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[54] **ADJUSTABLE MOUNTING DEVICE FOR ELECTROSTATIC COPIER DEVELOPER MAGAZINE**
10 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **118/637,** 117/17.5, 118/253
[51] **Int. Cl.** **G03g 13/00**
[50] **Field of Search** ..... 118/637, 637 LX; 117/17.5; 19/135; 175/183; 250/49.5

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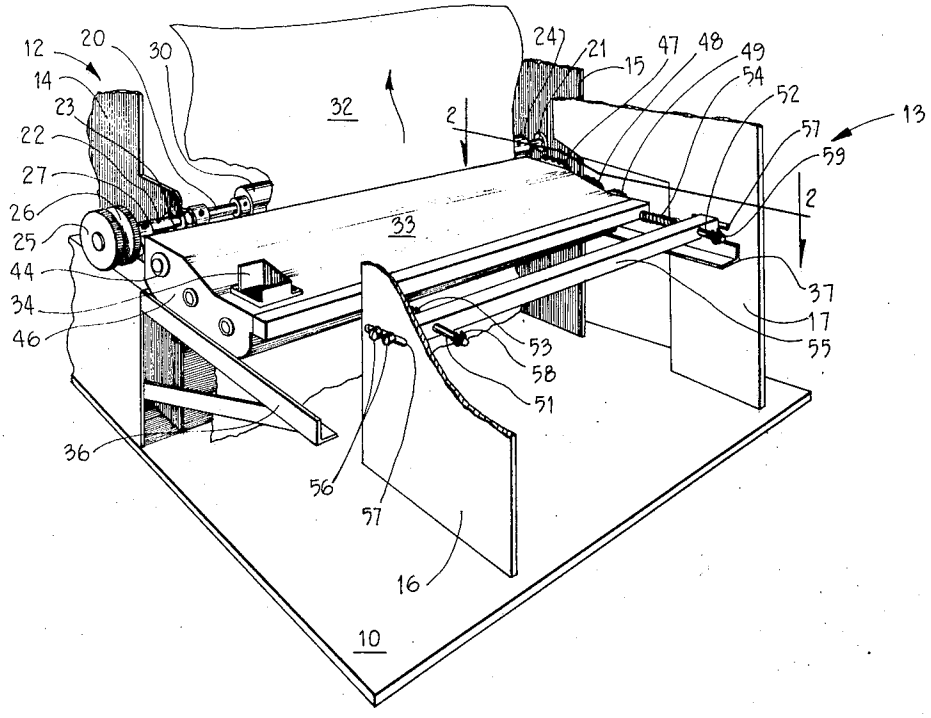
ABSTRACT: A mounting apparatus for the developer magazine of an electrostatic copier which enables the developer brush—xerographically sensitive element spacing to be varied across the width of the brush. Two independently adjustable eccentric cams bear upon the rear of the developer magazine to determine the spacing. A spring-loaded anchor bar is slidably received on spaced guide members secured to the front of the developer magazine to provide a rearward thrust for maintaining the spacing constant independently of dimensional changes in the copier frame units.



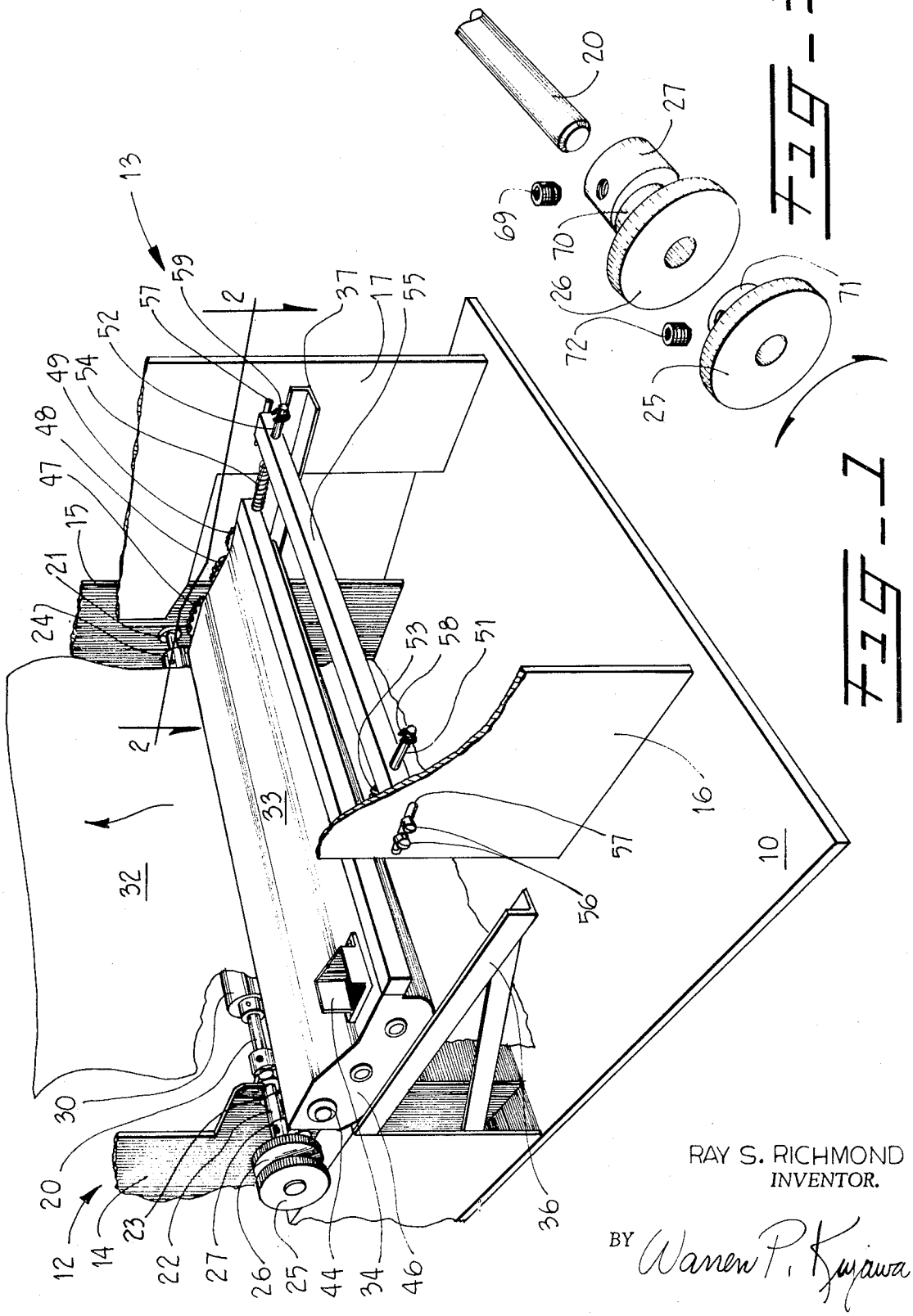


FIG-3
FIG-1
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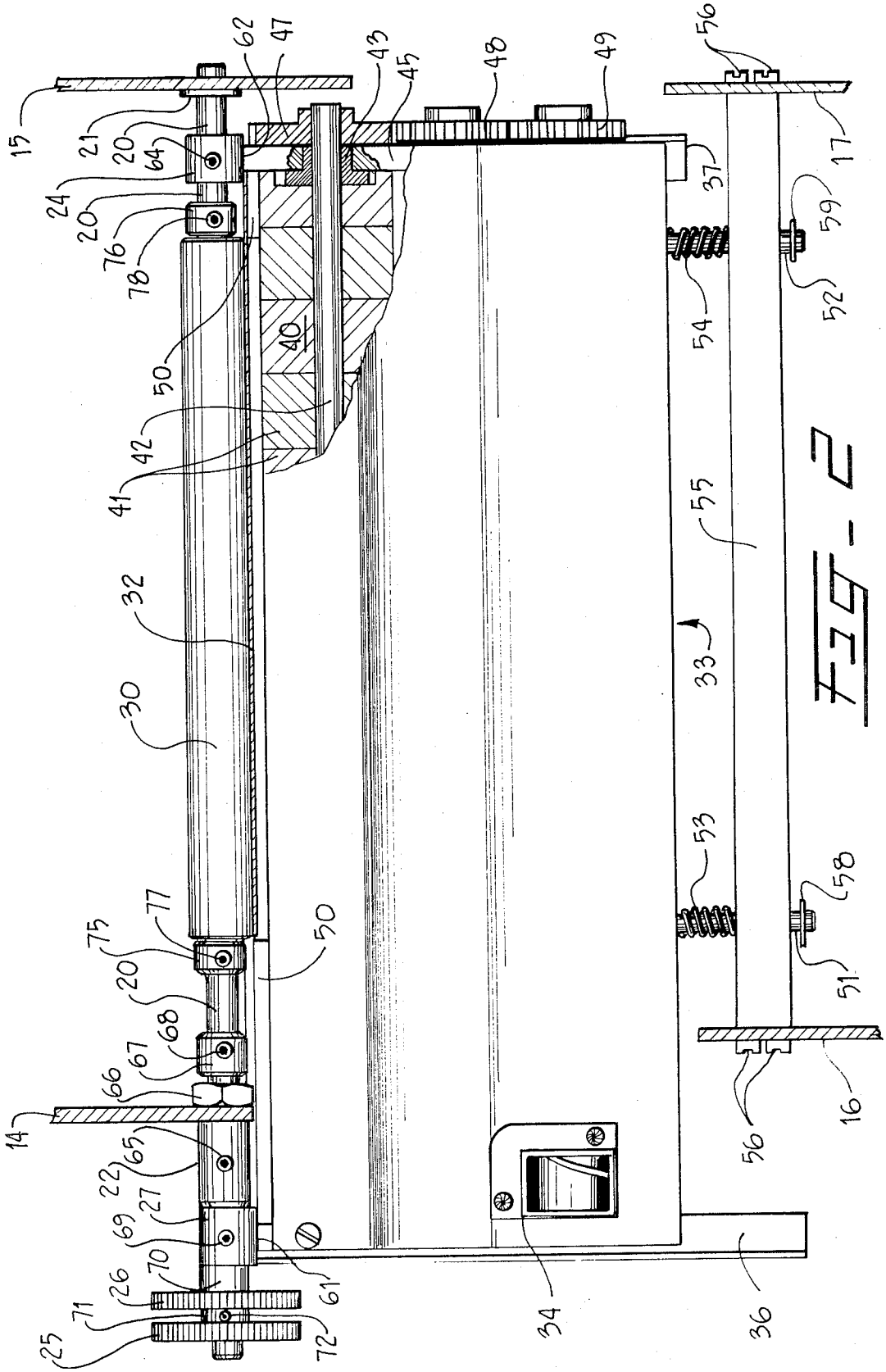
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FIG. 2

ADJUSTABLE MOUNTING DEVICE FOR ELECTROSTATIC COPIER DEVELOPER MAGAZINE

BACKGROUND OF THE INVENTION

I. Field of Invention

This invention relates to dry electrostatic copiers having a developer magazine with the brush for depositing toner particles on the surface of a xerographically sensitive element. More particularly, the invention relates to the mounting apparatus formed in such copiers for mounting the developer magazine adjacent the xerographically sensitive element.

2. Description of the Prior Art

Electrostatic copiers are known which employ a xerographically sensitive element, such as a zinc oxide coated paper web, for developing a visible image of a document to be reproduced. In such a device, a latent image is first formed on the surface of the web by depositing electrostatic charges thereon and selectively dissipating certain charges to form a charge pattern corresponding to the original document. Next, a dry visible toner powder is distributed onto the charged surface of the web, customarily by means of a magnetic brush which rotates about an axis parallel to the transverse direction of the web surface. By the mechanism of triboelectric attraction, the distributed toner particles adhere to the electrostatic charges on the web surface, thereby rendering the latent image visible. This visible image is then ordinarily fixed by heating until the toner particles melt and fuse with the web surface. Alternatively, the visible powder image may be transferred from the web surface to a second surface, such as a sheet of paper, and fixed thereon by heating.

While there are many determining factors which influence the quality of the developed image, given a substantially uniform surface charge distribution the single most significant factor determining image quality is the degree of uniformity with which the toner powder is distributed on the surface of the web. Many copiers employ magnetic brush development for distributing the toner. In a typical arrangement, the brush consists of a magnetized core member, such as a permanently magnetized cylinder, and magnetic particles, such as iron filings, which are attracted by magnetic forces to the surface of the core, forming brushlike tufts or streamers on the surface thereof. The brush is ordinarily encased in a developer magazine which also carries components for mixing the toner powder with the magnetic particles. In operation, the toner powder is introduced into the mixing portion of the developer magazine where it is thoroughly intermixed with the magnetic particles. During mixing, particles of toner are attracted by and adhere to the magnetic particles by triboelectric forces therebetween. The toner bearing magnetic particles are then swept over the charged web surface by the brush core. Those toner particles which encounter electrostatic charges are removed from their magnetic carriers by the force of electrostatic attraction therebetween and remain behind on the web surface. The magnetic carrier particles are then returned by the brush core to the mixing portion of the developer magazine where they acquire fresh toner particles, and the process is repeated.

It has been found that maximum utilization of a zerographically sensitive web is realizable if the web is arranged vertically in the working region, defined by the charging and developing stations in those copiers which fix the visible image on the web, and defined by the charging and transfer stations in those copiers which fix the visible image after transfer to a second surface. However, this arrangement introduces a critical parameter in the design of the developing station: namely, the separation distance between the surface of the charged web and the surface of the magnetic brush core. If this distance is too great, no toner particles will approach close enough to the surface charges on the web to be attracted thereto and the result will be an undeveloped, invisible image. On the other hand, if this distance is too small, the surface friction between the magnetic particles and the web surface will cause great quantities of the magnetic particles to be

separated from the brush core, causing partial dissipation of the charge distribution (since the magnetic particles are also electrically conductive), fouling of machine components located below the developing station and an excessive deposition of toner particles onto the web surface which results in an exceedingly dark and sometimes completely black developed image. In between these two extremes lies an optimum spacing which varies according to the desired image contrast, the magnetic field strength at the brush core surface, the permeability and linear dimensions of the magnetic particles, the strength of the triboelectric forces between the toner and magnetic particles, and other factors. Once achieved, this optimum spacing must be rigidly maintained to ensure good copy quality.

A further complicating factor tending to compound the web-core surface spacing problem resides in the requirement that the optimum spacing, once determined, must be maintained substantially constant across the entire width of the web surface. Stated otherwise, this spacing must not vary appreciably along a path traced parallel to the transverse direction of the web surface. In addition, any mechanism incorporated into the copier apparatus for obtaining and maintaining this optimum spacing must be extremely simple in order that it be easily adjustable in the operational environment of the copier and to avoid the unnecessary introduction of additional parts which necessitates further expense and increases the probability of operational failure of the device. Past efforts to devise such a simple mechanism have, at best, met with limited success.

Many copiers utilize two separate subassemblies for mounting the various electrical and mechanical components. Customarily, the main subassembly carries the main drive frame, the web supply system, and other copier components all mounted within a first frame unit, while the second subassembly carries the original document feed mechanism, the developer magazine, the corona stations and the fusing station used to fix the developed image, all mounted within a second frame unit. These two frame units are ordinarily positioned together in abutting relationship as a rigid unit, and in more advanced machines the connecting members serving to secure these frame units together are designed to be readily disconnected so that the two units can be easily and quickly separated to provide access to the interior of the copier when servicing is required. This convenient feature, however, creates a severe problem relating to the constancy of the web-core spacing. Due to the heat generated by the fusing station during the fixing step of the image development process, abutting portions of the two frame units expand. Since the developer unit ordinarily is rigidly mounted in the second frame unit, this expansion severely alters the web-core spacing and thus the copy quality in the manner discussed above. Moreover, during those periods when the fuser is deactuated, the above-mentioned portions contract upon cooling. Consequently, with prolonged use the resulting alternate expansion and contraction of the affected frame unit portions eventually results in a permanent misalignment of the web-core relationship which can only be rectified by costly, time-consuming repairs or by replacing the entire second subassembly.

SUMMARY OF THE INVENTION

The invention disclosed herein comprises a mounting apparatus for the developer magazine of an electrostatic copier which enables a quick, simple, and precise alignment of the web-core spacing without requiring any separation of the two subassemblies which carry the major components of the machine. More particularly, the disclosed invention resides in an eccentric cam assembly which is releasably secured to a transverse shaft to provide a pair of abutment surfaces for the brush end of the developer magazine, and which can be easily adjusted to vary the web-core spacing. Additionally, the disclosed invention includes a mechanism which coacts with the spacing adjustment means for maintaining the selected web-

core spacing constant independently of dimensional changes in the copier frame unit. More particularly, this portion of the novel mounting apparatus comprises a spring-loaded anchor bar fixed to a remote portion of the second frame unit and slidably received on spaced guide members secured to the front of the developer magazine to provide a rearward thrust for maintaining the web-core spacing constant over a wide range of such dimensional changes.

For a fuller understanding of the nature and advantages of the invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic perspective illustrating a preferred embodiment of the invention;

FIG. 2 is a plan view partially in section of the FIG. 1 embodiment; and

FIG. 3 is a detailed view of a portion of the preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1, a portion of an electrostatic copier is shown which illustrates the preferred embodiment of the invention. Situated on a copier base 10 are a pair of frame units 12 and 13. Main frame unit 12 includes a left sideplate 14 and a right sideplate 15, while front frame unit 13 includes a left sideplate 16 and a right sideplate 17.

Extending transversely of main frame unit 12 is a central support shaft 20. Shaft 20 is journaled at a first end into an aperture 21 in sideplate 15, and is rotatably supported at an opposite end by a cylindrical support member 22 which is positioned in a slot 23 in sideplate 14. Fixed to shaft 20 adjacent sideplate 15 is an eccentric cam 24. A first adjusting knob 25 is secured to the opposite end of shaft 20 so that rotation of knob 25 results in rotation of eccentric cam 24. Adjacent knob 25 is a second adjusting knob 26 which is secured to an eccentric cam 27. Cam 27 is rotatably received on shaft 20 between knob 26 and support member 22.

Located between sideplates 14 and 15 of main frame unit 12 is a web support cylinder 30 which is mounted on shaft 20 for free rotation thereabout. Web support cylinder 30 provides a rotatable support surface for the back of a photoconductive web 32. Web 32 is passed over cylinder 30 in the direction indicated by the arrow by a drive mechanism (not shown) carried by main frame unit 12. Main frame unit 12 carries other copier components which are known to those skilled in the art and which have not been illustrated for purposes of clarity.

A developer magazine 33 having an inlet 34 for the introduction of toner to the interior thereof is slidably supported at each side by a pair of L-shaped channel members 36, 37 which are secured to sideplates 14, 15 by any suitable means, such as welding. Although shown attached to sideplates 14, 15 of main frame unit 12, channel members 36, 37 may be attached to any of the sideplates 14–17 in any convenient fashion which provides a support for developer magazine 33.

As shown in FIG. 2, developer magazine 33 contains a cylindrical magnetic core 40 comprising a plurality of ferrite discs 41 concentrically mounted on a metal rod 42. Rod 42 is rotatably received by two bearings 43, 44 (the latter visible in FIG. 1) mounted in apertured sidewalls 45, 46 and preferably made of bronze. A gear 47 is mounted on the driven end of rod 42 and is arranged to mesh with the teeth of gear 48, which is also engaged with gear 49. Gears 48 and 49 are secured to bearing-mounted mixing augers (not shown) which are arranged in a known manner to transport toner from inlet 34 to the interior region adjacent core 40 and to mix the toner with iron filings contained in magazine 33. Gear 47 is driven by a spur gear (not shown) mounted on main frame unit 12 and driven in a known manner.

A real wall portion 50 of developer magazine 33 is cut away as shown to provide an open space between the surface of web 32 and core 40. As discussed above, when magnetic core 40 is rotated by gear 47, toner-bearing magnetic particles are brushed across the surface of photoconductive web 32 along the entire width thereof in the space provided by the cutaway portion of rear wall 50.

Extending forwardly of developer magazine 33 are a pair of guide members 51, 52 which are fixed to the front portion of magazine 33. Disposed about guide members 51, 52 are compressively mounted springs 53, 54. An anchor bar 55 is adjustably secured to sideplates 16, 17 of front frame unit 13 by screws 56 which pass through slots 57. Anchor bar 55 has a pair of apertures which slidably receive guide members 51, 52. A pair of keepers 58, 59 are mounted on guide members 51, 52 as shown to provide stops for presenting removal of anchor bar 55 from guide members 51, 52. As is evident to those skilled in the art, front frame unit 13 carries other copier components than developer magazine 33, such as the original document and copy paper feed mechanisms, and the fusing station, with the latter ordinarily located above developer magazine 33 adjacent the top surface of the copier. These components have been omitted for purposes of clarity in illustrating the preferred embodiment of the invention. In addition, front frame unit 13 is releasably secured to main frame unit 12 in any suitable manner known to those skilled in the art; e.g., sideplates 14, 15 may be provided with inwardly projecting dowel pins at their upper front portions and sideplates 16, 17 may be provided at their upper rear portions with pivotable hooks which are engageable with the dowel pins. Other arrangements will occur to those skilled in the art.

FIG. 2 illustrates in more detailed fashion the components of the preferred embodiment which comprise the web-core spacing means and the apparatus for maintaining this spacing constant independent of dimensional changes in the copier frame units. As shown in FIG. 2, in an assembled apparatus, developer magazine 33 is urged rearwardly by springs 53, 54 acting on the front of magazine 33 and anchored by fixed anchor bar 55. Front surfaces 61, 62 of sidewalls 46, 45 of magazine 33 bear against the contoured surfaces of eccentric cams 27, 24, respectively. Accordingly, the linear distance between front surfaces 61, 62 and the axis of rod 20 will vary according to the angular position of cams 27, 24, respectively. Since the position of the surface of web 32 is fixed with reference to the axis of rod 20, and since the position of core member 40 is fixed with reference to front surfaces 60, 61 by bushings 44, 43, respectively, the linear distance between the surface of web 32 and core 40 may be varied by adjusting the angular position of cams 27 and 24. Further, this linear distance between the web-core surface may be adjusted so as to be uniform across the entire width of web 32, or skewed, as desired, by independently varying the angular position of eccentric cams 27, 24. Thus, as viewed in FIG. 2, the web-core spacing at the right side of web 32 may be adjusted to be less than, equal to, or greater than the spacing at the left side of web 32, by individually rotating knobs 25, 26.

The adjustable web-core spacing assembly will now be described in detail with reference to FIG. 2. As viewed in FIG. 2, the right end of central support shaft 20 is rotatably journaled in right sideplate 15. Spaced from this journal is eccentric cam 24, which is provided with an axial cylindrical bore and a radial bore which is threaded to receive a lock screw 64. Adjacent the left end of support shaft 20 is cylindrical support member 22 having a threaded radial bore provided with a lock screw 65 and which is rigidly fixed to the front of left sideplate 14 by nut 66. Support shaft 20 is rotatably received by support member 22 and may be locked thereto by tightening lock screw 65. A spacing collar 67 is secured to support shaft 20 on the inner side of nut 66 to provide an adjustable amount of left end play for support shaft 20.

Mounted on support shaft 20 to the immediate left of support member 22 is eccentric cam 27, similar to eccentric cam 24, having an axial cylindrical bore and a radial bore which is

threaded to receive a lock screw **69**. Fixed to the left end of eccentric cam **27** is knob **26** having a cylindrical collar portion **70**. To the immediate left of knob **26** is knob **25**, having a cylindrical collar portion **71**, and which is fixed to the left end of support shaft **20** by lock screw **72** (see FIG. **3**).

Symmetrically mounted on support shaft **20** with respect to the inner surfaces of side plate **14**, **15** are two support collars **75**, **76** having lock screws **77**, **78**. Web support cylinder **30** is coupled to support collars **75**, **76** by any suitable low-friction means known to those skilled in the art, such as needle bearings, so as to be freely rotatable with respect to support shaft **20**. As mentioned above, web support cylinder **30** provides a freely rotatable support for the back of photoconductive web **32**.

The adjustable web-core spacing assembly is assembled as follows: central support shaft **20** is passed through the components interior to sideplates **14**, **15**, i.e., nut **66**, spacing collar **67**, support collars **75**, **76** and web support cylinder **30**, and eccentric cam **24**. Next, support member **22** is slipped onto shaft **20** and positioned in slot **23** (see FIG. **1**) after which the right end of shaft **20** is journaled into aperture **21** of sideplate **15**. Support member **22** is next secured in slot **23** by tightening nut **66**, care being taken to align support shaft **20** normal to sideplates **14**, **15**.

With reference to FIG. **3**, the eccentric cam **27**-knob **26** assembly is next fitted onto shaft **20**, after which knob **25** is fitted onto shaft **20** and secured thereto by tightening lock screw **72**. Spacing collar **67** is then positioned on shaft **20** to provide the desired amount of left end play and fixed to shaft **20** by tightening lock screw **68**. Following this, support collars **75**, **76** and web support cylinder **30** are centered on support shaft **20** and locked in place by tightening lock screws **77**, **78**. The apparatus is now ready for installation of developer magazine **33**.

The first set step in the installation of developer magazine **33** is the alignment of the angular positions of eccentric cams **27**, **24**. This is accomplished by rotating either one of the two knobs **25**, **26** while steadying the other until the angular positions of eccentric cams **27**, **24** are approximately equal. Eccentric cam **27** is then locked to shaft **20** by tightening lock screw **69**, thereby interlocking the two eccentric cams. The interlocked eccentric cams **27**, **24** are then rotated to an arbitrary intermediate angular position by rotating knobs **25**, **26**, after which they are locked against rotation by securing lock screw **65** of support member **22**.

Following this, developer magazine **33** is placed onto channel members **36**, **37** and slide rearwardly until front surfaces **61**, **62** bear against the surfaces of eccentric cams **27**, **24**. While maintaining this surface contact, springs **53**, **54** are next compressed by forcing anchor bar **55** rearwardly. Installation of developer magazine **33** is then completed by tightening screws **56** to secure anchor bar **55** in place. The copier is now ready for adjustment of the web **32**-magnetic core **40** spacing.

The copier is actuated in a known manner to provide a test electrostatic image on the surface of web **32** which is uniform across the width thereof. Lock screws **65** and **69** are then loosened so that eccentric cams **27** and **24** may be independently rotated. The test operator then adjusts the angular positions of eccentric cams **27** and **24** by rotating knobs **25** and **26** until a visible image is produced on the emerging surface of web **32** which is uniform across the entire width of web **32**. During the adjustment process, compressed springs **53**, **54** ensure that the front surfaces **61**, **62** of developer magazine **33** are maintained in contact with the surfaces of eccentric cams **27**, **24** so that the web **32**-core **40** spacing varies smoothly until the uniform image is obtained. Once the uniform image is thus obtained, eccentric cams **27** and **24** are interlocked by tightening lock screw **69** of eccentric cam **27**. Following this, eccentric cams **27**, **24** are rotated in synchronism to obtain the desired image intensity, and thus the optimum web **32**-core **40** spacing. During this adjustment, the interlock provided by tightened lock screw **69** of eccentric cam **27** ensures that the predetermined transverse image uniformity previously obtained is not disturbed. When the desired image intensity is obtained, eccentric cams **27**, **24** are locked against rotation by tightening lock screw **65** of support member **22**. With the optimum web **32**-core **40** spacing now determined, and eccentric cams **27**, **24** locked against rotation, the copier is now ready for use.

As mentioned above, the fusing station is ordinarily located above the web **32**-core **40** region. With prolonged copier use, the heat generated by the fusing station causes expansion of adjacent portions of sideplates **14**, **15** of main frame unit **12** and sideplates **16**, **17** of front frame unit **13**. In ordinary copiers not provided with the disclosed invention, this expansion can be communicated to developer magazine **33** resulting in alteration of the critical web **32**-core **40** spacing, which must be held to tolerances as close as ±0.010 inch in some copiers. As also noted above, alteration of the web-core spacing can have an extremely adverse affect on the quality of the visible image developed on the surface of web **32**.

In the disclosed invention, however, the web **32**-core **40** spacing is maintained constant independently of any expansion of portions of frame units **12**, **13**, which may be adjacent to the copier fusing station. As can be seen from FIGS. **1** and **2**, the web **32**-core **40** spacing is determined by the angular positions of eccentric cams **27**, **24** which bear upon front surfaces **61**, **62** of slidably mounted developer magazine **33**. So long as front surfaces **61**, **62** are maintained in contact with the surface of eccentric cams **27**, **24**, the web core spacing remains constant. Springs **53**, **54** ensure that this contact will be maintained over a wide range of dimensional changes in sideplates **14–17** of frame units **12** and **13**. Thus, the expansion of portions of frame units **12** and **13** due to heating by the fusing station, or due to thermal variations from any cause, does not affect the web-core spacing in the disclosed invention.

As has been made evident from the above description, the invention disclosed herein enables a very simple and precise adjustment of the web-core spacing in an electrostatic copier, which can be accomplished very quickly and which does not require sophisticated technical ability to perform. Moreover, when it is desired to change the overall intensity of the visible image developed on the copier web, this may be conveniently accomplished in a minimum of time by simply loosening lock screw **65** of support member **22** and rotating knobs **25**, **26** in unison. For this purpose, the decorative housing for the copier may be provided with a removable cover which, when removed, exposes knobs **25**, **26**, eccentric cam **27**, and lock screw **65**. As is further evident from the above description, once the desired web-core spacing has been fixed, the invention provides an extremely simple and reliable mechanical arrangement for maintaining this spacing constant independently of thermal variations in the dimensions of the copier frame unit.

While the foregoing provides a full disclosure of the preferred embodiment of the invention, it is understood that various modifications, alternate constructions, and equivalents may be employed without departing from the true spirit and scope of the invention. For example, leaf springs or a single serpentine spring may be substituted for springs **53**, **54** to provide a rearward thrust to developer magazine **33**. Also, other equivalent fastening devices for securing anchor bar **55** to sideplates **16**, **17** may be provided. Therefore, the above description and illustrations should not be construed as limiting the scope of the invention which is solely defined by the appended claims.

What is claimed is:

1. In an electrostatic copier having a main frame unit, a xerographically sensitive member located in said main frame unit for developing a latent electrostatic image, a second frame unit, and a developer unit carried by said second frame unit for rendering said latent electrostatic image visible, said developer unit having a brush member spaced from said xerographically sensitive member for depositing toner on the surface thereof, and a window for exposing a portion of said brush member, the improvement comprising:

spacing means for adjusting the spacing between said brush member and said xerographically sensitive member along the width thereof, and

means coupled to said developer unit for coacting with said spacing means to maintain said spacing constant along the width of said brush member and said xerographically sensitive member,

whereby said spacing is maintained constant independently of dimensional changes in said copier frame units.

2. The apparatus of claim 1 wherein said spacing means comprises a stop member adjustably mounted on said main frame unit relative to a fixed point thereon for providing a reference abutment surface for said developer unit, and means for firmly anchoring said stop member to said main frame unit.

3. The apparatus of claim 2 wherein said stop member comprises a rotatable eccentric cam having a threaded radial bore, and

said anchoring means comprises a shaft secured to said main frame unit and a lock screw engageable with said threaded bore and the surface of said shaft to lock said cam thereto.

4. The apparatus of claim 1 wherein said spacing means comprises a shaft journaled at a first end thereof in said main frame unit,

a first eccentric cam fixed to said shaft adjacent said first end for providing a first reference abutment surface for said developer unit,

a support fixed to said main frame unit for rotatably supporting the other end of said shaft,

a second eccentric cam positioned on said shaft adjacent said other end for providing a second reference abutment surface for said developer unit,

means for axially adjusting said first and second eccentric cams to a predetermined position, and

means for locking said first and second eccentric cams in said predetermined positions.

5. The apparatus of claim 4 wherein said adjusting means comprises a first knob fixed to said shaft adjacent said other end and a second knob fixed to said second eccentric cam.

6. The apparatus of claim 5 wherein said support includes a tubular member having a threaded radial bore, and

said locking means includes a first lock screw engageable with said threaded radial bore and the surface of said shaft for interlocking said shaft and said tubular member.

7. The apparatus of claim 6 wherein said second eccentric cam has a threaded radial bore, and

said locking means further includes a second lock screw engageable with said threaded radial bore of said second eccentric cam and the surface of said shaft for locking said second eccentric cam thereto.

8. The apparatus of claim 1 wherein said maintaining means comprises an anchor bar fixed to said second frame unit, and spring means coupled to said anchor bar for urging said developer unit against said spacing means.

9. The apparatus of claim 8 wherein said spring means comprises first and second spring members located adjacent opposite sides of the front portion of said developer unit.

10. The apparatus of claim 1 wherein said maintaining means comprises first and second channel members coupled to said frame unit for slidably supporting said developer unit at opposite sides thereof,

a pair of guide members secured to and protruding frontwardly of said developer unit,

an anchor bar rigidly secured to said second frame unit forwardly of said developer unit and slidably disposed on said guide members, and

a pair of spring members coupled to said anchor bar for urging said developer unit against said spacing means.

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