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71 Applicant: **Hewlett-Packard Company**  
**Mail Stop 20 B-O,**  
**3000 Hanover Street**  
**Palo Alto,**  
**California 94304 (US)**

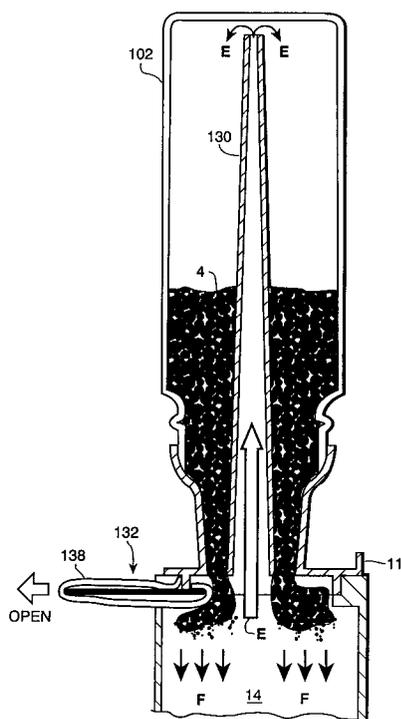
72 Inventor: **Clifton, George B.**  
**9997 W. Alliance Drive**

**Boise,**  
**Idaho 83704 (US)**  
Inventor: **Okamura, Mike H.**  
**11902 Alfred Street**  
**Boise,**  
**Idaho 83704 (US)**  
Inventor: **Lloyd, Michael B.**  
**5306 N. Noble Fir**  
**Boise,**  
**Idaho 83704 (US)**

74 Representative: **Schoppe, Fritz, Dipl.-Ing.**  
**Patentanwalt,**  
**Georg-Kalb-Strasse 9**  
**D-82049 Pullach (DE)**

54 **Dry toner refill system.**

57 In transferring dry toner from a dry toner refill container (102) to a storage hopper (14) in an electrophotographic machine (200), air displacement from the storage hopper into the refill container is used to facilitate the transfer of a refill charge (4) of dry toner from the refill container into the storage hopper. The system includes a cap apparatus (104) which permits refill of the container and substantially eliminates leakage of dry toner during the hopper refill process.



**FIG. 5**

**EP 0 663 628 A1**

## BACKGROUND OF THE INVENTION

### Field of the Invention

The present invention relates generally to electrophotographic technology, more particularly to dry toner electrophotographic hard copy apparatus, and, more specifically, to a system for refilling dry toner hoppers of such apparatus.

### Description of the Related Art

Electrophotography is an electrostatic image-forming process in which an optical signal generator (e.g. light, such as a laser beam, or other energy forms, such as x-rays, or gamma rays) form an electrostatic image on a photoconductive insulating medium. Generally, the charge image areas attract and hold a "toner." The powder image is then transferred to a print medium, such as paper, or fused there by heat.

One well-known example is the "xerographic" printing method in which a negative image is formed on an electrically charged plate then transferred and thermally fixed onto a paper as a positive. Computer laser printers also work using electrophotographic technology. Basic information regarding conventional techniques can be found in R.C.A. Vol. 15 (4), at p. 471 (1950) and IEEE Transactions on Electron Devices, Vol. Ed.-19, No. 4, pp. 396-412 (April 1972).

"Dry toner" is a fine, resinous powder (generally black, but also now used in color printers and copiers) used in electrophotographic imaging processes to make an image readable. The toner is either deposited directly on a coated paper or transferred from a charged surface to ordinary paper, then fused to the paper by heating, such as thermocompression bonding.

By its nature, the powdery toner is a difficult material to utilize. Dry toner has a tendency to agglomerate. If not properly handled, toner dust can settle within the apparatus and adversely affect component operation and overall apparatus performance.

In operation, toner is expended as hard copies are generated by the electrophotographic apparatus. Therefore, electrophotographic machines generally require a refill. While replacement of a substantially sealed toner cartridge alleviates the necessity of handling loose toner, such cartridges are expensive. Therefore, refillable toner storage hoppers are often provided in the hard copy machine by the original equipment manufacturer.

Referring to **FIGURE 1** (Prior Art), a simple dry toner refill bottle 2 is shown in a position to attempt to transfer toner 4 into a hard copy machine hopper 6 to add to the residual toner 8 from a prior

filled condition.

As the bottle 2 is inverted, and toner 4 shifts to block the nozzle 10 of the bottle 2, a vacuum region 12 is formed in the bottle 2. At the same time, in the empty volume containment chamber 14 of the hopper 6 above the residual toner 8 from a prior filling, the air starts to compress due to the exchange of dry toner 4 from the bottle 2 into the hopper 6. Generally, the compressed air will leak at the interface 16 of the bottle 2 and hopper 6 -- as depicted by arrows A -- and, due to the fine powdery nature of dry toner, result in an undesirable, spray-type "spill" of toner into the machine.

Such a spill of dry toner often requires service by a technician with expert knowledge. Besides the expense associated with service calls, there is added expense involved with the inability to use the machine while it is down, waiting for and receiving service.

Therefore, there is a need for owners of such machines to be able to refill toner hoppers without expert knowledge and skill. As refilling the hopper from a toner refill package or bottle is inherently awkward and messy, there is a need for an improved hopper refill system.

### Summary of the Invention

In its basic aspects, the present invention is useful for a hard copy apparatus, generally any type that includes a dry toner storage hopper, having a door providing an access for refilling said hopper. A dry toner refill system according to the present invention includes: a container for holding a refill charge of dry toner; a cap, affixed to said container, for selectively holding said dry toner charge within said container or selectively releasing said dry toner charge from said container into said storage hopper through said access for refilling said hopper; and a venting tube, connected to said cap, for allowing the displacement of air from said storage hopper into said container such that air displacement from said storage hopper into said container facilitates the transfer of dry toner from said container into said storage hopper.

It is an advantage of the present invention that it substantially eliminates the possibility of a toner spill.

It is another advantage of the present invention that it provides a free flow of toner from a refill container into an electrophotographic machine toner hopper.

It is yet another advantage of the present invention to promote complete transfer of toner from a container into a receiving hopper without having to perform excessive tapping or shaking of the bottle to affect the transfer.

Other objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description and the accompanying drawings, in which like reference designations represent like features throughout the FIGURES.

#### Brief Description of the Drawings

FIGURE 1 is a schematic drawing of the prior art.

FIGURE 2 is schematic, perspective drawing of the present invention.

FIGURE 3 is a schematic drawing of the present invention as shown in FIGURE 2 being attached to a hopper of a hard copy machine

FIGURE 4 is a schematic drawing of the present invention as shown in FIGURE 3, connected to the hard copy machine.

FIGURE 5 is a schematic, cross-sectional, plan view (side) depiction of the present invention as shown in FIGURE 2 in position to refill a hopper as shown in FIGURE 4.

The drawings referred to in this description should be understood as not being drawn to scale except if specifically noted.

#### Detailed Description of the Invention

Reference is made now in detail to a specific embodiment of the present invention, which illustrates the best mode presently contemplated by the inventor(s) for practicing the invention. Alternative embodiments are also briefly described as applicable.

Referring to **FIGURE 2**, a dry toner refill bottle 102, or other suitable containment vessel, itself refillable with dry toner is provided. The bottle 102 can contain a charge of dry toner suitable to fill or partially fill a dry toner hopper of a hard copy apparatus.

Provision of a refillable bottle 2 allows the machine operator to maintain a relatively large supply of dry toner at a location where a spill would not have any serious affects, such as an office store room, and so to be able to refill - arrow B - and cap the bottle safely.

A cap assembly 104 includes a bottle 102 receiving sleeve portion 106. A bottle receiving sleeve portion 106 of the cap assembly 104 is adapted at one end 108 to fit over and snap fit in a substantially sealing manner over the bottle spout aperture 10. It will be recognized to a person-skilled-in-the-art other connecting means, such as mating screw threads on the cap and bottle spout can be equally or more effective than a snap fitment. The important feature is that the fit be tight enough to prevent leakage of dry toner at the

interface between the bottle 102 and cap assembly 104 when engaged. Alternatively, the cap assembly 104 and the bottle 102 may be an integral unit with refill occurring through apertures 128 in the cap assembly as described hereinafter.

At the distal end 112 of the cap assembly 104 from the bottle fitment end 108 of the bottle 102, a hopper mating mechanism 114 is provided.

A hopper mounting member 116 is adapted to match the loading port of the particular hard copy machine with which the present invention is to be used. Referring briefly to FIGURE 3, an assemble version of the present invention is shown being connected to one hopper chamber access at hopper door 202. Obviously, many configurations of hopper chamber door shapes and sizes are possible and the mounting member designed accordingly. In the exemplary embodiment shown, the hopper mounting member 116 is a plate 116 that can be simply implemented in a design expedient to mate accordingly with the machine hopper access in order to form a substantially air tight seal between the mounting plate 116 and the hopper chamber door 202.

Referring back to FIGURE 2, in the present embodiment, the hopper mounting plate 116 is provided with at least one slot 118 for mating with an alignment pin 204 (FIG. 3) at the hopper chamber door. At its opposite end 120, the mounting plate 116 is provided with a protruding flange 122 that is designed to mate with a releasable securing clip 206 (FIG. 3) on the hard copy machine at the hopper access door 202.

A cap spout mechanism 124 is affixed to the hopper mounting plate 116 such that when placed into position to transfer dry toner from the bottle 102 into the hopper toner chamber, the cap spout mechanism 124 fits in an adjacent or abutting relation with the chamber door 202.

The cap spout mechanism 124 includes a first spout chamber portion 126 that further includes one or more nozzle apertures 128 in open communication with the bottle spout aperture 110.

The nozzle apertures 110 surround a fixed air displacement tube 130. The air displacement tube 130 is designed such that when the cap assembly 104 is affixed to the bottle 102 the tube 130 extends from the cap spout mechanism 124 to the lower most region of the bottle containment chamber (see e.g., FIG. 5.).

The cap spout mechanism 124 further includes a moveable door mechanism 132. In the present embodiment of FIGURE 2, a sliding door mechanism 132 is fit to the cap spout mechanism 124 by providing rails 134 to mate with a corresponding groove 136 on the cap spout mechanism 124. Again, the size, shape and movement mechanism of the door is adaptable to many variations depen-

dent on factors associated with the particular hard copy machine with which the refill system of the present invention is intended for use.

The cap door mechanism 132 is further provided with a means for sealing 138 the first spout chamber portion 126 in order to prevent leakage of toner before the system is engaged with the hopper access. In the present embodiment, a sheet of Mylar (trademark) is provided to seal the nozzles 128 and the air displacement tube 130 when the cap door mechanism 132 is shut (that is pushed in the opposite direction to the arrow labeled "OPEN" in FIGURE 2).

**FIGURES 3, 4 and 5** demonstrate the operation of the present invention.

In FIGURE 3, a hard copy machine 200 has one or more dry toner hoppers, for example one for each color toner used by the printing mechanism of the machine. Again, the present invention is easily adaptable to various configurations of hopper doors 202. To exemplify the operation of the present invention, the machine 200 is shown to have hopper doors 202 which are manually opened by sliding a lever 208 in the direction of the arrow labeled "C."

A filled refill bottle 102 with the cap spout mechanism 114 in place and the cap door mechanism 132 closed is aligned with a machine hopper. With the hopper door 202 closed, the assembled dry toner refill system is fixed into mating position by engaging the alignment pin 204 of the hopper using the slot 118 of the mounting plate 116. The system is rotated in the direction of arrow "D" to engage the mounting plate flange 122 with the releasable securing clip 206. Thus, the refill system is "locked" into a substantially air tight sealing relationship with the hopper.

Referring now to FIGURE 4, the lever 208 is pushed to open the hopper door 202. In the present embodiment, pushing the lever 208 engages and simultaneously opens the hopper door 202 and pushes the cap door mechanism 132 to its "OPEN" position as previously shown in FIGURE 2. The mechanism may be as simple having the hopper door 202 "peel" the Mylar sheath as shown in FIGURE 5. Alternative embodiments, such as leaf shutters, similarly should be configured to simultaneously open a correspondingly configured cap door mechanism.

Referring to FIGURE 5, once the hopper door and the cap door mechanism 132 are in their respective OPEN positions, dry toner 4 begins to fall -- as depicted by arrows labeled "F" -- into the hard copy machine's dry toner hopper containment chamber 14. As the powder falls, it displaces air in the chamber 14 from the chamber 14, through the air displacement tube 130, and into the interior of the dry toner bottle 102 as shown by arrows label-

led "E."

Thus, the venting of air from the hopper into the bottle cavity relatively behind, that is, being vacated by, the dry toner refill charge promotes the flow from the bottle cavity into the hopper chamber 14.

In order to prevent clogging of the tube 130, in the preferred embodiment the tube 130 is tapered from a wider diameter at the cap to a narrower diameter at the distal end. Air from the hopper chamber 14 is generally sufficient to dislodge any clog allowing it to blow into the container 102 or precipitate into the hopper chamber 14.

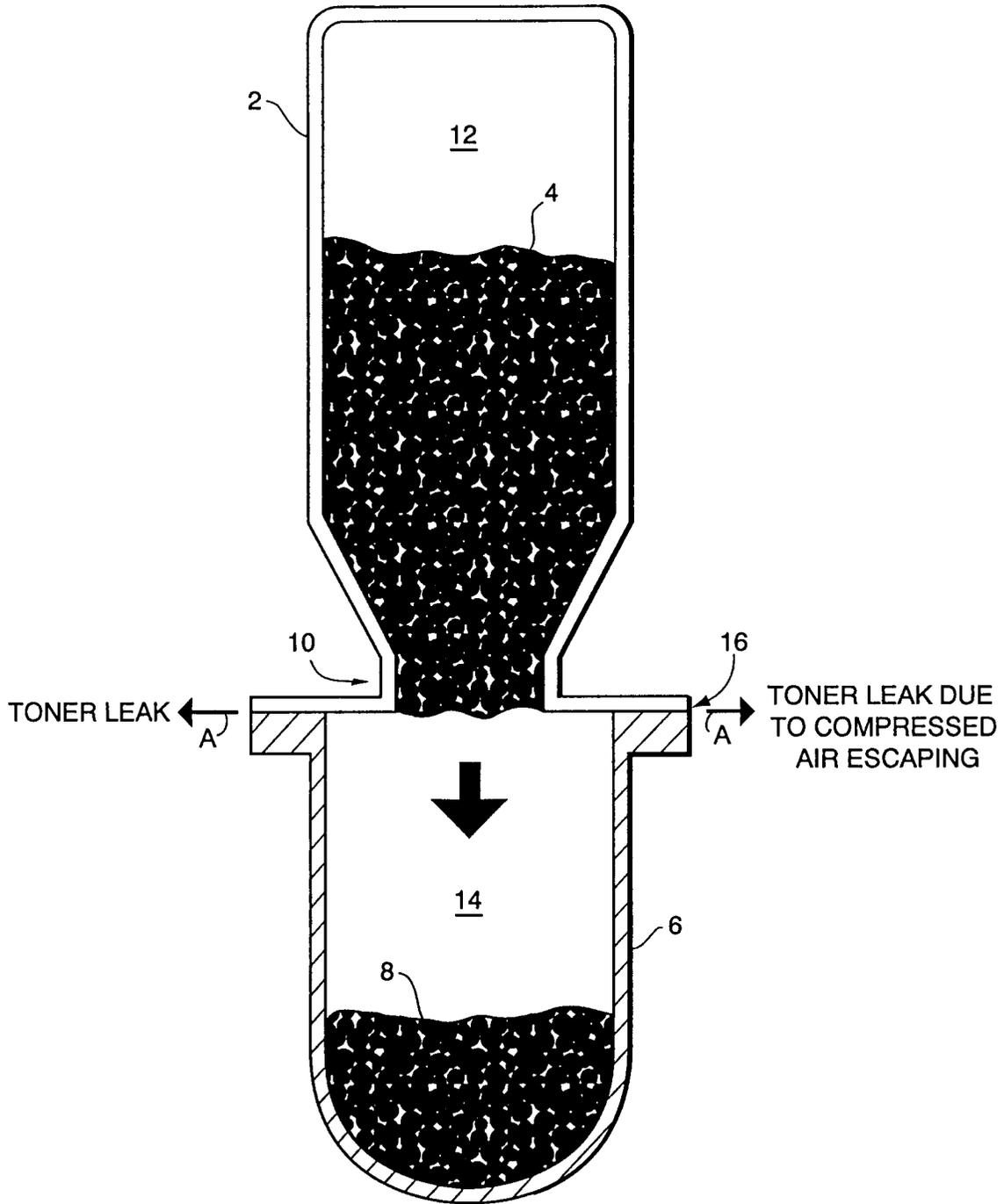
Once the dry toner charge 4 has been transferred, the process steps are reversed. With the doors closed before removal of the refill system from the machine, the possibility of a dry toner spill has been virtually eliminated.

The foregoing description of the preferred embodiment of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in this art. Similarly, any process steps described might be interchangeable with other steps in order to achieve the same result. The embodiment was chosen and described in order to best explain the principles of the invention and its best mode practical application to thereby enable others skilled in the art to understand the invention for various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

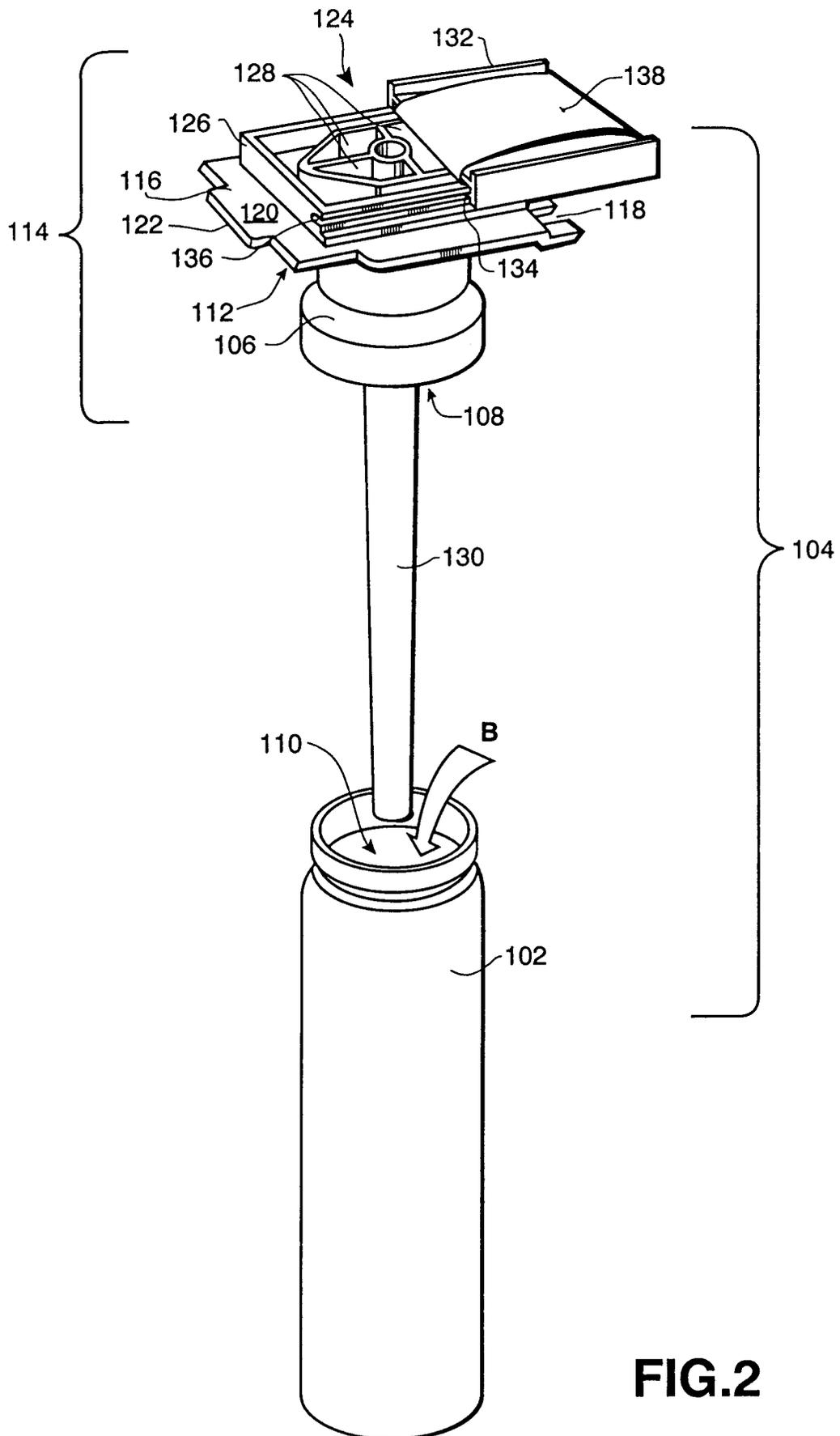
## Claims

1. In an hard copy apparatus (200), including a dry toner storage hopper (14), having a door (202) providing an access for refilling said hopper, a dry toner refill system comprising:
  - containing means (102) for holding a refill charge of dry toner (4);
  - capping means (104), affixed (106, 108) to said containing means, for selectively holding said dry toner charge within said containing means or selectively releasing said dry toner charge from said containing means into said storage hopper through said access for refilling said hopper; and
  - venting means (130), connected to said capping means, for allowing the displacement of air from said storage hopper into said containing means such that air displacement from said storage hopper into said containing means facilitates the transfer of dry toner from said

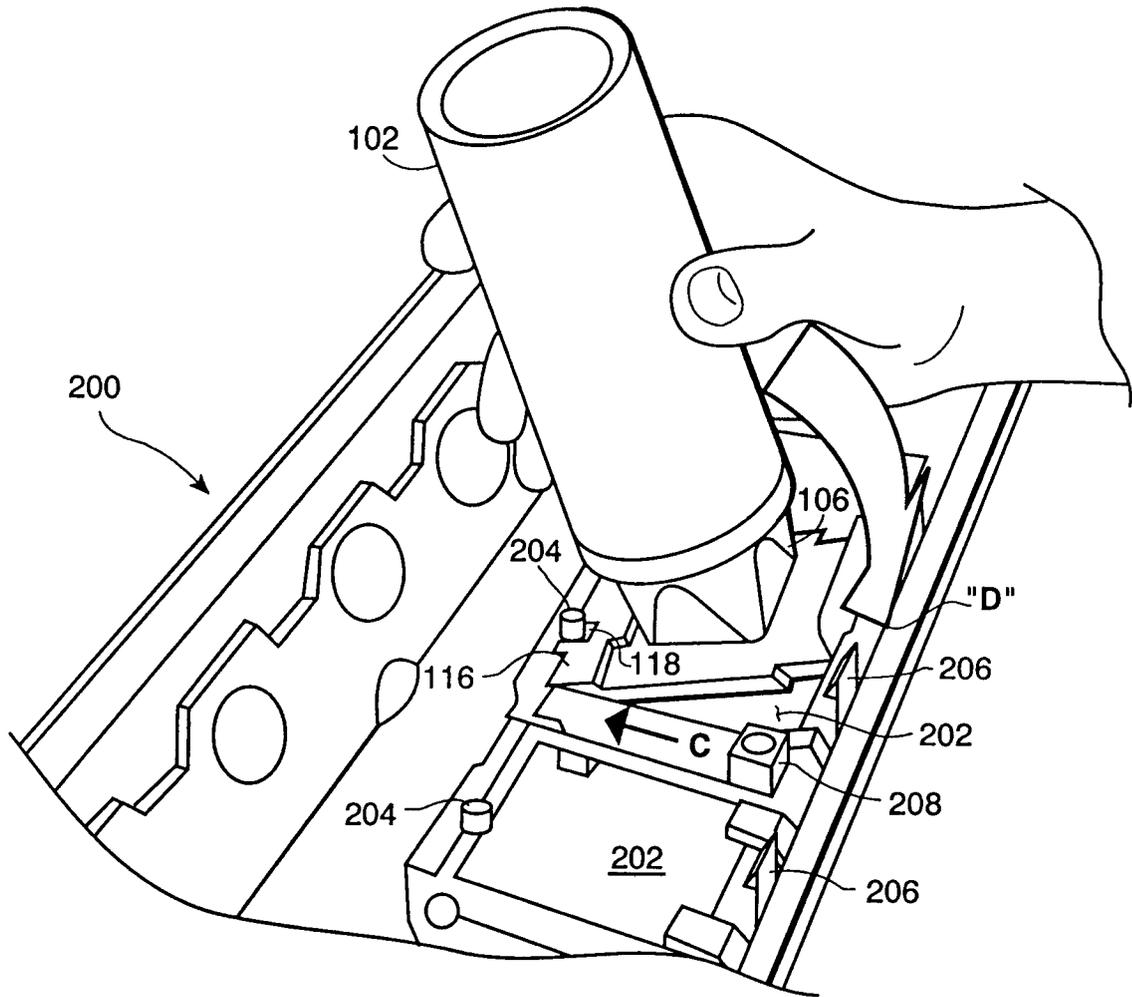
- containing means into said storage hopper.
2. The system as set forth in claim 1, wherein said capping means further comprising:
    - means (114) for substantially sealing said containing means to said storage hopper prior to selectively releasing said dry toner charge into said storage hopper.
  3. The system as set forth in claim 1, wherein said capping means further comprises:
    - connecting means (114) for selectively connecting said containing means to said storage hopper in a substantially sealed configuration.
  4. The device as set forth in claim 1, wherein said venting means further comprises:
    - an air displacement pipe (130) leading from said capping means at an end of the containing means proximate said capping means into said containment means to an end of the containing means distal said capping means when said device is in position to transfer dry toner from said containing means into said storage hopper.
  5. The system as set forth in claim 3, wherein said connecting means further comprises:
    - means for engaging said connecting means for opening said capping means to said door to selectively release said dry toner charge when said door is opened.
  6. The system as set forth in claim 1, wherein said capping means is affixed to said containing means with a releasable engaging means for removing said capping means from said containing means for refilling said containing means.
  7. The system as set forth in claim 4, wherein said air displacement pipe is tapered from a wider diameter cross-section at said capping means end to a narrower diameter cross-section at a distal end thereof.
  8. A dry toner refill system for a electrophotographic hard copy machine, having a toner hopper with an access having door with a hopper accessing device for selectively closing said hopper or providing access to said hopper, said system comprising:
    - a containment vessel (102) adapted to hold a charge of toner in a cavity of said vessel for partially or completely refilling said hopper;
    - a capping assembly (114) for said contain-
- ment vessel adapted to be affixed to said containment vessel, having
- a. a sleeve portion (106) adapted to mate with said containment vessel in a substantially air tight seal;
  - b. a mounting member (116) adapted to mate with said hopper access in a substantially air tight seal;
  - c. a cap chamber portion (126) having at least one aperture (128) therethrough open to said cavity and adapted to allow said charge to be released from said cavity;
  - d. an air displacement tube (130) adapted to allow air in said hopper to be vented into said cavity; and
  - e. a movable cap sealing member (132) adapted to selectively seal and open said containment vessel;
  - f. a means for connecting said movable cap sealing member to said hopper accessing device such that when said hopper accessing device is activated to allow access to said hopper said containment vessel cavity is substantially simultaneously opened to allow said charge to pass through said aperture.
9. The system as set forth in claim 9 wherein said means for connecting said movable cap sealing member to said hopper further comprises:
    - a Mylar sheathing means for being engaged with said hopper accessing device.
  10. The system as set forth in claim 9, wherein said air displacement pipe is tapered from a wider diameter cross-section at said capping means end to a narrower diameter cross-section at a distal end thereof.



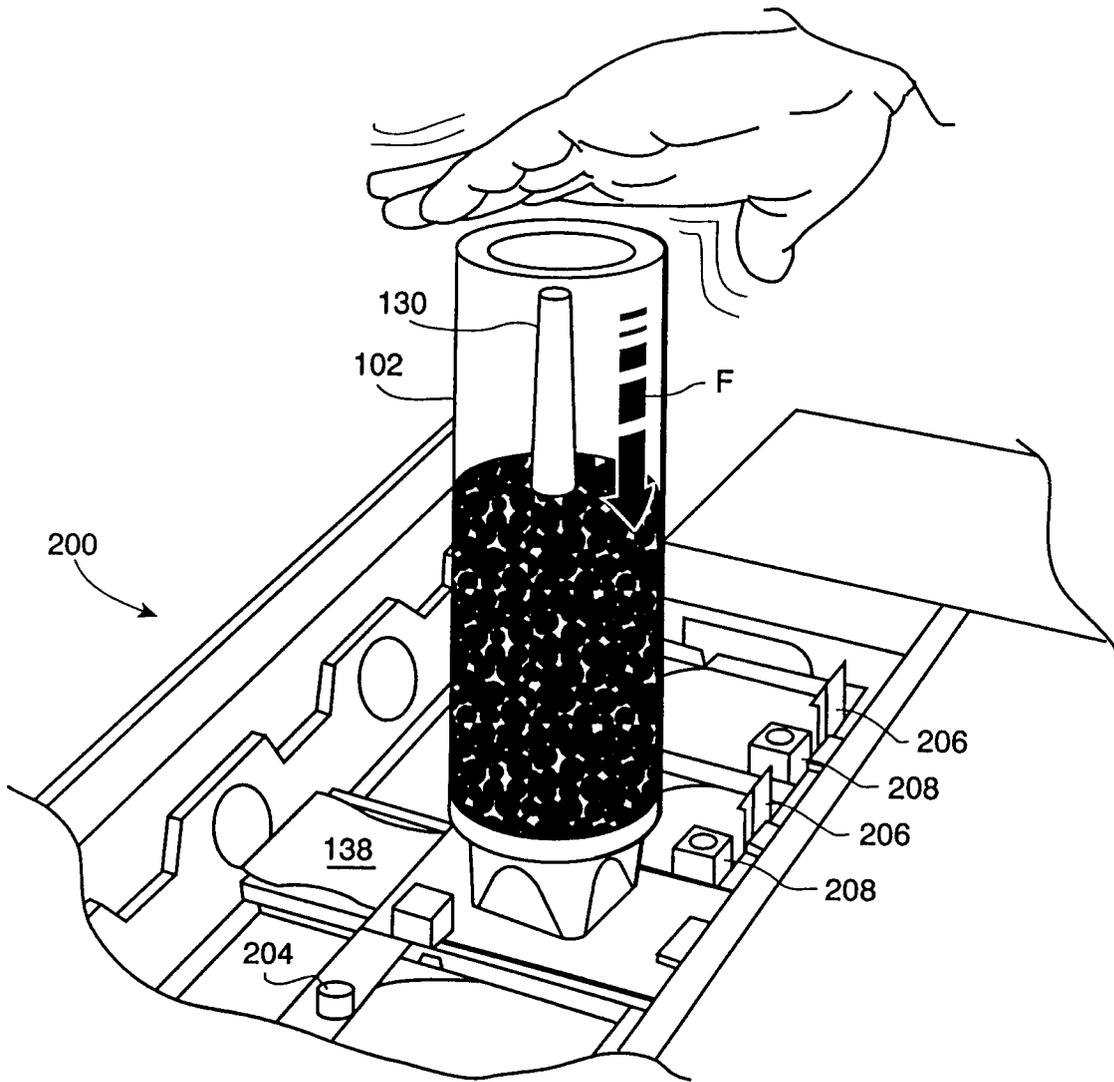
**FIG. 1 (PRIOR ART)**



**FIG.2**



**FIG. 3**



**FIG. 4**

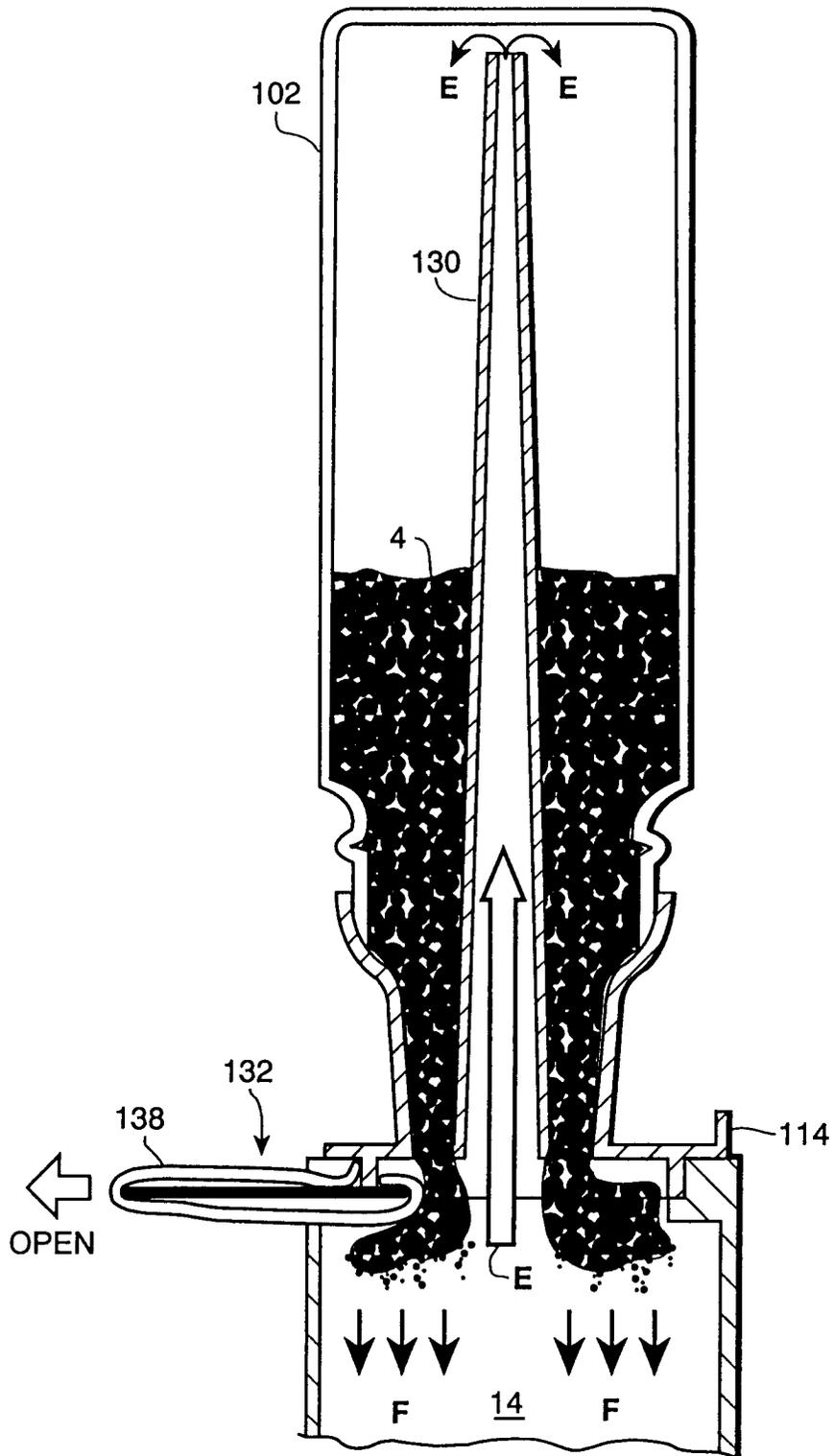


FIG. 5



European Patent  
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EUROPEAN SEARCH REPORT

Application Number  
EP 94 11 3320

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US-A-5 221 945 (SMITH MARK J) 22 June 1993 * column 2, line 46 - column 4, line 32; figures 1-2C * ---	1-6 8	G03G15/08
X Y	US-A-4 615 364 (KAWATA SHUN) 7 October 1986 * column 5, line 46 - column 6, line 68 * ---	1-3 8	
A	PATENT ABSTRACTS OF JAPAN vol. 016 no. 160 (P-1340) ,20 April 1992 & JP-A-04 009982 (MITA IND CO LTD) 14 January 1992, * abstract *	1,2,8	
A	PATENT ABSTRACTS OF JAPAN vol. 017 no. 432 (P-1589) ,10 August 1993 & JP-A-05 088541 (RICOH CO LTD) 9 April 1993, * abstract *	9	
The present search report has been drawn up for all claims			
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			G03G
Place of search		Date of completion of the search	Examiner
THE HAGUE		5 April 1995	Cigoj, P
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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