United States Patent [19]

Fantuzzo

[11] **3,743,409**

[45] **July 3, 1973**

[54] **CUTTER ASSEMBLY**

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[22] Filed: **June 11, 1971**

[21] Appl. No.: **152,097**

[52] **U.S. Cl.** **355/13,** 83/312, 83/336

[51] **Int. Cl.** **G03g 15/00**

[58] **Field of Search** 355/13, 28, 29; 83/336, 312, 298

[56] **References Cited**

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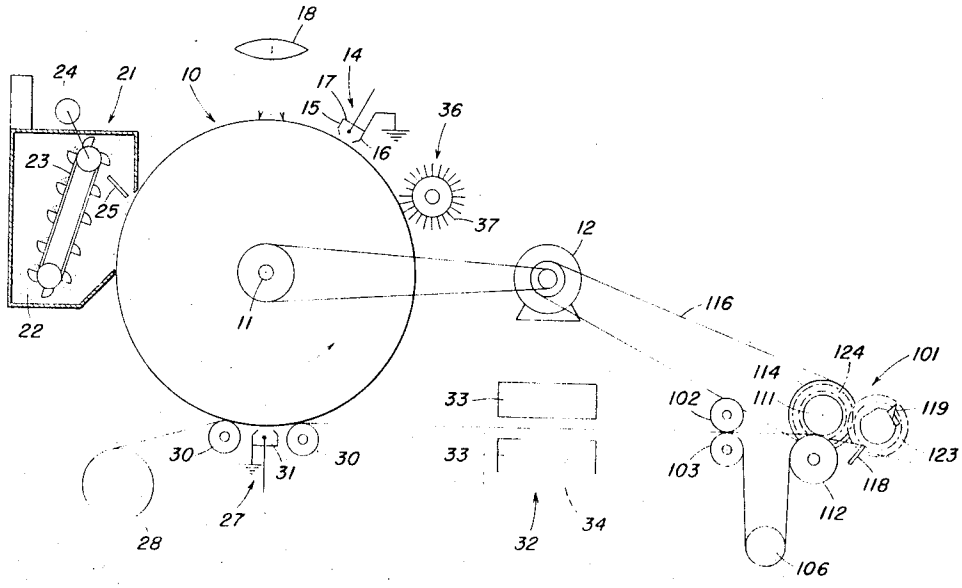
[57] **ABSTRACT**

Cutter assembly for an electrostatographic machine using a continuous web of transfer material in which the metering web of the cutter assembly is driven by the drive for the drum of the machine and the cutter is driven by the metering roll. In response to an increase in web tension, the metering roll is allowed to slip with respect to the drum to relieve tension, thereby providing uniform web tension without affecting the accuracy of the cut.

8 Claims, 4 Drawing Figures



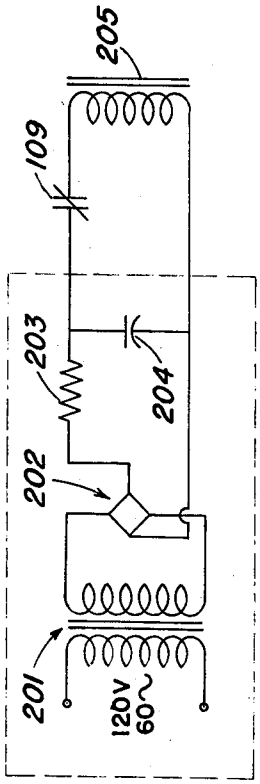


Fig. 4.

Fig. 1.

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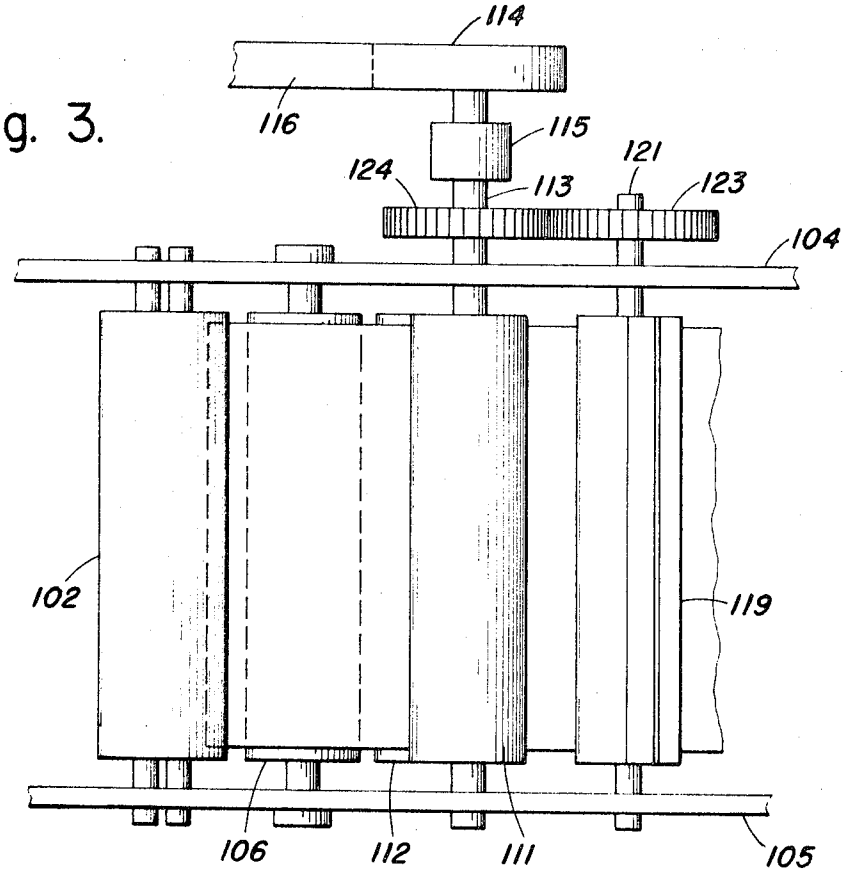
Fig. 3.



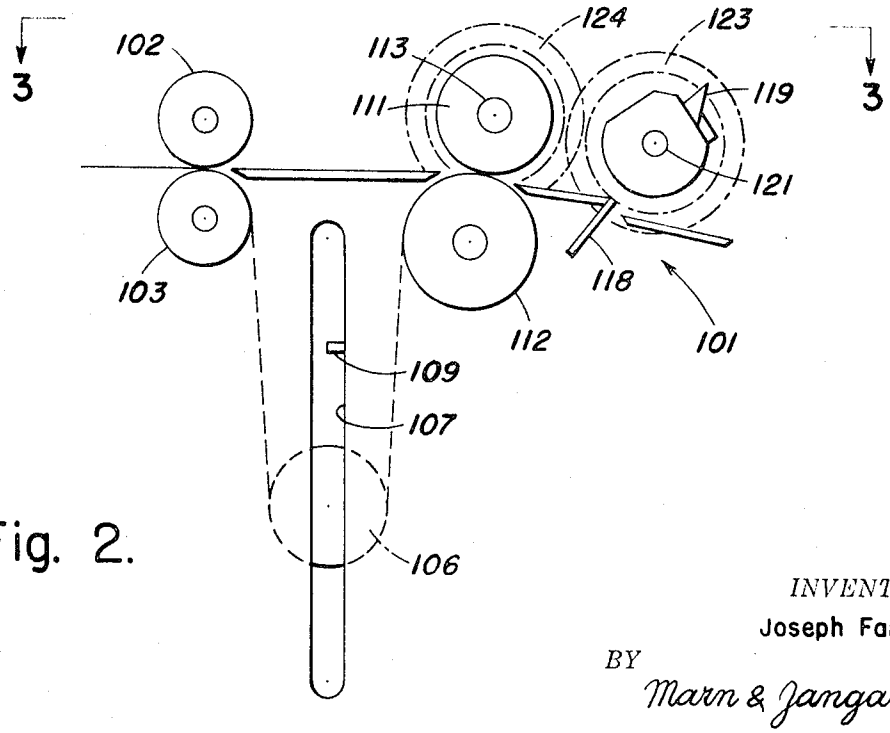


Fig. 2.

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CUTTER ASSEMBLY

This invention relates to cutting of a continuous web and more particularly to a cutter assembly which provides for uniform web tension. Still more particularly, this invention relates to the cutting of a continuous web from an electrostatographic machine having a developed image thereon.

In electrostatographic machines employing a continuous web as the support material to which the developed image is transferred, the web, after transfer of the image thereto, is preferably automatically cut by a cutter mechanism incorporated into or attached to the machine whereby the final copy is delivered from the machine in individual sheet form. In such machines, control means are provided to control the cutter whereby the cutter accurately cuts the web in relation to both the leading and trailing edge of the reproduction, as exemplified by U. S. Pat. No. 3,105,425 to Ceresani et al; U. S. Pat. No. 3,075,493 to Ceresani et al.

In machines for producing multiple copies of an original in order to maintain a desired repeat cut length along the web, the web should be introduced into the cutter under a substantially uniform predetermined tension, notwithstanding the tension varying effects of changes in other conditions. In addition, the maintenance of a predetermined web tension is important during the transfer of the powder image to the web in order to prevent smearing of the image on the web.

Accordingly, the principal object of the present invention is to provide a cutter assembly and control which maintains uniform web tension.

In accordance with one aspect of the present invention there is provided a cutting apparatus for cutting a web under substantially uniform web tension in which the web is metered from a feeding means to the cutter by a metering means and the web tension is maintained substantially uniform by selectively changing, in response to changes in web tension, the speed at which the metering means meters the web to the cutter with respect to the speed at which the feeding means feeds the web to the metering means. The means for feeding the web to the metering means and the metering means are preferably driven by a single drive means and the surface speed of the metering means is preferably changed by selectively engaging and disengaging the driving connection between the metering means and the drive to maintain a substantially uniform web tension.

More particularly, the cutting apparatus is specifically suited for cutting a continuous web, having a powder image thereon, fed to a metering means from an electrostatographic recording member. The drive means for the electrostatographic recording member also drives the metering means, preferably a metering roll, the drive means driving the metering means at a surface speed which is slightly greater than the surface speed of the recording member. In response to a change in web tension, the surface speed of the metering means is changed with respect to the surface speed of the recording member to maintain a predetermined substantially uniform web tension. The metering means preferably also drives the cutter, preferably a rotary cutter, at a predetermined surface speed ratio, which determines the length of the cut. In this manner, a change in the speed of the metering means, to provide for substantially uniform web tension, has no effect on the surface speed ratio between the metering means and the cutter and, accordingly, there is no change in the length of the cut.

The change of surface speed of the metering means with respect to the surface speed of the recording member may be effected by any of a wide variety of speed control means, preferably a clutch or an electric brake, more preferably an electric clutch, which decreases the surface speed of the metering roll, in response to an increase in web tension, by interrupting the driving connection between the metering means and its drive means, to thereby decrease the web tension and maintain a substantially uniform web tension.

The invention will be further described with respect to an embodiment thereof illustrated in the accompanying drawings wherein like numerals represent like parts and wherein:

FIG. 1 is a simplified schematic representation of an electrostatographic machine incorporating a cutter assembly of the present invention;

FIG. 3 is a top view of the cutter assembly of FIG. 2; and

FIG. 4 is a simplified schematic representation of an operating circuit for the embodiment of the cutter assembly illustrated in FIG. 2.

Referring to FIG. 1 of the drawings, there is illustrated an electrostatographic machine employing one embodiment of this invention. The machine includes an image forming member such as, for example, an electrophotographic cylinder designated **10** and generally comprising a photoconductive insulating layer disposed on a conductive backing. The cylinder is rotatably mounted on a suitable axle **11** or other bearing member and is adapted to be rotated by drive means such as, for example, an electric motor **12.** Preferably the cylinder, and in particular its conductive backing, is electrically grounded. The image forming or image receiving surface of the electrophotographic cylinder **10** is adapted to be rotated past appropriate electrophotographic processing stations disposed and positioned to form an electrostatic image on the cylinder surface. For example, when used with a photoconductive insulating electrophotographic image surface, the electrophotographic processing stations may include means for charging or sensitizing, exposure means, and cleaning means. Illustrated in the figure is a charging station generally designated **14** at which is positioned a corona discharge electrode **15,** desirably one or more high voltage corona discharge wires **16** mounted within a grounded shield **17** and adapted to be connected to a high voltage source such as, for example, a positive polarity direct current source of several thousand volts. In general the voltage applied to the corona discharge electrode will be sufficient to cause air ionization surrounding the corona wires and it is understood that such a corona discharge potential is generally in the order of several thousand volts and usually 5 to 10 thousand volts as disclosed, for example, in Walkup U. S. Pat. No. 2,777,957.

Positioned next adjacent to the charging station is an exposure station generally designated **18** and including suitable means for projecting or otherwise directing a light or optical image onto the surface of the electrophotographic drum. The exposure station may include a slit projection mechanism for exposing onto the drum surface a moving projected image of microfilm or the like, and may include means for projecting onto the surface documentary or other information or an image

corresponding to the face of a cathode ray tube or the like. As is disclosed in Carlson U. S. Pat. No. 2,297,691, the combination of electric field and exposure to activating radiation forms on the drum surface an electrostatic image capable of being developed or made visible by deposition of finely divided charged particles.

A development station for developing the latent electrostatic image, generally designated as **21**, is positioned at a subsequent location around the circumference of the drum. The development station, as shown, includes a sump **22** containing a two component developer material comprised of toner and carrier, for example of the type disclosed in U.S. Pat. No. 2,618,551 to Walkup; a conveyor **23**, which is driven through suitable drive means by a motor **24**; and a chute **25** for transporting developer released from the conveyor to the surface of the drum **10**. In operation, the conveyor **23** transports the developer from the sump **22** to the chute **25**, and the developer released from the chute **25** cascades over the surface of the drum **10**, whereby the toner particles are attracted to the image areas previously formed thereon to render the image visible. The unused developer material which has cascaded over the surface of the drum **10** falls into the sump **22**, and the developer material in the sump **22** is periodically provided with toner to replenish the toner used to develop the image.

Positioned subsequently around the surface of the electrophotographic drum is an image transfer station generally designated **27** including, for example, a supply roll **28** of transfer material such as, for example, a roll of paper together with guide means and the like to feed the image transfer material into contiguous relationship with the electrophotographic drum. As illustrated in FIG. **1**, suitable guide rolls **30** may guide the transfer web into contact with the electrophotographic drum, and transfer means such as, for example, a corona discharge electrode **31** is positioned to transfer the developer image to the image web at the transfer station. The drum **10** in conjunction with the guide rolls functions as a feed means for feeding the web having the transferred image thereon to the fuser, hereinafter described. In this manner the rate of web movement is identical to the surface speed of the drum **10**. Preferably, the transfer means is a corona discharge electrode of substantially the same construction as is located at the charging station **14** although other transfer means may be employed such as the means disclosed in U.S. Pat. No. 2,807,233. For the usual case of direct or positive-to-positive photographic copy the charging electrode **15** and the transfer electrode **31** are of the same polarity and for the opposite situation of photographic reversal the electrodes are of opposite polarity. Optionally positioned near the transfer station and along the line of travel of the transfer web subsequent to the transfer station is a fusing station generally designated **32** and including a plurality of heating elements **33** suitably contained within a housing **34** and adapted to fuse onto the web surface the image that has been transferred thereto. It is understood that suitable vapor fixing means may be employed as disclosed for example in Carlson U.S. Pat. No. 2,776,907. The web having the fixed image thereon is thereafter passed into the cutter assembly of the present invention, generally designated as **101**.

Disposed next adjacent to the transfer station and between the transfer station and the charging station is a cleaning station generally designated **36** and comprising for example a cloth or, preferably, rotatable brush **37** operated by suitable drive means to brush against the electrophotographic drum surface and remove residual powder therefrom. Suitable brush cleaning apparatus is illustrated in Turner et al, U.S. Pat. No. 2,751,616.

It is believed that the foregoing description is sufficient for the purposes of this application to show the general operation of an electrophotographic reproducing apparatus in which the cutter assembly of the present invention may be incorporated.

Referring now to the subject matter of the present invention, the cutter assembly (see FIGS. **2** and **3**) includes unidirectional slip rolls **102** and **103** rotatably journaled on the side frames **104** and **105** of the machine, for receiving the web having the image affixed thereon from the fuser **32**.

Thereafter, the web passes around a dancer roller **106**, the ends of which are arranged in vertical slot-like tracks **107** in the side frames **104** and **105** of the machine, to permit vertical reciprocal movement of the dancer roller **106**. A micro switch **109** has an operating arm arranged near the top of the track **107**, the switch **109**, as hereinafter described, functioning to operate the means for controlling the speed of the web metering means with respect to the surface speed of the drum **10** from which the web is fed. It should be readily apparent that the dancer roller **106** tensions the web between the drum **10** and the subsequent metering roller, and an increase in web tension, causes the dancer roller to move vertically upwardly in track **107**.

Thereafter, the web passes to a metering means comprised of a driven metering roller **111** and an idler roller **112** suitably journaled on the frames **104** and **105**. The shaft **113** of the driver roller **111** extends through the side frame **104** and is drivingly coupled to a pulley **114** through a speed controller in the form of a clutch **115**, preferably an electromagnetic clutch. The pulley **114** is drivingly connected by a belt **116** to a suitable pulley secured to the drive shaft of the motor **12** for the drum **10** (see FIG. **1**). The driving connection between the shaft **113** of roller **111** and the drive shaft of the motor **12** is such that the surface speed of roller **111** is slightly higher than the surface speed of the drum **10**.

Thereafter, the web passes between a fixed bed knife **118** and a rotary cutting knife **119**, mounted on a rotary cutter shaft **121**, rotatably supported between the side frames **104** and **105** in suitable bearing housings. The web passing between the rotary cutter **119** and the fixed knife **118** is severed upon the rotary cutting knife **119** being aligned with the fixed knife **118**.

The cutter shaft **121** extends through frame **104**, and has fixedly mounted thereon, a gearing arrangement **123** which is in engagement with a gearing arrangement **124** on the shaft **113** of roller **111**, whereby the rotary cutter **119** is driven by the shaft **113** of the roller **111**. The gearing arrangement **124** determines the ratio of the surface speed of the roller **111** to the surface speed of the cutter **119**, the aforesaid speed ratio determining the length of the cut. Accordingly, the length of the cut is conveniently changed by changing the gearing arrangement between the metering roll **111** and rotary cutter **119**.

After being cut, the sheet slides into a suitable unit, such as a stacker (not shown) for receiving the cut sheets.

The switch **109** functions to disengage and reengage the driving connection between the metering roll **111** and the drum drive motor **12** through suitable circuitry. A representative example of such a circuit is illustrated in FIG. **4**.

Referring now to FIG. **4**, there is shown a transformer **201** having its primary winding connected to a suitable power source and its secondary winding to a rectifier circuit **202**. The output of the rectifier circuit **202** is connected to a resistor **203** and capacitor **204**, as illustrated. The microswitch **109** and power winding **205** of the electric clutch **115** are connected across the capacitor **204**.

The microswitch **109** is normally closed until activated by the upward movement of the dancer roller **106**, activation of the switch **109** opening the circuit and deactivating the clutch **115**. Upon the dancer roller **106** moving downward in track **107**, the microswitch **109** is again closed re-energizing the clutch **115**.

In operation, the drum **10** functions as a feed means for feeding the web to the drive roller **111** of the metering means, and as hereinabove noted, the drum **10** operates at a surface speed slightly less than the surface speed of the driver metering roller **111**, whereby the metering roller **111** feeds the web to the cutter at a speed slightly higher than the speed at which the drum **10** feeds the web to the metering roll **111**. Accordingly, any changes in the tension of the web passing over the dancer roller **106** will be an increase in web tension.

An increase in web tension causes the dancer roller **106** to move upwardly in track **107** and eventually, in response to such an increase in web tension, the roller **106** activates the operating arm of microswitch **109**, opening the circuit which powers clutch **115** thereby de-energizing clutch **115**. The de-energization of clutch **115** interrupts the driving connection between the metering roll **111** and the drum drive motor **12**, thereby causing the metering roll **111** to slip with respect to the drum **10**; i.e., the surface speed of the metering roll **111** is reduced with respect to the surface speed of the drum **10**. The slippage between the metering roll **111** and the drum **10** relieves the web tension, and in response to the reduction in web tension, the dancer roller **106** moves downwardly in track **107**, thereby reclosing the switch **109** and re-energizing the clutch **115** to thereby re-establish the driving connection between the metering roll **111** and the drum drive motor **12**.

The accuracy of the cut is not affected by the change in surface speed of the metering roll **111** in that the surface speed of the cutter **119** is changed proportionately, thereby maintaining the preselected speed ratio which determines the length of the cut.

Numerous modifications and variations of the particularly described embodiments are possible within the spirit and scope of the invention. Thus, the surface speed ratio of the metering means to the drum may be varied other than as particularly described. For example, the driving connection between the metering means and the drum drive may be interrupted by means other than a clutch. The clutch could be replaced by an electric brake in which case the power circuit would be normally open and the driving connection interrupted by the dancer roller closing a microswitch to energize the electric brake. As a further alternative, although less preferred, the dancer roller could actuate mechanical means for slowing the metering roll without interrupting the driving connection between the metering roll and the drum drive motor. Similarly, the increase in web tension may be sensed by means other than a dancer roller as particularly described.

As a further alternative, the metering means for metering the web to the cutter may be driven independently of the drum, but such construction is less preferred in that there is more difficulty in controlling the relative speeds of the metering means and drum.

Similarly, although the invention has been particularly described with respect to an electrophotographic process, the invention is equally applicable to other electrostatographic processes, for example, electrostatographic process in which an electrostatic latent image is formed by pulsing electrodes.

It should also be apparent that although the teachings of the invention are particularly applicable to electrostatographic processes, the teachings of the invention may also be applied to other processes in which cutting of a web at substantially uniform tension is desirable.

The present invention is particularly advantageous in that as incorporated into an electrostatographic machine employing a continuous web as a transfer medium, the web may be facilely cut at a substantially uniform predetermined tension, without affecting the length of the cut.

Numerous modifications and variations of the present invention are possible in light of the above teachings and, therefore, within the scope of the appended claims the invention may be practiced other than as particularly described.

What is claimed is:

1. In combination with an electrostatographic recording member, a cutting apparatus for cutting a continuous web having a powder image thereon, comprising:

cutting means for cutting the web; web metering means for metering the web to the cutting means from the surface of the recording member; a drive means drivingly connected to the recording member and the metering means for driving both the metering means and the recording member, said drive means driving said metering means at a surface speed which is slightly greater than the surface speed of the recording member; and control means responsive to web tension for maintaining a substantially uniform web tension, said control means selectively changing the speed at which the metering means meters the web to the cutting means with respect to the speed at which the web is fed to the metering means from the recording member to thereby maintain a substantially uniform web tension.

2. The apparatus of claim **1** wherein the control means includes means selectively engaging and disengaging the driving connection between the metering means and the drive means to maintain said substantially uniform web tension.

3. The apparatus as defined in claim **1** wherein the cutting means is movable and further comprising means for drivingly connecting said cutting means to said metering means whereby said cutting means is driven by said web metering means.

4. The apparatus as defined in claim **3** wherein said means for drivingly connecting said metering means to

said cutting means includes means for maintaining a predetermined ratio of movement between said cutting means and said metering means which controls the length of the cut.

5. In combination with an electrostatographic recording member, a cutting apparatus for cutting a continuous web, having a powder image thereon, comprising:

support means; a rotary cutter journaled for rotation in said support means; a metering means for metering the web from the recording member to the cutter comprising a drive roller and an idler roller both journaled for rotation in said support means; a dancer roller connected for reciprocal movement to said support means, the web from the recording member passing in tension over the dancer roller, between the drive roller and the idler roller and past the rotary cutter, increases and decreases in tension of the web effecting reciprocal movement in opposite directions of the dancer roller; means for drivingly connecting the drive roller to the rotary cutter, whereby the rotary cutter is rotated by rotation of said drive roller; drive means for rotating said drive roller, said drive means also driving said recording member, said drive means driving the drive roller at a surface speed slightly greater than the surface speed of said recording member; and control means for maintaining a substantially uniform web tension including a speed control means for decreasing the surface speed of said drive roller with respect to the surface speed of said recording member and operating means connected to said speed control means to operate said speed control means, said operating means being responsive to reciprocal movement of said dancer roller, said operating means operating said speed control means in response to movement of said dancer roller in one direction caused by an increase in web tension.

6. The apparatus as defined in claim **5** wherein said speed control means decreases the speed of the drive roller by interrupting driving connection.

7. The apparatus as defined in claim **5** wherein the speed control means is a clutch which disengages and engages the drive roller to the drive means, said operating means disengaging said clutch in response to movement of the dancer roller in said one direction and engaging said clutch in response to subsequent movement of said dancer roller in said opposite direction.

8. In combination with an electrostatographic recording member, a cutting apparatus for cutting a continuous web having a powder image thereon, comprising:

movable cutting means for cutting the web; web metering means for metering the web to the cutting means from the surface of the recording member; means for drivingly connecting said cutting means to said metering means, whereby said cutting means is driven by said web metering means; and control means responsive to web tension for maintaining a substantially uniform web tension, said control means selectively changing the speed at which the metering means meters the web to the cutting means with respect to the speed at which the web is fed to the metering means from the recording member to thereby maintain a substantially uniform web tension.

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