

[54] TONER LEVEL DETECTOR ASSEMBLY INCLUDING MAGNETICALLY RESPONSIVE SWITCH ACTUATED BY DIFFERENTIAL LOADED BLADE TYPE ROTOR CARRYING MAGNETIC ACTUATOR

[75] Inventor: Kiyoshi Sugawara, Ebina, Japan
[73] Assignee: Rank Xerox, Ltd., London, England
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[58] Field of Search..... 200/61.2, 61.21, 84 C, 200/85 R; 222/DIG. 1, 52, 56, 64, 66, 67, 342; 335/205-207

[56] **References Cited**

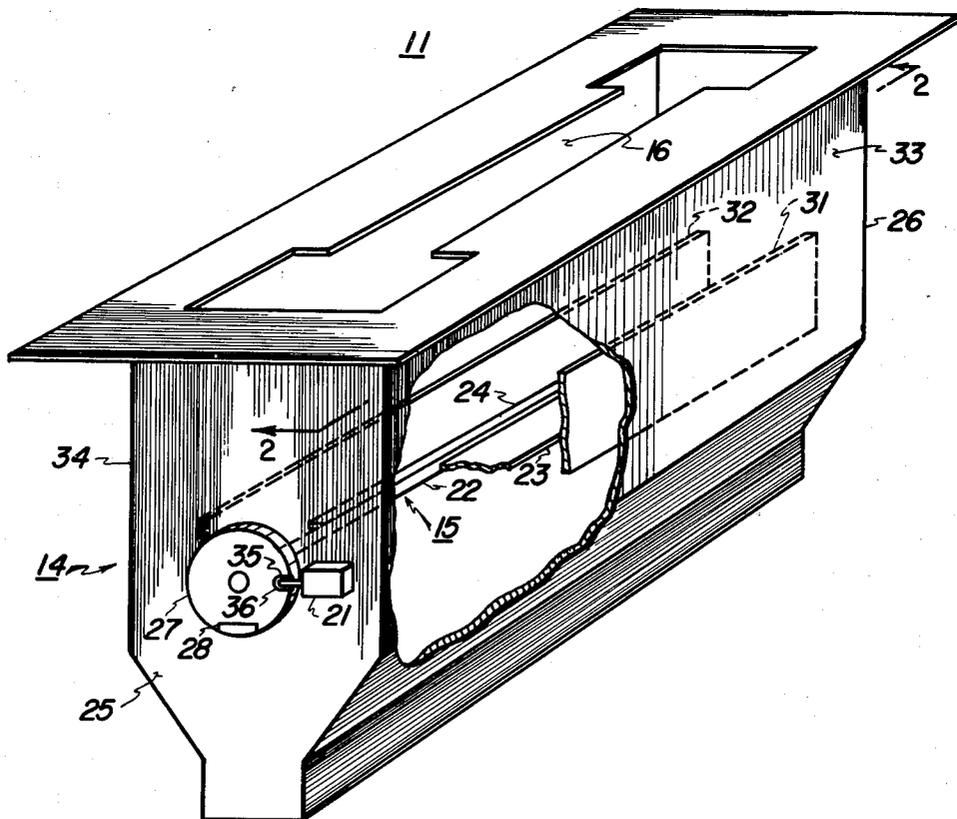
UNITED STATES PATENTS

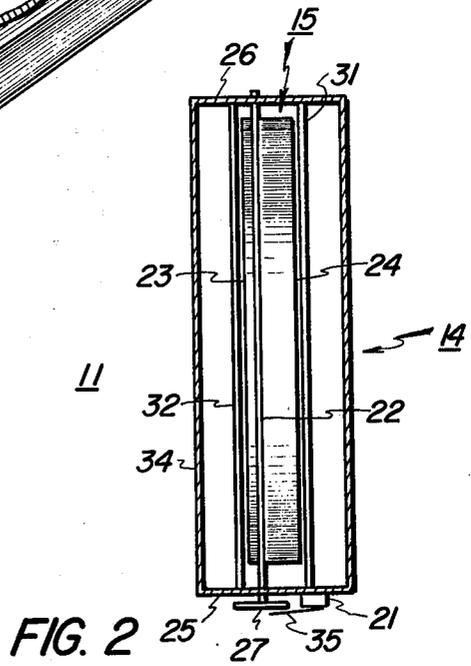
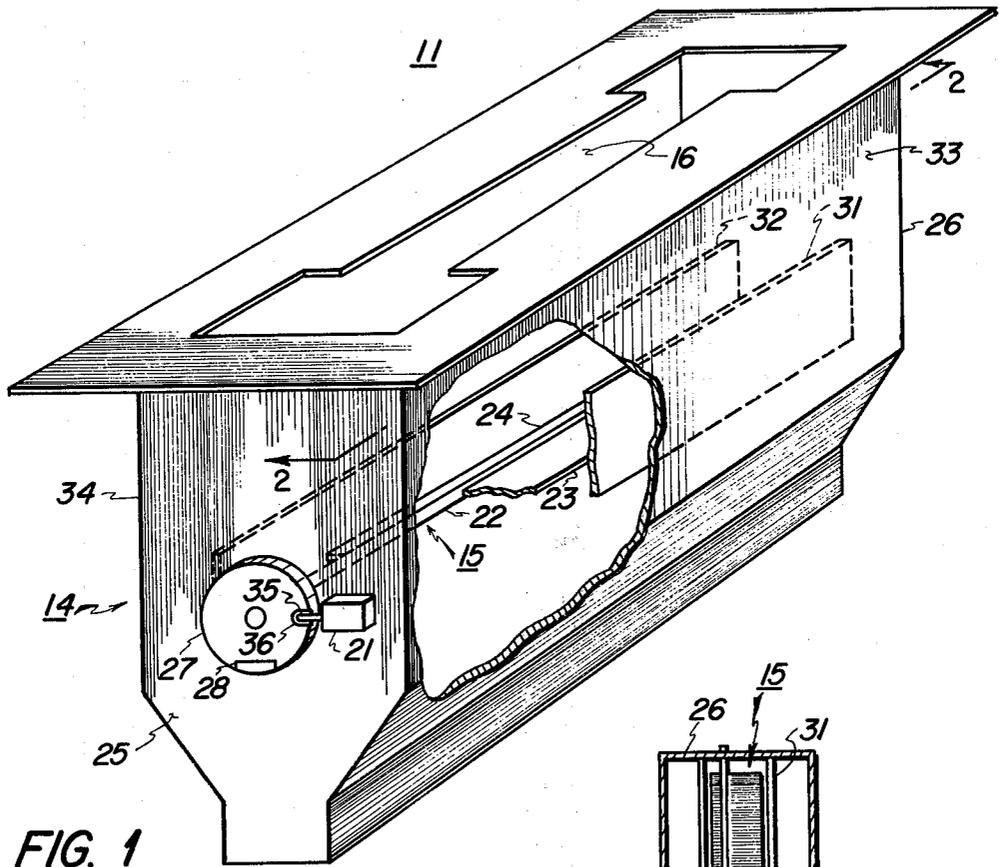
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Primary Examiner—James R. Scott

[57] **ABSTRACT**
A detector for providing an operator of an electrostatic copier with an early warning of impending exhaustion of the supply of toner in the reservoir of a toner dispenser comprises a rotor with a plurality of blades of significantly different surface areas in the reservoir for activating a switch when the supply of toner drops below a predetermined level so that a suitable indicator is then activated to provide the warning.

5 Claims, 8 Drawing Figures





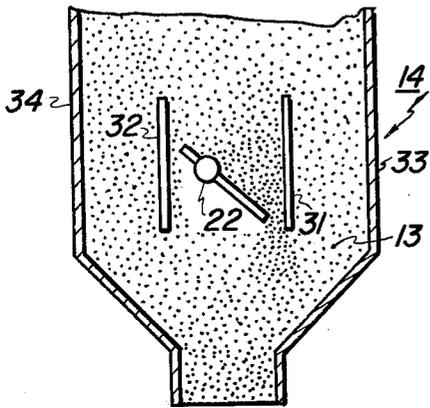


FIG. 3a

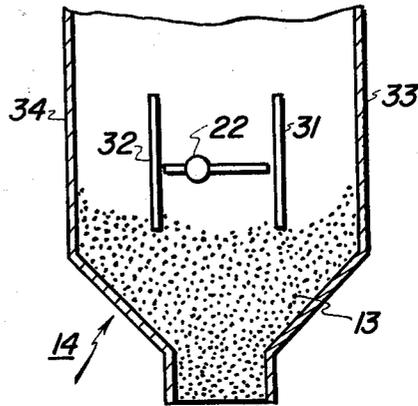


FIG. 4a

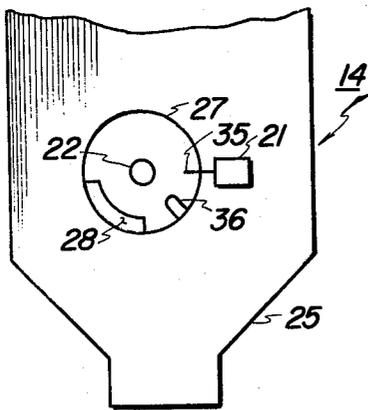


FIG. 3b

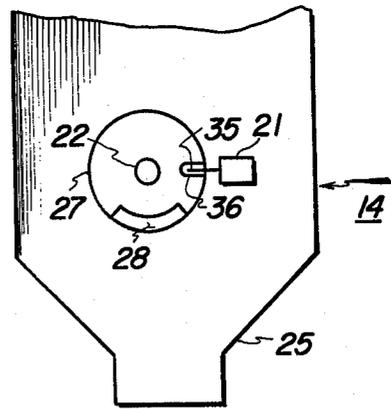


FIG. 4b

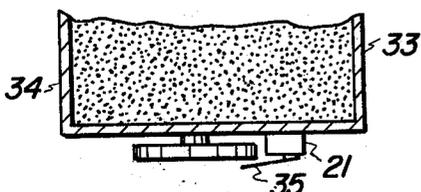


FIG. 3c

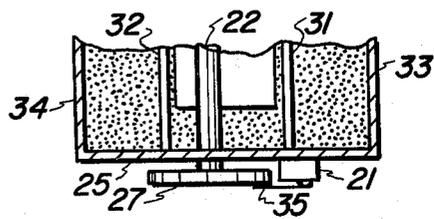


FIG. 4c

**TONER LEVEL DETECTOR ASSEMBLY
INCLUDING MAGNETICALLY RESPONSIVE
SWITCH ACTUATED BY DIFFERENTIAL LOADED
BLADE TYPE ROTOR CARRYING MAGNETIC
ACTUATOR**

BACKGROUND OF THE INVENTION

This invention relates to toner dispensers for electrostatographic copiers and duplicators and, more particularly, to detectors for warning a machine operator of impending exhaustion of the toner supply.

Conventional electrostatographic copiers and duplicators (hereinafter jointly referred to as copiers) use an electroscopic "toner" to develop the latent electrostatic image from which the copy is made. Toner is, therefore, necessarily consumed in the copying process, thereby depleting the toner supply. When the supply of toner finally nears exhaustion, there is a perceptible reduction in the density of the developed image and, therefore, a corresponding degradation of the copy quality. That is usually the first indication that the toner supply is in need of replenishment. A knowledgeable operator will, of course, add additional toner upon noticing that the density of the copied image has decreased, but several substandard copies may be made before that happens.

Accordingly, it has been recognized that an earlier warning of impending toner exhaustion would be desirable. One approach to solving that problem has been to use a transparent toner dispenser so that light emitted by a lamp at one side of the dispenser is visible at the other side when the toner supply drops below a predetermined level. Another proposal has been to provide an out of toner indication when the density of the developed image does not materially increase after repeated calls from an automatic development control system for additional toner. Still an additional suggestion has been to monitor the toner dispenser electronically to detect the change in dielectric coefficient which takes place when the gap between two spaced apart plates in the toner dispenser is occupied by air rather than by toner.

SUMMARY OF THE INVENTION

An object of this invention is to provide a reliable and economical detector, which drains little if any power when in a standby condition, but which still supplies an early warning of impending exhaustion of the toner in a toner dispenser.

To achieve that and other objects of the present invention, a rotor having diametrically opposed blades of significantly different surface areas is journaled in the reservoir of a toner dispenser and is biased so that the blades tend to assume a generally horizontal orientation. Because of their surface area differences, the blades are differentially loaded when the reservoir is full of toner and are, therefore, inclined under those circumstances. But, as the toner supply is depleted, the rotor rotates under the influence of the bias to actuate a switch when the supply of toner drops below a predetermined level, thereby activating an indicator to warn the operator of impending exhaustion of the toner supply.

BRIEF DESCRIPTION OF THE DRAWINGS

Still other objects and advantages of this invention will become apparent upon reading the following de-

tailed description in conjunction with the attached drawings, in which:

FIG. 1 is a perspective view, with certain parts broken away for clarity, of a toner dispenser including a toner level detector constructed in accordance with the present invention;

FIG. 2 is a sectional view of the toner dispenser taken along the line 2—2 in FIG. 1;

FIGS. 3a—3c are a series of fragmentary stop motion views showing the conditions of the rotor blades, switch actuator and switch, respectively, when the reservoir is full; and

FIGS. 4a—4c are additional fragmentary stop motion view showing the conditions of the rotor blades, switch actuator and switch, respectively, when the supply of toner drops below the level at which a warning of impending exhaustion of the toner supply is provided.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

While the invention is described in some detail hereinafter with specific reference to a single embodiment, it should be understood that there is no desire to limit it to that embodiment. On the contrary, the intent is to cover all modifications, alternatives and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

Turning now to the drawings, it will be seen that there is a toner dispenser 11 having a reservoir 14 for granular toner material 13. A detector 15 provides the operator with a warning whenever the supply of toner 13 in the reservoir 14 falls below a predetermined level, thereby encouraging the operator to replenish the toner supply before there is any perceptible change in the copy density. The additional toner 13 that may be needed from time-to-time is added through an opening 16 at the top of the reservoir 14.

In accordance with this invention, the detector 15 includes a switch 21 and a rotor 22 which rotates as the supply of toner 13 is depleted to actuate the switch 21 when the toner supply drops below a predetermined level. When the switch 21 is actuated, a suitable indicator, such as a lamp (not shown), is activated to thereby warn the operator of impending exhaustion of the toner supply.

More particularly, in the illustrated embodiment, the rotor 22 carries a pair of diametrically opposed blades 23 and 24 and is journaled in the opposite end walls 25 and 26 of the reservoir 14. One end of the rotor 22 is extended outwardly from the reservoir 14 and is connected to a disc 27 which is eccentrically weighted by a slug-like insert 28 so that the blades 23 and 24 are biased toward a horizontal orientation. However, the blades 23 and 24 have significantly different surface areas and are nested between a pair of substantially vertical baffles 31 and 32. As will be seen, the baffles 31 and 32 are supported by the ends 25 and 26 of the reservoir 14 in essentially parallel alignment with the forward and rearward sidewalls 33 and 34, respectively of the reservoir.

Due to the differences between their surface areas, the blades 23 and 24 are differentially loaded when the reservoir 14 contains a full supply of toner 13. Under these conditions, therefore, the blades 23 and 24 are inclined from the horizontal (FIG. 3a) despite the biasing affect of the weight 28. But, as the toner supply is depleted, the differential between the loads acting on

the two blades 23 and 24 decreases, with the result that the rotor 22 rotates under the influence of the weight 28 to bring the blades toward a horizontal orientation (FIG. 3b).

The switch 21 is mounted on the end wall 25 of the reservoir 14 (by means not shown) so that its actuator 35 is maintained in a fixed position to be tripped by an actuating element 36 on the disc 27 when the blades 23 and 24 reach the horizontal. As previously mentioned, a suitable indicator (not shown) is activated in response to the actuation of the switch 21 to provide the operator with a timely warning of impending exhaustion of the supply of toner 13.

As shown in FIGS. 3b, 3c, 4b and 4c, the switch 21 is suitably a magnetic proximity switch. In that event, a magnet is used as the actuating element 36 and the disc is otherwise formed from non-magnetic materials.

CONCLUSION

In view of the foregoing, it will now be understood that the present invention provides a relatively simple and reliable detector which may be advantageously utilized in the toner dispenser of an electrostatographic copier to warn the operator of impending exhaustion of the toner supply before there is any perceptible change in the density of the copied image.

What is claimed is:

1. In a toner dispenser having a reservoir for storing a supply of toner, a detector for sensing impending exhaustion of the toner supply; said detector comprising the combination of a rotor journaled in opposed ends of said reservoir with a plurality of blades of different surface areas extending therefrom to be differentially

loaded by toner when said supply is above a predetermined level, bias means for urging said rotor to rotate against said differential loading, actuating means mounted for rotation with said rotor along a predetermined path, a switch, and means for supporting said switch in a predetermined position relative to said path so that said switch is positioned to be actuated by said actuating means when said toner supply drops below said predetermined level.

2. The toner dispenser and detector of claim 1 further including a pair of baffles supported by said reservoir on opposite sides of said rotor for preventing toner for accumulating in the area of said reservoir immediately below said rotor in quantities sufficient to interfere with the rotation of said rotor.

3. The toner dispenser and detector of claim 1 wherein said bias means comprises a disc mounted for rotation with said rotor, said disc being eccentrically weighted to supply said bias for said rotor.

4. The toner dispenser and detector of claim 1 wherein there are only two blades on said rotor and said blades are diametrically opposed from one another.

5. The toner dispenser and detector of claim 4 wherein said switch is a magnetically responsive switch, said bias means comprises an eccentrically weighted disc of non-magnetic material mounted for rotation with said rotor, and said actuating means comprises a magnet carried by said disc for actuating said switch when the toner supply drops below said predetermined level.

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