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Sugawara

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[54] **TONER LEVEL DETECTOR**

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[52] **U.S. Cl.** **222/23;** 222/232

[51] **Int. Cl.²** **B67D 5/32;** G01F 11/00

[58] **Field of Search** ..... 222/56, 64, 65, 66, 23, 222/232, 196; 214/17 CA

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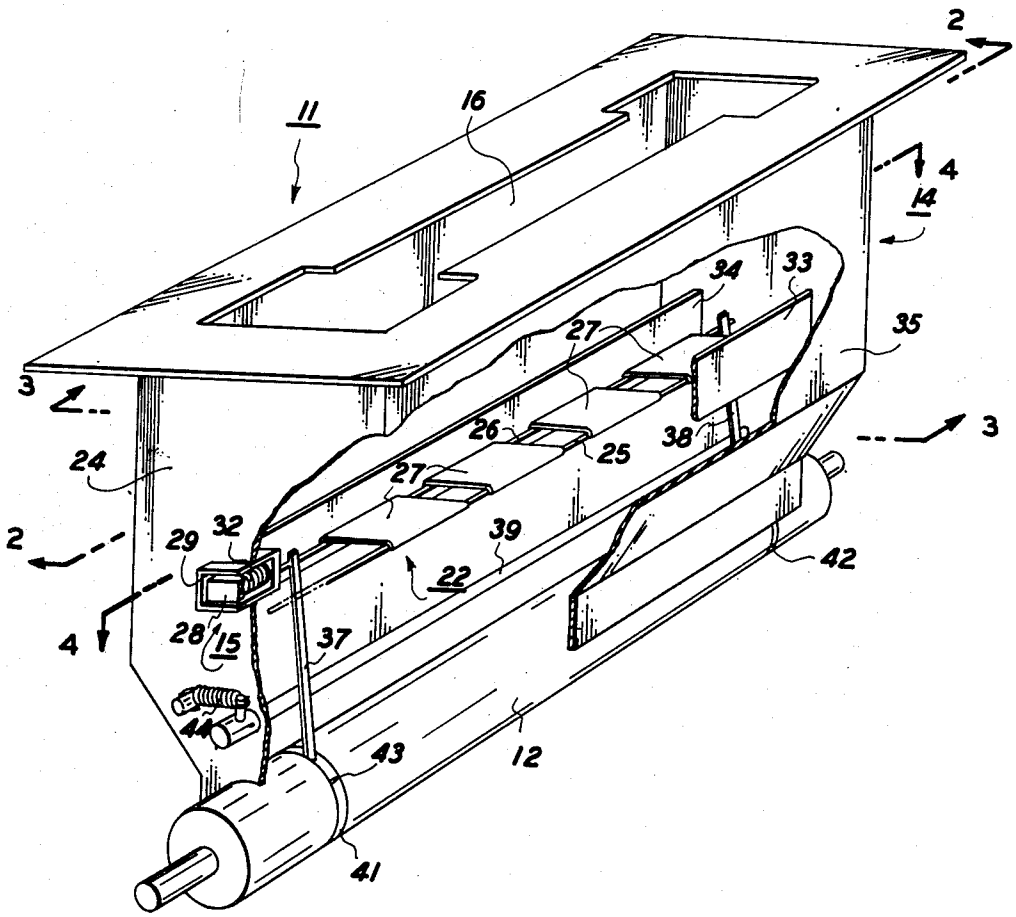
[57] **ABSTRACT**

A detector for providing an operator of an electrostatographic copier with an early warning of impending exhaustion of the supply of toner in the reservior of a toner dispenser comprises a flexible member bridged across the reservior for actuating a switch to, in turn, activate a suitable indicator when the supply of toner drops below a predetermined level.

9 Claims, 4 Drawing Figures



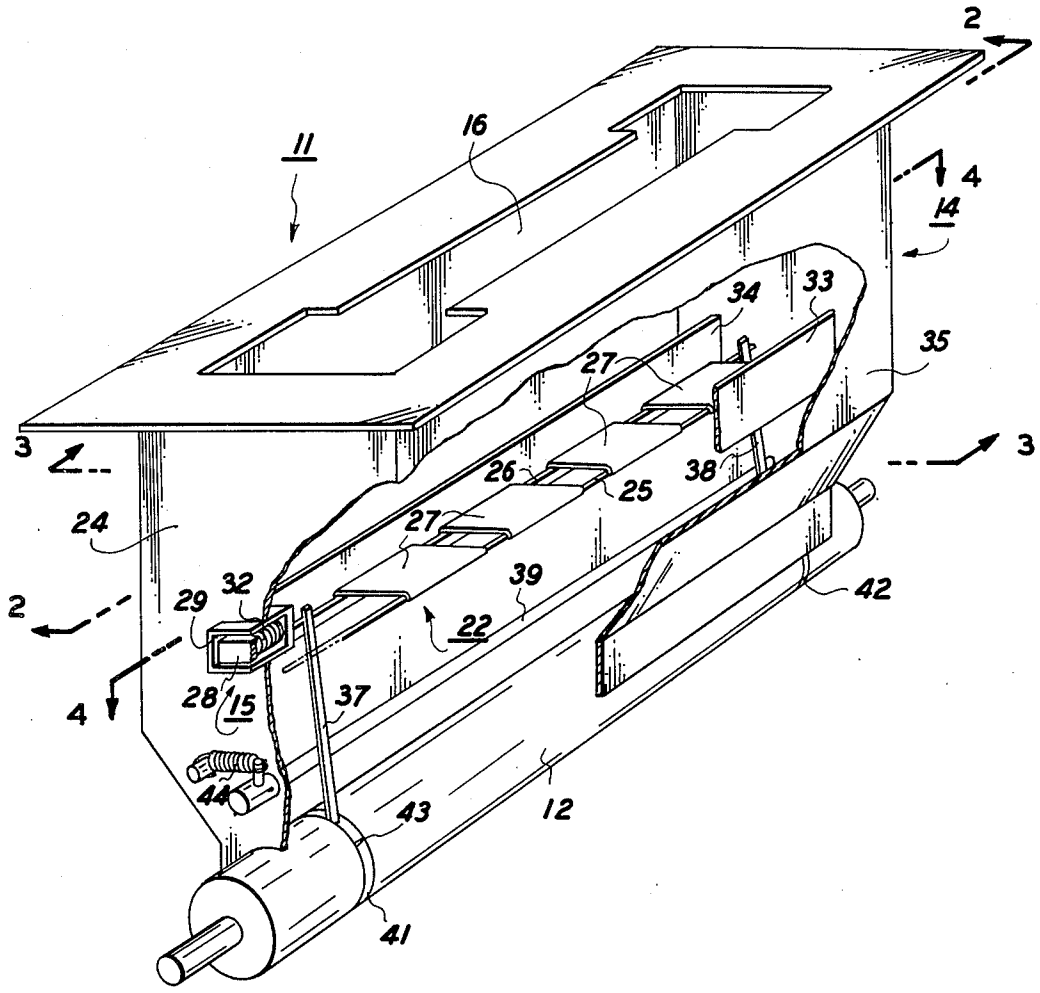

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FIG. 1

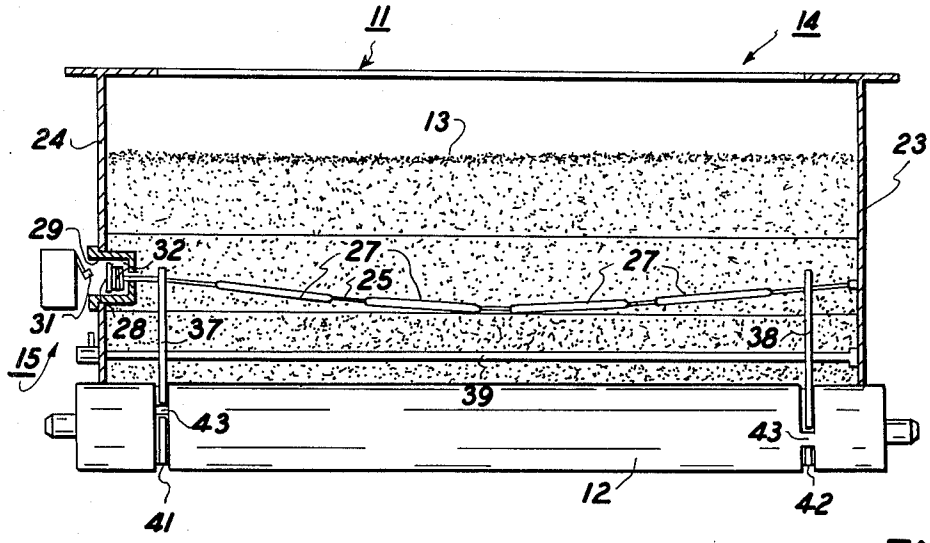

FIG. 2

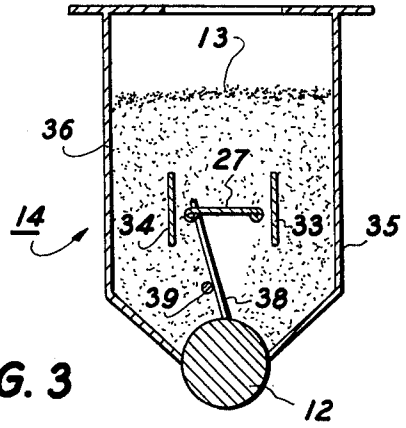

FIG. 3

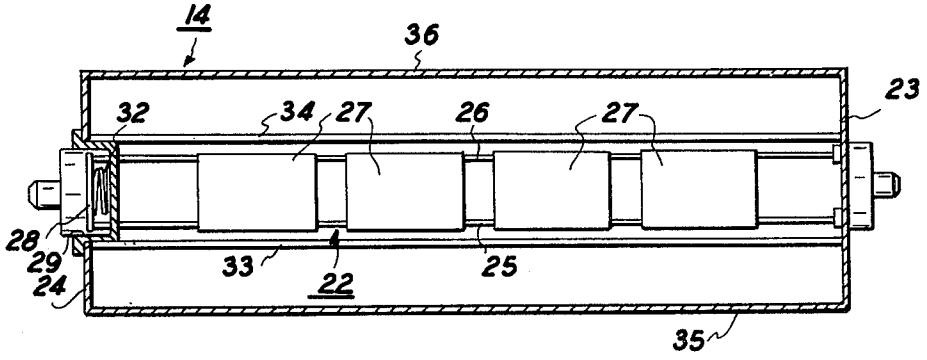

FIG. 4

TONER LEVEL DETECTOR

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 consummed 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 flexible member is bridged across the reservior of a toner dispenser so that it is gradually unloaded as the toner is consummed. When the toner level reaches a predetermined low level, the flexible member actuates a switch to thereby activate a suitable indicator, such as a lamp.

BRIEF DESCRIPTION OF THE DRAWINGS

Still other objects and advantages of this invention will become apparent upon reading the following detailed description in conjunction with the attached drawings, in which:

FIG. 1 is a fragmentary, perspective view of a toner dispenser including a toner level detector constructed in accordance with this invention;

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

FIG. 3 is another sectional view of the toner dispenser taken along the line 3—3 in FIG. 1; and

FIG. 4 is still another sectional view of the toner dispenser taken along the line 4—4 in FIG. 1.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

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 roll **12** which is rotatably driven (by means not shown) to discharge granular toner material **13** through a constricted opening at the bottom of a hopper-like reservior **14.** A detector **15** provides the operator with a warning whenever the supply of toner **13** in the reservior **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 that may be needed from time-to-time is added through an opening **16** at the top of the reservior **14.**

In accordance with this invention, the detector **15** includes a pressure responsive switch **21** and a flexible member **22** which is bridged between the opposite ends **23** and **24** of the reservior **14** to actuate the switch **21** when the supply of toner **13** in the reservior **14** drops below a predetermined level. A suitable indicator, such as a lamp (not shown), is activated when the switch **21** is actuated, thereby providing the operator with a warning of impending exhaustion of the toner supply.

More particularly, in the illustrated embodiment, the flexible member **21** comprises a pair of flexible rods **25** and **26** for supporting a plurality of generally horizontal plates **27** in spaced apart relationship between the opposite ends **23** and **24** of the reservior **14.** One end of each of the rods **25** and **26** is anchored to an end **23** of the reservior **14** and the other end of each of them is connected to a plunger **28,** which in turn, is guided in an outwardly opening cavity **29** at the opposite end **24** of the reservior **14.** The switch **21,** which is typically a microswitch, is mounted (by means not shown) adjacent the cavity **29** so that its actuator **31** is aligned with the plunger **28,** and the plunger **28** is biased toward the switch actuator **31** by a spring **32.**

In keeping with one of the more detailed aspects of this invention, the plates **27** are nested between a pair of substantially vertical baffles **33** and **34** which are held in generally parallel alignment with the forward and rearward sidewalls **35** andd **36,** respectively, of the reservior **14** by its end **23** and **24.** Thus, when toner **13** is initially loaded into the reservior **14,** or when the toner supply is replenished, some of the toner **13** comes to rest on the plates **27,** but most of the balance is deflected outwardly by the baffles **33** and **34** toward the forward and rearward sidewalls **35** and **36.** Accordingly, as shown in FIGS. **2** and **3,** the space directly beneath the plates **27** is relatively free of toner **13,** thereby enabling the rods **25** and **26** to flex downwardly into that space under the influence of the loading effect of the toner **13** on the plates **27.** Of course, the downward flexure of the rods **25** and **26** overcomes the bias supplied by the spring **32** to pull the plunger **28** away from the switch actuator **31.**

To maintain a flow of toner **13** through the reservior **14,** the rods **25** and **26** are vibrated from time-to-time during operation of the dispenser **11.** This feature of

the invention is carried out by providing a pair of rigid elastic fingers 37 and 38 for tapping the rod 25 so that toner 13 tends to spill off the plates 27 into the lower part of the reservior 14. The fingers 37 and 38 are secured to a shaft 39 and each of them has its upper end adjacent the rod 25 and its lower end riding in a respective one of a pair of annular grooves 41 and 42 in the dispenser roll 12. The shaft 39 is journalled in the ends 23 and 24 of the reservior 14, and each of the grooves 41 and 42 has one or more projections 43 for engaging the lower ends of the fingers 37 and 38. Consequently, as the dispenser roll 12 rotates in, say, a counter-clockwise direction (as viewed in FIG. 1), the shaft 39 tends to rotate in a clockwise direction. Connected between the reservior 14 and the shaft 39, however, there is a spring 44 which resists the rotation of the shaft 39 in that direction. Therefore, when the lower ends of the fingers 37 and 38 engage the projections 43, the shaft 39 initially rotates counter-clockwise to swing the upper ends of the fingers 37 and 38 away from the rod 25 and then snaps back in the other or clockwise direction to swing the upper ends of the fingers 37 and 38 against the rod 25.

As will be appreciated, the supply of toner 13 in the reservior 14 is gradually depleted in operation. Thus, the load on the plates 27 is gradually reduced, thereby permitting the rods 25 and 26 to slowly straighten. That, in turn, causes the plunger 29 to move toward the switch actuator 31 such that the plunger ultimately actuates the switch 21 when the toner supply 13 drops below a predetermined level. As previously mentioned, a suitable indicator (not shown) is activated at that point to warn the operator of impending exhaustion of the toner supply.

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 flexible member horizontally bridged between opposed ends of said reservoir to flex downwardly in response to loading thereof by said supply of toner, a pair of substantially vertical baffles disposed on opposite sides of said flexible member for maintaining a space below said member to accomodate downward flexure of said member when said member is loaded with toner, and a switch positioned to be actuated by said member when said supply of toner drops below a predetermined level.

2. The toner dispenser and detector of claim 1 wherein said flexible member comprises a plurality of substantially horizontal plates for supporting toner in an upper area of said reservior: and further including means for vibrating said plates from time-to-time to thereby maintain a flow of toner from said upper area to a lower area of said reservior as toner is discharged by said dispenser.

3. The toner dispenser and detector of claim 1 wherein said flexible member is flexed downwardly into said space under the weight of toner supported in an upper area of said reservoir: and further including means for maintaining a flow of toner from said upper area of said reservoir as toner is discharged by said dispenser.

4. The toner dispenser and detector of claim 3 wherein said flexible member comprises a plurality of substantially horizontal plates supported in spaced apart relationship between the opposed ends of said reservior, and said flow maintaining means includes means for vibrating said plates from time-to-time as toner is discharged by said dispenser.

5. The toner dispenser and detector of claim 1 wherein said flexible member comprises a plurality of generally horizontal plates and a flexible rod for supporting said plates in spaced apart relationship between the opposed ends of said reservoir.

6. The toner dispenser and detector of claim 2 further including a plunger, an outwardly opening cavity at one end of said reservior for guiding said plunger, and means for biasing said plunger away from said reservior; and wherein said switch is a pressure sensitive switch having an actuator aligned with said plunger, and said plunger is connected to one end of said rod, whereby said plunger ultimately engages the switch actuator as the level of toner in said reservior is reduced.

7. The toner dispenser and detector of claim 6 further including a rotatably driven roll for dispensing toner from said reservoir, said roll having an annular groove with at least one projection extending outwardly therefrom: and wherein said finger has one end riding in said groove, whereby said shaft is rotated first in said one direction and then released to rotate in the opposite direction as the end of said finger engages with and disengages from, respectively, said projection.

8. The toner dispenser and detector of claim 5 further including a shaft journalled in the opposed ends of said reservior, a finger secured to sadi shaft and extending therefrom into adjacent relationship with said rod, means for biasing said shaft against rotation in one direction, and means for rotating said shaft from time-to-time against said bias and for then releasing said shaft to rotate in the opposite direction so that said finger snaps back against said rod, whereby said rod and plates are vibrated from time-to-time to maintain a flow of toner from an upper area to a lower area of said reservior as toner is discharged by said dispenser.

9. The toner dispenser and detector of claim 8 further including a plunger, an outwardly opening cavity at one end of said reservoir for guiding said plunger, and means for biasing said plunger away from said reservoir; and wherein said switch is a pressure sensitive switch having an actuator aligned with said plunger, and said plunger is connected to one end of said rod, whereby said plunger ultimately engages the switch actuator as the level of toner in said reservoir is reduced.

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