oscillated in unison in the toner in the hopper **22** in the directions indicated by the arrows *e* and *f* in FIG. **3**. Therefore, the toner is prevented from being solidified or agglomerated or forming a large cavity above the feed roller **24** in the hopper **22**. The toner mixing bars **42** are disposed on the feed roller, preferably slanting toward the axis of the roller; so that the bars will stir up the toner in the hopper **22** uniformly. When it is not desired to provide such mixing bars **42**, the feed roller **24** is so arranged as to rotate only in the direction indicated by the arrow *c* in FIG. **3**.

Although the present invention has been described as being applied to a particular cascade developing device, it is understood that the present invention may be applied to the cascade developing device using a bucket belt or conveyor and to any other dry developing device such as fur brush, magnetic brush, impression, powder cloud or open chamber developing device.

I claim:

1. A toner supply device of an electrostatic photocopying apparatus comprising:

a toner supply hopper;

a rotary feed roller disposed along an elongated opening formed at the bottom of said toner supply hopper such that a slit-shaped toner discharge opening is defined by one of the side edges of said elongated opening and the surface of said feed roller to permit toner to drop therethrough;

a wire extended below said toner discharge opening along the surface and parallel to the axis of said feed roller;

a plurality of toner mixing bars arrayed on the surface of said feed roller and extending into said toner supply hopper through said elongated opening and of a length greater than the width of said discharge opening so as to confine their operation within the walls of said hopper; and

means for oscillating said feed roller to cause said mixing bars to agitate and feed toner through said discharge opening from said toner supply hopper and said wire to remove toner upon the surface of said feed roller.

2. A device as in claim **1** wherein said plurality of toner mixing bars are disposed on the feed roller slanting toward the axis thereof.

3. A device as in claim **1** further comprising bracket means fixed on said toner supply hopper at the opposite ends of said elongated opening for supporting said wire along the surface of said feed roller.

4. A device as in claim **1** wherein said oscillating means comprises a crank connected at one end of said feed roller.

5. A device as in claim **1** wherein said one of the side edges of said elongated opening has an opening adjusting plate mounted thereon.

6. A device as in claim **1** wherein said opening adjusting plate is slidably mounted on the side edge by means comprising screws fitted into elongated slots formed in the plate in parallel to each other at an angle relative to the side edge of said adjusting plate.

7. A device as in claim **6** further comprising means at one end of said opening adjusting plate for selectively sliding said plate along said elongated opening.

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