Sept. 1, 1970 B. H. JOHNSTON 3,526,341

POWDER DISPENSER AND CANISTER

Filed Sept. 20, 1967 2 Sheets-Sheet 1

Fig. 1

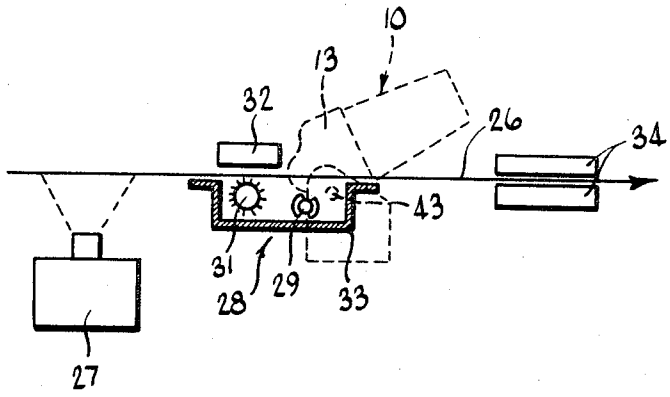
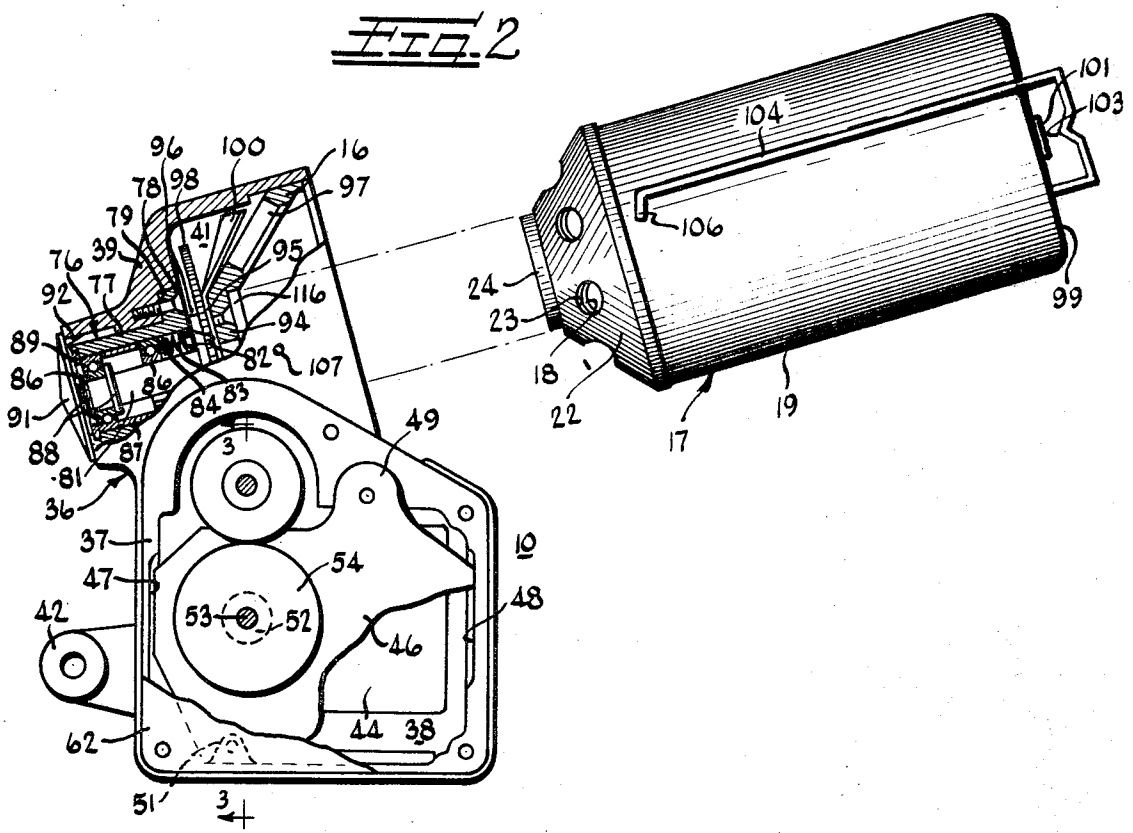


Fig. 2



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FIG. 3

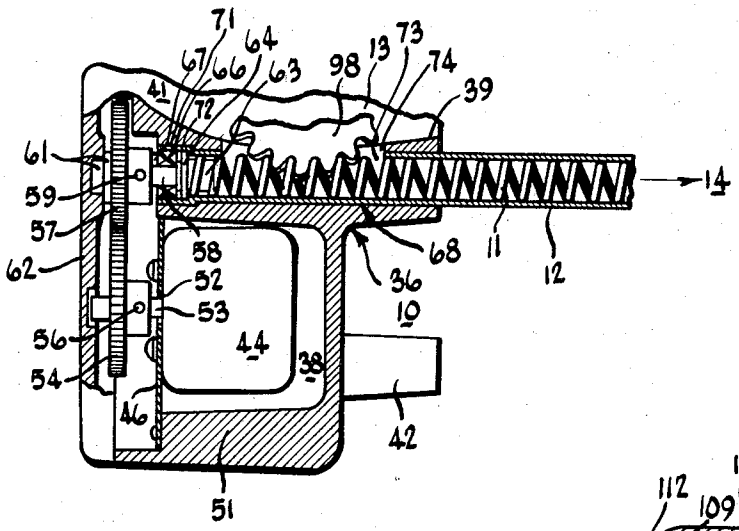
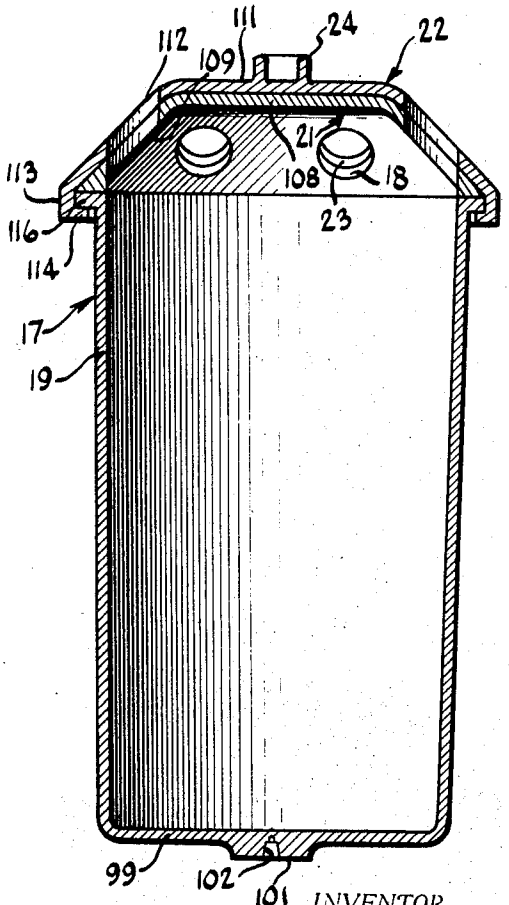


FIG. 4



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3,526,341

POWDER DISPENSER AND CANISTER

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U.S. Cl. 222—167 7 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus is described for dispensing very fine powder, such as toner for an electrostatic printer. The apparatus utilizes a powder canister removably held in a rotary support. The rotary support rotates the canister to cause powder to pass out of the canister through apertures at one end.

This invention relates to dispensing apparatus and, more particularly, to improved apparatus for dispensing very fine powder, such as toner for an electrostatic printer.

In certain types of machines, it is necessary to dispense regulated amounts of very fine powder from a storage reservoir to a station at which the powder is used in the machine. The handling of very fine powders is difficult because turbulence in the powder frequently generates a cloud causing powder to settle on surrounding machinery or operators. Turbulence may be necessary, however, since very fine powder must usually be stirred and agitated constantly in order to keep it moving. Forcing the powder, such as by a closed piston-like device, may cause the powder to pack into a solid mass.

One example of a type of machine in which very fine powder is utilized is the electrostatic printer. A latent image defined by an electrostatic charge on a sheet may be developed by spreading a very fine pigmented plastic powder, known as toner, over the surface of the sheet. The toner is electrically charged to adhere to the sheet in accordance with the latent image thereon. The excess powder is then removed from the sheet and the powder remaining on the sheet is heated to a point where it fuses to itself and to the sheet, becoming in appearance much like ink. In an electrostatic printer, dispensing apparatus may be utilized to dispense regulated amounts of toner from a storage reservoir to the device of the printer which spreads the toner on the sheet.

Because, as previously set forth, fine powder, such as toner, is difficult to handle, some problems may be encountered in the design of satisfactory dispensing apparatus. The fine powder in the storage reservoir may occasionally require replenishment. If the reservoir is filled by pouring or spooning the powder out of a container, a cloud of powder may be generated which splashes powder on the surrounding machinery and its operators. This can be excessively messy, and in many instances have a detrimental effect on the operation of the machinery and its porduct. Because many very fine powders pack easily into a solid mass, it is usually unsatisfactory to force the powder along its path of movement. As a result the maintenance of an accurately regulated flow of fine powder may be difficult to achieve. Where the powder is gravity fed from a hopper type device, the flow of the powder out of the device is frequently dependent upon the level of powder in the hopper. This may cause an undesirable variation in dispensing rates. Additionally, it is sometimes difficult to determine how much powder is remaining in a reservoir out of which it is being fed without taking off a cap or similar closure for the reservoir and subjecting the surrounding machinery and operators to a possible powder cloud problem.

It is an object of this invention to provide improved apparatus for dispensing very fine powder such as toner for an electorstatic printer.

A further object of the invention is to provide dispenser apparatus for very fine powder wherein the powder is handled easily and in a manner which minimizes the danger of powder splashing on surrounding objects or operators.

Still another object of the invention is to provide dispensing apparatus for very fine powders wherein a steady regulated output is provided which is not affected by the level of the powder in the reservoir.

A still further object of the invention is to provide dispensing apparatus for very fine powders wherein a ready indicia of powder level is provided.

Other objects of the invention will become apparent to those skilled in the art from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a schematic diagram illustrating an electrostatic printer which may utilize a toner dispenser constructed in accordance with the invention, the latter being indicated in dotted lines;

FIG. 2 is a side view, partially in section, and with parts broken away, of a toner dispenser constructed in accordance with the invention and illustrating a toner canister and retainer therefor in exploded relation;

FIG. 3 is a sectional view of the dispenser taken along the line 3—3 of FIG. 2; and

FIG. 4 is a full section view of the canister assembly rotated about 105° from the position shown in FIG. 2.

Very generally, the apparatus **10** of the invention includes means **11** and **12** (FIG. 3) for transporting powder from an intermediate station **13** to a dispensing station **14**, and means for depositing powder at the intermediate station from a canister. The depositing means (FIG. 2) comprise a holder **16** for removably receiving and supporting a canister **17** which contains powder and which has at least one opening **18** through which powder may pass when the canister is rotated. The holder is supported for rotation with respect to the transporting means and positions the canister so that the canister opening is adjacent the intermediate station when the canister is received in the holder. The holder is rotated to deposit powder from the canister at the intermediate station.

The invention utilizes an improved storage reservoir or canister for use with fine powder dispensing apparatus. The canister **17** (FIG. 4) comprises a body portion **19** including a wall **21** having a plurality of apertures **18** therein. A cap **22** is provided over the wall and has a plurality of apertures **23** therein corresponding in distribution to the apertures **18** in the wall **21**. The cap may be rotated with respect to the wall to operate as a shutter for aligning or misaligning the apertures and includes means **24** for mating in the rotary holder **16** of the dispensing apparatus to remain in fixed relation thereto. The wall **21** is fixed to the rest of the body portion **19** to be rotatable therewith so that relative rotation between the wall and the cap **22** may be effected by rotating the rest of the body portion with respect to the cap. This enables the shutters to be opened or closed a desired amount.

Referring now more particularly to FIG. 1, an electrostatic printer in which the invention is used is illustrated schematically. Paper coated with photo-resistive material upon which the printing is to be made is passed along a path represented by the line **26** in the direction indicated by the arrowhead, by using a suitable conveyor, not shown. The paper is charged to the required potential by means not illustrated. The paper is then carried into alignment with an image projector **27** and an image of the desired material to be printed is flashed on the surface of the charged paper. In accordance with known principles, the

impingement of light on the surface of a charged sheet of paper causes dissipation of the charge in general proportion to the amount of light striking the surface of the paper. Thus, dark areas in the flashed image will be represented by a stronger charge on the surface of the paper than light areas. A latent image is therefore formed on the surface of the paper corresponding to the strength of the static charge remaining thereon after the image flash.

After formation of a latent image on the charged paper, the paper passes into the developer **28**. The developer is supplied with toner from the toner dispenser **10**, which will be described in greater detail subsequently. The developer includes a rotary agitator **29** and a magnetized rotary brush **31**. The brush **31** operates to uniformly spread a very fine powder or toner on the charged surface of the paper sheet. The toner may be charged oppositely from the electrostatic charged image and clings to the charged areas generally in proportion to the amount of charge thereon. To insure that the toner does not cling to the uncharged areas on the sheet, a background charge grid **32** may be provided. A suitable blower or brushing device, not illustrated, may be provided to brush off the excess toner including that which does not cling to charged areas on the paper. The latent image on the paper is thus developed, being defined by the dispersion of the toner remaining on the paper.

The developer **28** includes a trough **33** in which the toner dispenser **10** deposits the toner. The trough also contains iron particles. Rotary action of the agitator **29** thoroughly mixes the toner and iron particles, and the iron and toner particles are triboelectrically charged to opposite polarities. The toner particles then cling to the iron particles. Rotary action of the cylinder **31**, which is magnetized, picks up the iron particles and forms a brush, which is lightly stroked across the surface of the paper and develops the latent image as described above.

To fix the toner onto the sheet, the sheet is passed through a heater **34**. The toner comprises in part a suitable resin which causes the pigment to fuse to itself and to the paper. The result is similar to ink on a printed page. After passing through the heater, the paper may be fed to a suitable output facility, not shown.

As previously mentioned, very fine powder, such as the toner which is utilized in the electrostatic printer of FIG. 1, is very difficult to handle. This is because the clouds of powder are easily produced, causing settling of powder on adjacent items and persons. Additionally, the fine powder of the toner is readily compacted into a solid mass, and thereby must be kept stirred and agitated in order to keep it moving. Moreover, the flow characteristics of such fine powders add complications to design of equipment in attaining a uniform steady flow of such powder.

FIGS. 2 through 4 illustrate the toner dispenser **10** used to supply toner to the developer **28** of FIG. 1. The toner dispenser includes a cast housing **36** which has a lower portion **37** defining a generally rectangular chamber **38** and which has an upper portion **39** defining a cylindrical chamber **41** having sections of different diameters. The axis of the cylindrical chamber in the upper section of the housing is inclined at an angle of approximately 15° from the horizontal. A projection **42** on one side of the lower section of the housing provides means by which the toner dispenser may be mounted in the electrostatic printer. As will be explained, the toner is supplied to the developer through an opening in the developer housing (not shown). The opening is in the end of the trough **33** above the level of the iron-toner mixture therein and its location is indicated at **43** in FIG. 1. The powder passing therethrough falls into the mixture in the trough.

Power for operation of the toner dispenser **10** is provided by a motor **44** mounted in the rectangular chamber **38** defined by the lower section **37** of the housing **36**. The motor **44** is bolted on a motor mounting plate **46**. The two side edges of the motor mounting plate extend

into vertical slots **47** and **48** formed in opposite vertical interior surfaces of the lower chamber **38**. The upper edge of the motor mounting plate has a projection **49** thereon which extends into a corresponding recess in the upper wall of the lower chamber **38** and which is bolted to a vertical surface of the recess. The lower edge of the motor mounting plate fits against the floor of the lower chamber and is bolted to the end of a rib **51**. The rib **51** projects upwardly along the floor of the chamber and extends about three-quarters of the distance across the chamber from a side wall of the lower section, as may be seen best in FIG. 3.

The motor **44** drives a gear train which transfers torque from the motor to various elements of the dispenser subsequently described. A central opening **52** is provided in the motor mounting plate and a drive shaft **53** extends from the motor through this opening. A drive gear **54** is mounted on the drive shaft and is drivingly coupled thereto by a drive pin **56**. The drive gear is in engagement with a driven gear **57** which is drivingly secured to a worm shaft **58** by a drive pin **59**.

The worm shaft **58** rotates a worm coil **11** for directing the toner to the developer **28** as explained below. The worm shaft extends through the driven gear and one of its ends is journalled in a bushing **61**. The bushing **61** abuts the gear **57** and is supported in a recess formed in a housing cover **62**. The housing cover **62** is bolted to the rest of the lower section **37** of the housing **36** to close the lower chamber **38**. The worm shaft **58** has an annular member **63** which is fixed to and surrounds the shaft, and which is located on the opposite side of the gear **57** from the bushing. A flange **64** extends outwardly of the member **63** and a bearing **66** is positioned between the flange and a snap ring **67** secured to the shaft **58**. A worm tube passage **68** is formed in the lower portion of the housing and a worm tube **12** is disposed in the passage. The end of the worm tube **12** has a larger diameter portion **71** which mates in a corresponding enlarged portion **72** of the passage **68**. The bearing **66** permits the worm shaft to rotate with respect to the worm tube in response to the rotation of the driven gear.

The worm tube **12** projects beyond the housing and extends into the opening **43** in the trough **33** (FIG. 1). The worm coil **11** is supported on the annular member **63** and is rotated therewith by the worm shaft. The worm coil may be attached to the member **63** such as by soldering. The outer diameter of the worm coil is slightly less than the inner diameter of the worm tube and, as the worm coil is rotated, it transports or pushes toner along the tube, carrying it from the intermediate station **13** to the dispensing station **14** which is at the opening **43** (FIG. 1) in the trough **33** of the developer **28**. The toner will therefore fall into the developer trough. The upper side of the worm tube near the end thereof toward the driven gear **57** is provided with an elongated opening **73** which is at the intermediate station **13** and through which the worm tube receives toner. The opening **73** communicates with the upper chamber **41** through a passage **74** provided in the housing and communicating between the upper chamber and the worm tube opening **73**.

As mentioned before, the upper chamber **41** is cylindrical and of stepped diameters. The smaller end of the chamber **41** contains a shaft assembly **76** for rotating the canister holder **16**, described in greater detail below. The shaft assembly **76** includes a shaft housing **77** having an outwardly turned flange **78** at one end which is bolted against a face **79** between two of the stepped diameter portions of the chamber. The shaft housing extends from the flange and terminates at the small end of the upper chamber. A shaft seal **82** is positioned between the shaft housing and a holder drive shaft **81** at the flanged end of the shaft housing. A coil spring **83** surrounds the holder drive shaft and biases a washer **84** which surrounds the shaft in a direction away from the seal **82**. A pair of bearings **86**, separated by a spacer **87**, also surround the

shaft. One of the bearings abuts the spring-biased washer **84**, whereas the other bearing is held in fixed position on the shaft by means of a pair of retaining rings **88**. A further retaining ring **89** is disposed in an annular recess in the shaft housing at the opposite end from the flange **78** and engages one of the bearings to retain the bearing arrangement against the bias of the spring.

A plug button **91** is held in place by resilient projections **92** which extend into the annular space **93** between the upper section **39** of the housing and the shaft housing **77** contained therein. The plug button serves to close off the smaller end of the upper chamber **41**.

The holder drive shaft **81** supports the canister holder **16** for rotation. The canister holder is of generally frustoconical configuration, having a disc portion **94** partially closing the smaller end. The disc portion is bolted to a disc **96** fixed on the holder drive shaft. A plurality of openings **97** are distributed about the frustoconical holder **16** and permit toner to pass therethrough into the upper chamber **41**. The toner falls from the upper chamber through the passage **74** and the slot **73** into the worm tube **12**.

Motive power for rotating the holder drive shaft **81** and canister holder **16** is taken off the worm coil **11** by means of a sprocket **98**. The sprocket is mounted on the holder drive shaft **81** between the disc portion **94** of the holder and the disc **96** on the shaft. The teeth of the sprocket engage the worm coil through the passage **74** and the slot **73** and, since the worm coil and worm shaft are being positively driven by the motor, the sprocket will turn therewith to turn the holder drive shaft and the canister holder.

As previously mentioned, the nature of very fine powders and, in particular, toner for electrostatic printers, is such as to require constant agitation in order to effect a smooth and steady flow. In order to maintain agitation of the toner in the upper chamber, an agitator is provided. The agitator consists of a disc-like portion **95** mounted on the holder drive shaft between the canister holder and the sprocket, and a plurality of agitator blades **100** which extend from the disc-like portion. The agitator blades are twisted slightly and terminate close to the walls of the upper chamber in order to scrape any powder which may adhere to the walls. The agitator rotates with the holder drive shaft and the canister holder and sprocket.

The construction of the toner dispenser thus far described effects a smooth and continuous flow of toner passing through the openings in the canister holder, through the worm tube to the developer. The rotary holder permits a powder containing canister to be inserted therein, and rotates the canister such that toner will fall therefrom through the openings in the canister holder. Upon depletion of the toner in the canister, the open construction of the canister holder permits ready replacement of the empty canister with a full one.

The canister **17**, which may be used in the previously described dispenser, is illustrated in FIGS. 2 and 4. The canister includes a body or jar **19**, preferably made of some clear substance such as polystyrene in order that the level of toner therein may be readily observed by an operator. The jar is generally cylindrical in shape, but has a slight taper along its axis to facilitate emptying of the jar. One end of the jar is closed by a wall **99** which may be molded integral with the rest of the jar. A projection **101** is provided in the wall **99** and has a conical notch **102** therein. This notch accommodates a V-shaped projection **103** in a generally U-shaped spring retainer **104**. The two ends **106** (only one of which is visible in the drawings) of the retainer fit into two holes **107** (only one of which is visible in the drawings) on opposite sides of the upper portion **39** of the housing **36**, permitting the jar to rotate with respect to the housing, but holding it in the rotating holder, as will be explained in more detail below.

The end of the jar **19** opposite the wall **99** is closed by the front end wall **21**. The front end wall has a disc-shaped portion **108** and a frustoconical portion **109** joining the disc-shaped portion to the forward edge of the jar. The front end wall may be attached to the edge of the jar by suitable means such as threads, a snap, or glue. In any case, such attachment should fix the front end wall **21** to the rest of the jar **19** so that the front end wall will turn with the jar.

The frustoconical portion **109** of the front end wall **21** is provided with the plurality of apertures **18** distributed thereabout. The apertures **18** are distributed in identical manner to the distribution of openings **97** around the frustoconical holder **16**. Accordingly, the apertures **18** in the front end wall **21** of the canister **17** may be aligned with the openings **97** in the holder **16** to permit toner to pass out of the canister and into the upper chamber **41** in the upper portion **39** of the housing **36**.

In handling toner and other fine powders, as mentioned before, clouds of the toner may be produced relatively easily. It is therefore desirable that the canister **17** be kept closed until the last possible moment before use. The canister **17** may be kept closed until actually positioned for operation in the dispenser **10**, and particularly, until received in the holder **16**. Possibility of splashing of powder on surrounding equipment and operators is thereby eliminated.

To effect closure of the canister until it is positioned for operation, the closure cap **22** is secured over the front end wall **21**. The closure cap conforms in shape to that of the front end wall and the holder **16**, and includes a disc portion **111**, and a frustoconical portion **112** extending outwardly thereof. The outer periphery of the frustoconical portion of the closure cap includes a ring extension **113** with an inwardly turned lip **114**. This lip snaps over the periphery of the end wall **21**, engaging an outwardly turned flange **116** on the jar **19**. This secures the closure cap in place, but permits the closure cap **22** to turn with respect to the front end wall **21**. The closure cap is provided with the plurality of apertures **23** distributed around the frustoconical portion thereof in the same pattern as the apertures **18** in the end wall **21** and the openings **97** in the holder **16**. Accordingly, the closure cap acts as a shutter for opening and closing the apertures in the end wall.

With the apertures **23** in the closure cap **22** misaligned with the apertures **18** in the end wall **21** to an extent such that there is no overlap, the canister **17** is completely closed and powder cannot escape therefrom. After the canister is inserted in the holder **16**, the operator may grip the jar **19** and turn it to cause relative rotation between the closure cap and the end wall and thus bring the two sets of apertures therein into a desired degree of alignment. By regulating the degree of alignment, the flow of powder from the canister may be regulated.

In order for powder to flow from the canister through the openings in the holder, it is, of course, necessary that the apertures in the closure cap be aligned with the openings in the end wall. To accomplish this alignment, the end cap is provided with the elongated ridge or projection **24** extending outwardly from the disc portion thereof. A corresponding recess **116** is provided in the holder **16** and, when the canister **17** is placed in the holder, the elongated projection mates in the recess and prevents the closure cap from turning with respect to the holder. The orientation of the projection and the recess is such that the apertures in the end cap are aligned with the openings in the holder. With the apertures in the end wall misaligned, however, powder will not flow out of the canister as explained above. It is thereby necessary for the operator to turn the jar to bring the apertures in the end wall into at least partial alignment with the apertures in the closure cap. This done, the motor may be started and the dispenser operated.

The canister may be constructed of low cost plastic, such as polystyrene, such that it may be disposed of when empty. Messy refilling operations thereby are unnecessary, as the canisters may be filled directly at the supplier's factory and the user need not expose himself to the undesirable task of handling toner in an open environment. The canisters, however, may be constructed to be refillable if desired, since the canisters may be filled either through the apertures in the end wall and closure cap, or may be filled by removing the closure cap and end wall therefrom. It has been found that this type of canister construction, when utilized in accordance with the dispenser of the invention, effects a smooth and continuous regulated flow of toner to the developer. Clogging and packing of the powder is avoided and, as previously mentioned, there is no possibility of clouding or splashing of toner since the canisters remain unopened until positioned for operation.

It may therefore be seen that the invention provides improved apparatus for dispensing very fine powders, such as toner for an electrosatic printer. The dispensing apparatus of the invention is such that handling of the powder is easily accomplished, an indication of powder level is readily available since the jar may be transparent, and a steady output of powder is provided which is not affected by the level of the powder in the reservoir.

Various embodiments of the invention in addition to those shown and described herein will be apparent to persons skilled in the art from the foregoing description and accompanying drawings. Such other embodiments, and modifications thereof, are intended to fall within the scope of the appended claims.

What is claimed is:

1. Apparatus for dispensing very fine powder, including in combination, a housing, means for transporting powder from an intermediate station to a dispensing station, a holder for removably receiving a powder containing canister which has at least one opening therein for passing powder out of the canister when the canister is rotated, said holder comprising a receptacle adapted to mate with at least a portion of the canister, said receptacle being apertured to permit powder from the canister to flow therethrough, means supporting said holder for rotation with respect to said housing and being positioned to support said holder so that the canister opening is adjacent said intermediate station when the canister is received in said holder, and means for rotating said holder to deposit powder from the canister at the intermediate station.

2. Apparatus according to claim 1 wherein said receptacle includes means for holding a canister received therein in a fixed relationship with said receptacle.

3. Apparatus according to claim 2 including a powder-containing canister having one end with at least one opening therein, said one end being disposed in said receptacle and being positioned by said holding means with said opening substantially aligned with an aperture in said receptacle to permit powder to flow therethrough.

4. Apparatus according to claim 3 wherein said one end of said canister has means thereon for closing said opening therein to prevent escape of powder when said canister is not received in said receptacle.

5. Apparatus according to claim 4 wherein said closing means are operable to open said openings with said canister received in said receptacle.

6. Apparatus according to claim 4 wherein said one end of said canister comprises a wall having a plurality of first apertures therein, wherein said closing means comprise a cap having a plurality of second apertures therein corresponding in pattern to said first apertures, said cap being rotatable with respect to said wall to operate as a shutter for aligning or misaligning said first and second apertures.

7. Apparatus according to claim 6, wherein said cap mates in said receptacle in fixed relation thereto with said second apertures in said cap aligned with the apertures in said receptacle, and wherein said wall is fixed to the rest of said canister to be rotatable therewith, whereby relative rotation between said wall and said cap may be effected by rotating the rest of said canister with respect to said holder.

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U.S. Cl. X.R.

222—325, 333

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,526,341 Dated September 1, 1970

Inventor(s) Bevan H. Johnston

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, lines 3 and 4 - instead of "assignor to Stromberg-Carlson Corporation, Rochester, N. Y.", read "assignor to Stromberg DatagraphiX, Inc., San Diego, California".

SIGNED AND SEALED NOV 17 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334