Sept. 21, 1971 W. D. PERUN 3,606,864

DONOR ASSEMBLY

Filed March 10, 1969

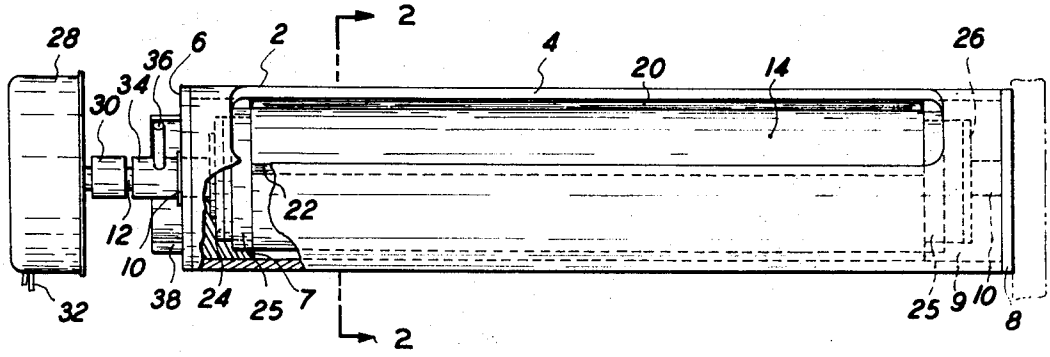


FIG. 1

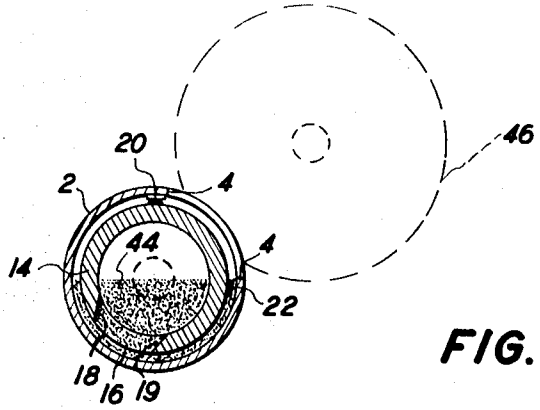


FIG. 2

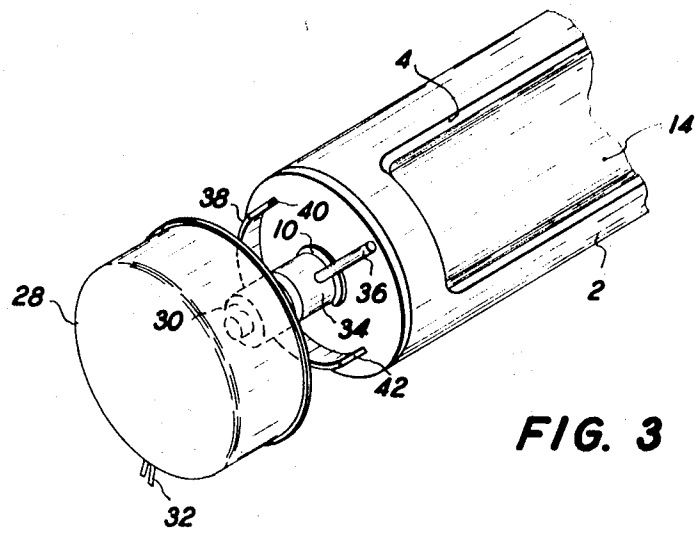


FIG. 3

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DONOR ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

An electroscopic marking particle supply and donor assembly having a cylindrical housing with an opening therein to make accessible to another member a crescentic tubular member enclosing a supply of developer material and which reciprocates inside the housing and about the axis thereof.

This invention relates, generally, to apparatus for supplying predetermined amounts of electroscopic marking particles and, specfically, to donor assemblies used to load electrostatic latent image developing apparatus.

The varied applications to which the principles of electrostatic recording have been directed have exacerbated the operational requirements of the developer assemblies used to make the recordings visible. One direct reason for this is the requirement of mobility placed on certain electrostatic recorders. Great mobility implies anything but a normal fixed orientation of the parts of the recorder. Gravity forces no longer can be considered effective from a single direction. Mobility also implies compactness, reliability, and a minimum of parts. Periodic maintenance preferably should also be expedited by the design of the recorder and the quality of its recordings cannot be compromised.

In addition, prior art developer assemblies have presented a problem of insufficient agitation of the developer material creating poor quality and inconsistencies in the developed recording.

Therefore, it is an object of the present invention to improve development of electrostatic charge patterns with electroscopic marking material.

It is another object of the present invention to provide an improved, low-cost, very compact developer donor assembly.

A still further object of the present invention is to provide an improved donor assembly which is easily maintained and self-agitating.

These objects and others not specifically mentioned will become more apparent when the following detailed description of the present invention is read in connection with the appended drawings wherein:

FIG. 1 is a front view of the present invention with some parts broken away along with a source of motive drive;

FIG. 2 is a cross-sectional view of the present invention as seen at section 2—2 in FIG. 1; and,

FIG. 3 is a perspective view of one end of the present invention showing one source of motive drive therefor.

Before reference is made to a detailed description of the drawings, a brief mention of the utility of the present invention may be helpful in better understanding its objects and features. In the art of electrostatics wherein it is desirable to render latent electrostatic charge patterns visible by the deposition thereon of electroscopic marking particles, it is necessary to convey such marking particles to the pattern. This conveyance can be accomplished by various apparatus with which the present invention is compatible and, for illustration, a natural fur applicator or brush will be considered. The triboelectric relationship between the applicator and the electroscopic marking particles, or toner as they are conventionally referred to, is

such that when placed in contact with each other the applicator attracts the toner. Movement of the brush thus loaded with toner across the electrostatic charge pattern results in this pattern attracting the toner from the applicator thereby developing or rendering the pattern visible. In order to make this development cycle efficiently repetitive at a high rate, it is necessary to conveniently and effectively load the applicator with toner in a manner to replenish those areas of the applicator from which toner has been removed by the attractive force of the charge pattern. The system which serves this function is called a donor assembly and it is this assembly to which the present invention relates.

Reference will now be made to FIGS. 1, 2, and 3 wherein like reference numerals refer to like elements. A cylindrical housing **2** forms the outer dimensions of the donor assembly in accordance with the present invention. This housing may be made of a non-metallic or insulative material and have any desirable dimension. In the outer surface of this housing there is located an opening or slot **4** the sides of which parallel to the axis of the housing subtend an angle of approximately 80 degrees. As shown, the housing **2** has two end plates **6** and **8** which are fixed respectively to two plug members **7** and **9**. A bearing **10** passes through the center of each end plate and plug member and is supported thereby.

On the inside of the housing **2** there is mounted for rotation concentrically with the axis thereof a crescentic member **14** which is best shown by its cross-sectional configuration illustrated in FIG. 2. This crescentic member **14** is tubular or cylindrical in form and has along its axial length a slot or opening **16** the edges **18** and **19** of which subtend an angle with its center of rotation, for example, of approximately sixty degrees. As shown in FIG. 2, the edges **18** and **19** of this opening **16** are bevelled for purposes which will be seen more clearly hereinafter. The crescentic member **14** has an exterior diameter less than the interior diameter of the housing **2** and may be comprised of a conductive sleeve having an insulative coated exterior. This member **14** has attached to its ends terminal members **24** and **26**, the former being mechanically coupled to a shaft **12** which passes through and cooperates with bearing **10** to translate a rotative force to the member **14**. The other terminal member **26** is attached to a shaft (not shown) which passes through and cooperates with bearing **10** to permit the crescentic member **14** to rotate freely within housing **2**.

The bearings **10** are isolated from the volume defined by terminal members **24** and **26** and the interior surfaces of housing **2** by two O-ring seals **25** which may be of any suitable material such as polyurethane. These seals cooperate and mate with the plug members **7** and **9** to provide a bearing surface for the crescentic member **14** as it rotates.

The shaft **12** is attached to a source of motive power **28** via a mechanical coupling **30** of conventional design. The motor **28** may be a permanent magnet synchronous type or an inductor alternating current type. As an example only, a Haydon General Times Series MP20 inductor A.C. 4 r.p.m. motor has been utilized successfully. Input leads **32** may be used to provide suitable electrical power to the motor **28**.

As shown best in FIGS. 1 and 3, fixed to shaft **12** is a collar **34** having a pin **36** extending radially therefrom relative to the shaft **12**. The pin **36** has an axial dimension sufficient to contact stop member **38** at two stopping surfaces **40** and **42** as the shaft **12** is rotated in either direction.

The stop member **38** and the pin **36** cooperate to control the motor **28** to operate in a reciprocating or reversing mode. The types of motors hereinabove specified can be made to mechanically oscillate when their "no-back" sys-

tem is removed. This system is generally composed of a step "no-back" gear on the rotor running against a special tooth-formed idler gear. This combination permits free rotation in the desired direction but prevents motion in the reverse direction. If this "no-back" system is omitted, the motor can start and operate in either direction if it is supplied with two mechanical stops. These stops are provided by the surfaces **40** and **42** of stop member **38**. In operation what occurs is the motor will proceed in one direction until pin **36** abuts one of the stop surfaces. The motor will momentarily stall and reverse its direction of movement in the opposite direction until it reaches the other stop surface. This cycle is repeated creating a reciprocating drive force on the shaft **12** and ultimately the crescentic member **14**.

From FIGS. 2 and 3 is can be realized that the stop surfaces are so positioned relative to each other and the slot **4** in housing **2** to control the ultimate position of leading edge of the crescentic member **14**. Therefore, for example, as pin **36** approaches stop surface **42**, edge **18** approaches seal **20** as the upper limit on its movement toward opening **4**. The stop surfaces are established relative to these edges **18** and **19** to insure that neither edge will be moved past either seal **20** or **22**.

As best shown in FIG. 2, the donor assembly of the present invention may be filled to approximately half of its volume or completely filled with a conventional developer which may be a suitable mixture of carrier material and toner. As shown, the developer **44** generally fills the volume created inside the cylindrical housing **2** by the crescentic member **14**. Some of the developer material succeeds in filling the space between the outer surface of the crescentic member **14** and the interior surface of the cylindrical housing **2**. As the crescentic member **14** is made to rotate through a specific angle, such as 180 degrees for the stop surfaces as shown, the developer material is agitated with the bevelled edges **18** and **19**, the crescentic member can move more easily through the developer material thereby increasing the agitation thereof.

In describing the operation of the present invention, it is helpful to refer to the exterior or donative surface of the crescentic member **14** as being composed of a first and a second area. The first area begins at edge **18** and extends toward edge **19** while the second area begins at edge **19** and extends toward edge **18**. Each of these areas overlap each other since the extent of each from its respective edge is that arc of the cross-section of member **14** equal to the angle through which member **14** is rotated in one cycle.

Assuming that the crescentic member **14** is in an initial position as depicted in the drawings, when the motor **28** is energized member **14** will be rotated in either of two directions. If this direction is such as to move the crescentic member **14** in a counterclockwise direction as FIG. 2 is viewed, then the first area of member **14** is moved through and enveloped by the developer material **44** while the second area is moved across and positioned at opening **4** in housing **2**. The pin **36** then abuts against stop surface **40** and the motor **28** reverses thereby rotating member **14** in a clockwise direction. This reversal withdraws the first area from the developer material **44** in the sump and moves it toward the opening **4**. Both during its immersion into and withdrawal from the sump, the first area triboelectrically attracted toner to it. Just as the first area is withdrawn from the developer, the second area is moved through the developer wherein toner is triboelectrically attracted to it. As the pin **36** continues to move toward stop surface **42**, the first area passes seal **20** which effectively meters the toner layer now adhering to the first area. As the toner ladened first area passes seal **20** it moves into contact with another toner conveyor **46**, which may be a developing applicator. As this contact continues, due to the rotation of the applicator **46** and crescentic member **14** toner may be transferred by triboelectric attraction from the first area to the applicator.

The transferred toner may then be utilized in any of several ways such as in rendering a latent electrostatic charge pattern visible.

When pin **36** strikes stop surface **42**, the cycle is complete and the motor reverses as hereinabove described. The next cycle will bring the first area back into the developer where it will be replenished with toner and the second area into contact with the applicator **46** at the opening **4** in housing **2**.

In order to insure consistent donation of toner to the applicator **46**, two seals **20** and **22** are provided which may be of polypropylene. As shown best in FIG. 2, each seal (**20** and **22**) is fixed to the interior surface of housing **2** and extends between seals **25** substantially parallel to each other and to the edges of opening **4** which are parallel to the axis of rotation of crescentic member **14**. The dimension of each seal (**20** and **22**) in a radial direction relative to this axis is such as to effectively allow only a predetermined substantially uniform layer of toner to pass into the donative zone formed by opening **4**. In addition, these seals also insure that no carrier material is allowed to pass into this zone which would be undesirable.

As can be seen from the foregoing description, the present invention has a compactness which permits mobility and efficiency in operation. When the toner supply is depleted, the housing **2** may be easily removed as a single unit and a fully toner-charged donor assembly installed.

While a preferred embodiment has been described, variations in mechanical structure are possible within the basic concept of the present invention. For example, while certain angles have been specified, other angles may be employed in designing the openings in housing **2**, or the crescentic member **14**, or the desired rotation of member **14**. In addition, although a specific drive system for crescentic member **14** has been detailed, other systems may also be suitable. For instance, an eccentric cam may be rotated to actuate a spring biassed rod coupled to the crescentic member **14** such that as the cam rotates the member **14** reciprocates through a predetermined angle. The crescentic member **14** has been described as being conductive with an insulating exterior coating. However, it is possible to use an insulative material entirely. While the crescentic member **14** is preferably a cylinder with a slot running its entire length, it may also take the form of the cylindrical housing **2**.

While a particular relationship between aperture **4** in housing **2** and the axis of housing **2** has been described, such an orientation may be varied without departing from the essence of the inventive concept. For example, the middle of opening **4** may be located at the position of seal **20** as FIG. 2 is now depicted.

Further, the advantages and features of the present invention would not be substantially compromised if the crescentic member **14** were rotated only in a single direction inside housing **2** instead of the previously described reciprocating action.

In addition, although the donor member **14** is shown having a slot therein, it is within the present inventive concept that another opening or series of openings of suitable configuration may be substituted for this slot as long as they permit the developer to pass from the volume defined by the donor member to the space between this member and the interior of housing **2**.

While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the true spirit and scope of the invention.

What is claimed is:

1. A powder dispensing apparatus comprising:

(a) a substantially cylindrical powder container having an elongated opening in its surface generally parallel to its longitudinal axis;

(b) a generally cylindrical dispenser housing having a

slightly larger diameter than said container positioned concentrically outside said container said housing also having an elongated slot in its surface generally parallel to its longitudinal axis;

(c) said container having an outer surface, comprising a material adapted to pick up and carry a thin layer of said powder; and,

(d) means to oscillate said container within said housing so that powder in the container is gradually dispensed from within it and carried on its outer surface to the opening in said housing without the openings in said container and housing coming into alignment with each other.

2. Apparatus as defined in claim 1 further including a powder applicator positioned outside said housing and supported in powder transfer relationship with the surface of said container through the slot in said housing.

3. A donor assembly for electroscopic marking particles comprising:

a housing member having a cylindrical surface equidistantly spaced from an axis and having an aperture therein defined by first and second edges substantially parallel to said axis;

a tubular member mounted for rotation within said housing member and having a surface substantially equidistantly spaced from said axis with a slot therein having third and fourth edges substantially parallel to said axis;

motive means for rotating said tubular member relative to said housing member in a first direction until a predetermined proximity between said first and third edges exist and in a second direction until a predetermined proximity exists between said second and fourth edges such that said aperture and said slot are prevented from becoming aligned; and

two seal means inside said housing and attached thereto, one of said seal means extending proximate to and along each of said first and second edges.

4. An assembly for making a layer of electroscopic marking particles available comprising:

a housing having a surface with an aperture therein;

a donor member having an outer surface subdivided into a first and second portion, said donor member mounted for relative motion inside said housing;

a supply of electroscopic marking particles in said housing;

motive means for alternately moving said first portion into said supply while moving said second portion to said aperture and moving said second portion into said supply while moving first portion to said aperture;

seaid donor member being tubular and having a crescentic cross-section and said supply at least partially filling the volume defined by said donor member; and

means provided inside said housing for decreasing the space between said housing and said outer surface proximate the side of said of said aperture transverse to the direction of movement of said donor member.

5. Developer apparatus comprising:

a housing having an opening therein;

a donor member storing developer internally thereof, said donor being supported in said housing for movement relative thereto and comprising an opening and an outer surface capable of carrying developer thereon;

means for moving said donor member whereby developer is dispensed through the opening therein and into said housing, with a subsequent movement of said outer surface into contact with said developer and into a position opposite the opening in said housing; and

a developer applicator positioned externally of said housing and supported for movement in developer transfer relationship with said surface.

6. Apparatus according to claim 5 wherein,

said outer surface is subdivided into first and second portions, and

said means for moving said surface comprises means for reciprocating said donor member whereby said portions are alternately moved into contact with said developer and then opposite the opening in said housing without overlapping of said openings.

7. Apparatus according to claim 5 including means for reducing the space between said housing and said outer surface proximate said opening in said housing.

8. Apparatus according to claim 5 wherein,

said housing comprises a cylindrical surface and said donor member has a tubular configuration, said housing and said donor member being concentrically supported and said housing having a slightly larger diameter than said donor member, and

wherein said opening in said donor member comprises an elongated slot delineated by a pair of beveled edges.

9. Apparatus according to claim 8 including, at least one seal means inside said housing and attached thereto and extending proximate to and coextensively with one of said beveled edges.

10. An assembly for making a layer of electroscopic marking particles available comprising:

a housing having a surface with an aperture therein;

a donor member having an outer surface subdivided into a first and second portion, said donor member mounted for relative motion inside said housing;

a supply of electroscopic marking particles in said housing;

motive means for alternately moving said first portion into contact with said supply while moving said second portion to said aperture and moving said second portion into contact with said supply while moving said first portion to said aperture; and

an applicator positioned externally of said housing and supported for movement in developer transfer relationship with said surface.

11. An assembly according to claim 10 wherein said donor member is tubular and has a crescentic cross-section and said supply at least partially fills the volume defined by said donor member.

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