June 21, 1966 C. F. CARLSON 3,257,222

ELECTROSTATIC RECORDING METHOD AND APPARATUS
USING SHAPED ELECTRODES
Filed July 2, 1962

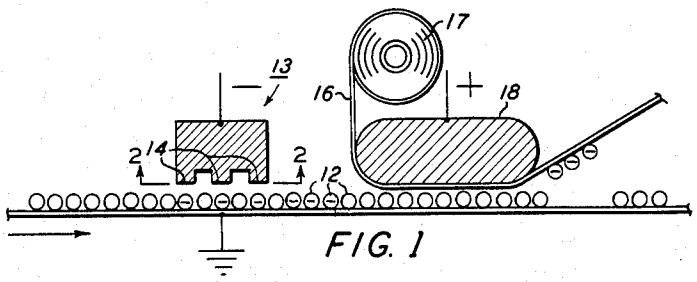



FIG. 1

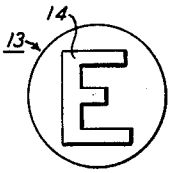



FIG. 2

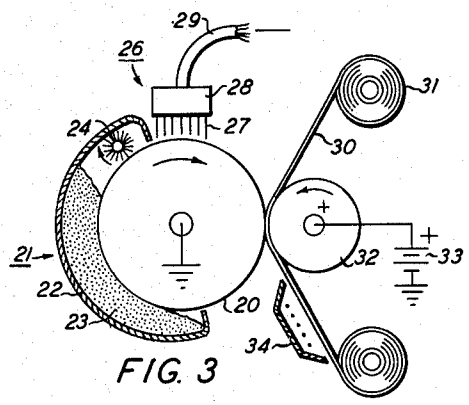



FIG. 3

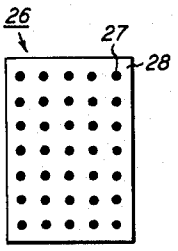



FIG. 4

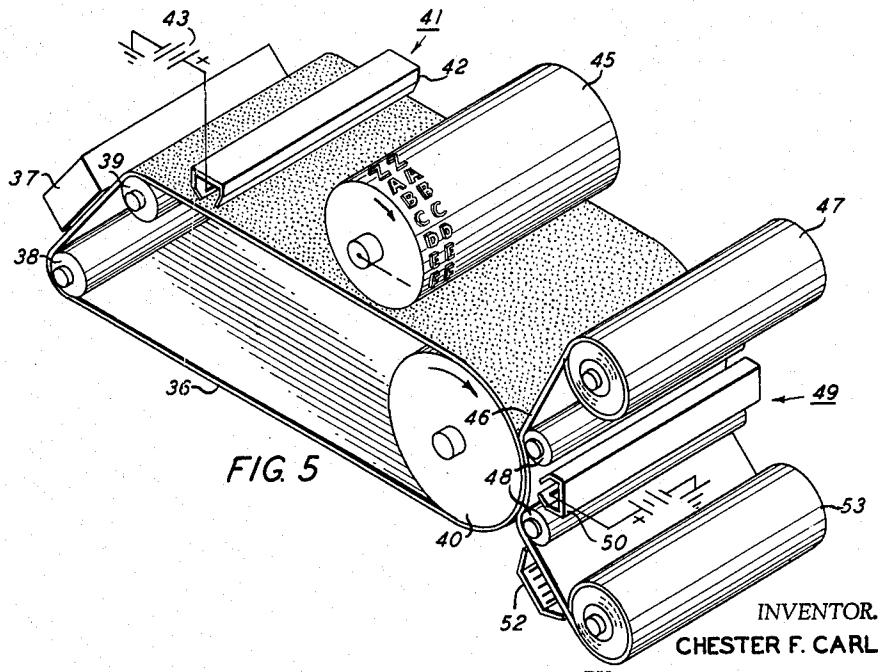



FIG. 5

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# ELECTROSTATIC RECORDING METHOD AND APPARATUS USING SHAPED ELECTRODES

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20 Claims. (Cl. 117—17.5)

This invention relates in general to electrostatic recording, and, in particular, an improved method of Tesiprinting.

As originally conceived and disclosed in U.S. Patent 2,297,691 to Carlson and later related patents, latent electrostatic images are generally formed for use in the graphic arts by charging a photoconductive insulating member and subjecting it to a pattern of activating electromagnetic radiation which serves to render it relatively conductive in radiation struck areas thereby allowing the dissipation of charge in those and areas and leaving a charge pattern conforming to the electromagnetic radiation pattern. Thus, a uniform charge pattern is placed over the whole surface of the photoconductor and selectively dissipated in accordance with the image to be reproduced. The image is then developed or made visible by the deposition therein of electrostatically attractable finely divided material referred to in the art as toner.

More recently, it has been found that electrostatic latent images may advantageously be formed upon insulating mediums by controlled or selective charging from a shaped electrode, thereby eliminating the need for a photoconductor and an exposure step. Since pohotoconductors operate with relatively low speeds normally associated with photographic material, their inclusion is the main speed limiting factor in the formation of electrostatic images. It has therefore been found this new method of image formation known is Tesiprinting and first disclosed in British Patent 734,909 to Carlson is virtually instantaneous in its response and is well adapted for the recording of conventional coded electric signals including high speed alphanumeric computer output printing high speed facsimile output printing, and the like. A typical application of Tesiprinting is disclosed in U.S. Patent 2,919,967 to Schwertz. Various other electrode configurations including bar matrics, pin matrices of the type shown in FIGURES 4 and 5 of U.S. Patent 2,978,968 to Schwertz, or the like may also be used. Since tesiprinting produces a latent electrostatic image in the shape of the electrode or electrode combination used, image shape is limited only by the imagination of the electrode designer.

The type of Tesiprinting described above forms a latent electrostatic charge pattern upon an insulating recording medium which generally requires an additional developing step in order to make it visible. Inherently, this separate development produces spatial and temporal separation between image formation and image visibility. Since the type of Tesiprinting described above deposits charge on the insulating recording web by virtue of an ionizing field discharge between two electrodes on either side of the recording web, the recording web must be a good enough insulator so that it does not break down upon charge deposition. This frequently requires use of coated papers or papers which have been pre-dried immediately prior to use. This limitation is overcome by the technique of this invention.

It is an object of this invention to provide a novel tesiprinting method and apparatus.

It is a further object of this invention to provide a novel Tesiprinting method and apparatus which may employ ordinary paper as its recording medium.

It is also an object of this invention to provide a tesiprinting system which affords more ready access to a visible image after image formation.



It is a further object of this invention to provide a novel method of Tesiprinting.

The above and still further objects, features, and advantages of the present invention will become apparent upon consideration of the following detailed disclosure of the invention especially when taken in conjunction with the accompanying drawings where:

FIGURE 1 is a simplified side view of the improved Tesiprinting system with some portions enlarged to facilitate description.

FIGURE 2 is a sectional view taken along section lines A—A of FIGURE 1.

FIGURE 3 shows the improved printing system of this invention being used with an alphanumeric high speed electrode wheel cylinder.

FIGURE 4 is a side view of the improved Tesiprinting system of this invention including a pre-charging station and a pin matrix electrode.

FIGURE 5 is a plan view of the pin matric of FIGURE 4.

Referring now to FIGURE 1 there is shown a grounded conductive belt **11** which may be of copper, aluminum, or the like, carrying a relatively uniform layer of finely divided electroscopic particles **12**. The belt may be smooth or grained as long as it is relatively smooth with respect to the raised portions **14** of electrode **13**. Likewise, the belt can carry a bonded insulating coating either as a continuous film of plastic, for example, or discrete small islands or a grid pattern of insulating material. The particles, which have been grossly enlarged in this view for purposes of illustration, may be of the same composition and size as developing particles of the type generally used in xerographic development and referred to in that art as toners, and must be electrically insulating. These toners, which are available from Xerox Corporation of Rochester, New York, under the trade names 914 Toner, Type 10 Toner, etc., are made of insulating material such a rosin modified phenol formaldehyde, polystyrene, and styrene-methacrylate copolymer containing a coloring material such as carbon black and range in the size from 1–20 microns and as a rule have an average size of from 3–10 microns. Toners of this type are more fully described in U.S. Patent 2,788,288 to Rheinfrank et al., U.S. Patent 2,891,-011 to Insalaco, and U.S. Reissue 25,136 patent to Carlson, among others.

The conductive belt coated with toner particles moves into the system from the left, as seen in FIGURE 1. As shown in this figure, the entering toner particles are uncharged. As the belt moves along through the system it comes under character electrode **13** which has raised portions **14** in the form of an arbitrary character or symbol to be printed. This is shown more clearly in FIGURE 2. The character electrode **13** is spaced a short distance above the toner covered belt, the distance ranging from 2–7 mils for best results, however the distance may be substantially greater. Toner coated web **11** then moves into contact with a copy sheet **16** from supply roll **17**. At the point where the copy sheet **16** contacts the toner coated conductive belt **11** the copy sheet is positioned adjacent to electrode **18**. In this illustration a positive potential is applied to the electrode to strongly attract any negative toner particles between the copy surface **16** and conductive belt **11** toward the copy surface and to repel any positively charged toner particles toward the conductive belt **11**.

If the particles are uncharged or positively charged as they enter the system no particles will transfer to the copy sheet **16** unless negative charge is imparted to some or all of the particles during their passage through the system.

If it is desired that particles on the web in the form of the character E be transferred to the copy surface **16**, a relatively high negative potential with respect to the belt is applied to character electrode **13**. This potential must be of sufficient magnitude to cause an ionizing field discharge between the raised portions **14** of character electrode and the grounded conductive belt **11**.

If desired, the belt **11** may be maintained at a bias potential with respect to the character electrode. By keeping a positive bias potential relatively large but below that necessary to initiate field discharge, i.e., below the breakdown point, a relatively small negative pulse applied to the character electrode is all that is necessary for printing. Once breakdown occurs in the gap between the character electrode and the grounded belt **11**, negative ions and electrons move toward the relatively positive grounded belt depositing negative charge on the toner particles. Since the raised portions **14** of the character electrode are closer to the grounded conductive belt **11**, field discharge is confined to the spaces between these raised portions of the electrode and the grounded belt owing to the higher electric field in those areas thus causing charge to deposit only on those toner particles opposite the raised portions of the character electrode. This charges the particles in character configuration.

Although the potential necessary to initiate an ionizing field discharge between the character electrode and the grounded conductive belt **11** is dependent on many factors including gap spacing between the electrode and the belt, and the ambient relative humidity, voltages of from 750 to 2,000 volts are generally used at the gap spacings given above. U. S. Patent 2,937,943 to Walkup describes such field discharges and FIGURE 4 of that patent illustrates a set of curves defining discharge conditions. Although the above noted potentials are operative it is generally preferred to use a voltage ranging from 900 to 1200 volts so as to insure a field strong enough to initiate the field discharge without requiring an excessively high voltage power supply. The width of the pulse should generally be narrow with respect to the speed of belt **11** so as to prevent image blurring. Since pulses in the 2–50 microsecond range have been found effective for charging, blurring is not generally a problem even at high belt speeds.

As should be clear at this point in the explanation of this invention, the polarity of voltages applied to character electrode **13** and transfer electrode **18** may be reversed and still produce the same results. It should also be noted that the toner particles instead of coming into the system uncharged may all be uniformly precharged to the polarity opposite to that applied to the character electrode and therefore to the same polarity as the transfer electrode **18**. This tends to insure that toner particles which are not charged by the character electrode will not transfer to the copy sheet **16** since the transfer electrode **18** which is of the same polarity as the toner originally coming into the system tends to repel any toner particles whose polarity have not been changed by the character electrode. It also eliminates the effect of any accidental precharging of particles. Precharging in this manner creates a bias which allows a lower voltage to charge particles in image configuration. The needed voltage for an ionizing field discharge is supplied in such an instance by the sum of the pulse and the voltage of the precharge.

Alternatively, if the polarity of the potential applied to the transfer electrode is the same as the polarity of the charge on the toner particles selectively charged by the printing electrode and opposite to that of all other precharged particles, only the particles not acted upon by the printing electrode will transfer to the copy sheet resulting in a negative copy.

In FIGURE 3 there is shown an automatic continuous machine embodying the concepts of this invention utilizing a cylindrical conductive drum **20** in place of the conductive belt **11** shown in FIGURE 1. As drum **20** rotates in the direction indicated a coating apparatus **21** deposits toner particles uniformly over its surface. The coating apparatus includes a C-shaped container **22** adjacent the drum **20**. A supply of developer **23** in the container coats the surface of conductive drum **20** with toner when the drum runs through it. A rotary brush **24** may optionally be provided to smooth out the toner coating on the drum surface and to remove any excess toner which may be left on the drum **20** after it passes through developer supply **23**. Preferably, drum **20** has a grained or grid-like surface or small raised islands across its surface to more easily pick up and carry toner particles from the developer supply **23**. Developer **23** may consist of a two-element developing mixture including the toner particles and grossly larger carrier beads. As described more fully in U. S. Patents 2,618,551, 2,618,552, and 2,636,416 to Walkup, Wise, and Walkup et al., respectively, the carrier beads serve to deagglomerate the toner particles and to charge them by virtue of the respective positions of the carrier beads and the toner particles in the triboelectric series when the developing mixture is tumbled in the C-shaped container. In addition, conductive drum **20** may be coated with an insulating material so as to precharge the toner particles and electrostatically attract them to drum **20**. This type of charging is accomplished by virtue of the respective positions of the insulating coating on the drum and the toner particle material in the triboelectric series. With this technique the particles may be either positively or negatively charged depending upon whether the insulating coating on drum **20** is above or below the toner particle material, in the triboelectric series.

As the toner-loaded conductive drum **20** rotates in the direction indicated by the arrow in FIGURE 3 it comes below a pin matrix generally designated **26** which is made up of a number of uniformly spaced protruding conductive pins **27** embedded in an insulating block **28**. Each pin is thus maintained electrically separated from each of the other pins. Although the number of pins used and their configuration is optional, a matrix made up of five columns, each containing 7 pins with successive pins of each column forming rows as shown in FIGURE 4, is used here. Each of the pins is connected to one of a group of separate actuating wires in a cable **29** so that a source of high potential may be applied to any pin or group of pins in the form of any letter, number, or arbitrary symbol. This potential is shown as negative for purposes of illustration. Each pin so actuated initiates an ionizing field discharge between its end and the drum surface thereby serving to charge toner particles directly beneath the end of actuated pins. The drum then continues to move, coming into contact with a moving web or copy sheet **30** supplied from roll **31** and backed up by transfer electrode roller **32**. Transfer electrode roller **32** is kept at a relatively high voltage by potential source **33**. By maintaining this potential at least a few hundred volts from ground and making its polarity opposite to that applied to the actuated pins of pin matrix **26**, transfer of any toner particles selectively charged by the pin matrix from the drum to the copy sheet is accomplished. In this case the transfer electrode is kept positive. If the particles are precharged, as for example by the use of an insulating coating on drum **20** having the proper triboelectric properties, and if this precharging is to the same polarity as the potential maintained on the transfer electrode roller **32**, the transfer electrode will serve not only to attract selectively charged particles but also to repel particles on the drum which have not been so charged. In the case of the illustrative embodiment described in connection with FIGURE 3, the coating on the drum would be selected so as to give the toner particles a positive precharge. However if the polarities applied to the pin matrix and the transfer electrode are reversed, the precharging polarity should also be reversed

to produce the same effect. It should be noted at this point that the embodiment of this invention described in FIGURE 3 might also utilize other toner precharging techniques known in the art. For example, a corona discharge electrode or electrode array may be used to uniformly precharge the toner coating after it is applied to conductive drum **20** and just prior to its selective charging by pin matrix **26**. This type of precharging is more fully described in connection with the FIGURE 5 embodiment of this invention. Preferably, all of the ends of conductive wires **27** on pin matrix **26** are spaced a uniform distance from the surface of conductive drum **20**. This may be accomplished either by using pins of different lengths at different positions in the matrix so that long pins are used at the ends of the matrix as seen in FIGURE 3, with progressively shorter pins being used toward the middle of the matrix, or by a using an insulating block **28** having a face curved so that it is concentric with the drum. After selectively charged toner particles are transferred to the copy sheet **30** which moves at the same speed as the peripheral speed of drum **20**, the copy sheet passes under a resistance heater **34** which fuses the toner particles to the copy sheet, making a permanent copy of the printed material. Alternatively, other well known xerographic fixing techniques may be used, such as spraying the copy sheet with a solvent mist, applying an adhesive overcoating to the copy sheet, or the like. Thus it may be seen that by moving the circumference of drum **20** a distance equal to the width of the pin matrix for each actuation of the matrix, toner particles are selectively charged in any desired configuration by the matrix and this charged toner is then transferred to a sheet of copy paper. Since the copy sheet merely serves as a substrate or support for this transferred toner, the copy sheet may be an inexpensive paper or plastic material.

Although only one pin matrix has been described in connection with FIGURE 3, a number of matrices may be utilized in a row across the width of the conductive drum **20** so as to allow for line-at-a-time printing on a wide copy sheet by exciting the proper pins in each matrix simultaneously to produce all the letters in a complete line of print.

In FIGURE 5 there is illustrated a conductive belt **36** similar to belt **11** of FIGURE 1. This belt is coated with toner particles by a diagrammatically illustrated powder cloud generator **37**. The generator forms the toner particles into an aerosol and deposits particles from the aerosol onto the belt. Powder cloud generators of the type generally used in xerography may be used here. Exemplary generators of this type are disclosed in U.S. Patents 2,862,646 to Hayford, 2,918,900 to Carlson, 2,725,304 to Landrigan, and 2,943,950 to Ricker. These patents also describe techniques for charging the particles in the aerosol prior to the application to the belt **36**. Powder may also be applied to belt **36** by a rotating brush in contact with the belt supplied with toner as described for example in U.S. Patent 2,959,153 to Hider or with a rotary brush duster of the type shown in FIGURE 1 of U.S. Patent 2,624,652 to Carlson.

Belt **36** is entrained about 3 rollers **38**, **39**, and **40**, at least one of which is driven to move the belt. At least one of these three rollers is preferably formed of a conductive material and is grounded so as to keep the belt at ground potential. Although three rollers have been shown in this figure with grounding accomplished through one of the rolls, it should be clear that various other roller drive arrangements or drives of altogether different types may be used. Other grounding techniques may also be used. For example, the belt could be driven around four small rolls such as **38** and **39** and grounding could be accomplished through a wiping contact rubbing against the back of the belt.

Although, as described above, the toner particles may be charged prior to or at the time of their deposition on the grounded conductive belt, for example by using a powder cloud generator in the charging mode, a charging apparatus **41** is included in this embodiment of the invention as an alternative and in order to insure uniformity of charge polarity and magnitude on the toner particles previously deposited on belt **36**. This charging apparatus consists of a shielded corona generating filament or filament array **42** connected to a source of high potential **43** as more fully described in U.S. Patents 2,588,699 to Carlson, 2,777,957 to Walkup, 2,778,946 to Mayo, and 2,836,725 to Vyverberg. By bringing the charging apparatus **41** to a high potential with respect to belt **36**, an ionizing field or corona discharge takes place between the filaments of the charging apparatus and the conductive belt **36**. The ions drawn toward belt **36** serve to charge the toner particles on the belt surface. After the layer of toner particles on belt **36** has been uniformly charged to one polarity by the charging apparatus it moves beneath a high-speed, rotary alphanumeric electrode drum **45** of the type shown and described in U.S. Patent 2,919,967 to Schwertz. This drum which is rotatably mounted and driven at a high constant angular velocity has on its surface a bank of identical character rings each containing a series of character shaped raised electrodes in a circumferential arrangement. One ring of characters is provided for each column of material to be printed. The characters in each ring may be composed of alphabetical letters, numbers, or any other arbitrary symbols as desired. By electrically separating the character rings on the alphanumeric drum and applying a short-duration, high-magnitude pulse to each ring at a selected point in the rotation of the drum, toner particles representative of a complete line of print containing the desired characters are charged on the conductive belt surface **36** by virtue of the ionizing field discharge between the selected character electrodes and the conductive belt surface. Exemplary pulsing circuits necessary for this type of operation are disclosed in U.S. Patents 2,919,967 to Schwertz and 2,776,618 to Hartley. The circuits generally include means to decode binary-coded input information, means to compare these inputs with the angular position of the drum, and means to apply an electrical pulse to the proper character ring on the drum when there is coincidence between the input signal and the angular position of the drum. Preferably, the percentage of the circumference of alphanumeric drum **45** taken up by any one character in a character ring is small so that none of the points on the face of any one character vary very widely in their spacing from the surface of conductive belt **36**. Obviously this may be accomplished either by using a relatively large drum or relatively small characters. If this is not done it may be found that, because the center of a character is closer to conductive belt **36** than its top and bottom, only the center of the character will print when the printing pulse is applied. Alternatively, alphanumeric drum **45** may have a relatively small radius and each character on its surface may be fabricated with a compensated or planar face so that when one of these characters is directly opposite conductive belt **36** its face will be substantially parallel with the belt.

After selective charging of the powder layer by the alphanumeric drum it moves forward on belt **36** until it comes into contact with a copy sheet **46** from a supply roll **47**. The copy sheet **46** is entrained about two rollers **48** which press it up against the toner coated conductive belt **36** as it passes over roller **40**. Behind copy sheet **46** and between rollers **48** there is a transfer charging device **49** made up of a shielded corona discharge filament **50** and a potential source **51** opposite in polarity to the potential applied to alphanumeric drum **45**. This transfer charging device may be of essentially the same construction of charging device **41** described supra. Charging device **49** acts to deposit charged ions on the back of copy sheet **46** in a manner similar to the charg-

ing of the toner layer by charging device **41**. These charges on the back of copy sheet **46** act either to attract or repel toner particles passing the copy sheet on conductive belt **36** according to the polarity of charge on the particles. If the precharging device **41** had uniformly charged all toner particles passing beneath it on belt **36** to a positive polarity and alphanumeric drum **45** had selectively recharged toner particles in the configuration of the material to be reproduced by the system to a negative polarity all of these recharged particles could be transferred to the web or copy sheet **46** by applying a positive potential to charging device **49** so that it would deposit positive charge on the back of the copy sheet **46**. This would occur since the positive charge on the back of copy sheet **46** would attract negatively charged toner particles on conductive belt **36** to the copy sheet while repelling any positively charged particles on the belt. This serves to produce a sharp, background-free image on the copy sheet conforming in shape to the pulsed characters on alphanumeric drum **45**. After the toner image is transferred to copy sheet **46** it passes a fusing device **52** and is then wound on a take-up roll **53**. In this view the fusing device **52** is of the resistive heating type well known in the xerographic art, however any known fixing technique may be utilized with this invention.

The present invention has been described with reference to certain specific embodiments which have been presented merely to illustrate the invention. It is to be understood, however, that numerous variations of the invention may be made and such variations are well within the intended scope and spirit of the invention. These variations may include such diverse modification as the use of different types of toner, the use of various types of apparatus and techniques for precharging the uniform toner layer, for selectively recharging the layer, and for transferring the toner to a copy sheet. Variations may also be made in the type and form of the conductive toner carrier. In addition to these various alternatives, many of which have been described in the body of this specification, other modifications coming within the scope of the invention may also be made. For example, the polarity of either the transfer electrode or the transfer corona generating electrode may be reversed so as to transfer only toner particles in areas which have not been selectively recharged by either the pin matrix or the alphanumeric wheel, as the case may be. This would result in the transfer of a negative image to the copy sheet rather than in the transfer of a positive. This same result could also be accomplished by maintaining the same polarity on the transfer mechanism while reversing the polarities of the precharging and the selective charging steps. In addition the positive or negative image may be left on the conductive carrier, whether it be in the form of a drum or a belt, and may be viewed directly if this should prove desirable. Thus it is to be understood that all such variations are within the scope of the following claims:

What is claimed is:

**1.** An electrostatic printing apparatus comprising:
(a) a conductive carrier member,
(b) means to deposit a layer of finely divided electroscopic particles on a surface of said carrier member,
(c) electrode means including at least one shaped electrode having a surface area shaped in the form of at least a part of an image to be formed, said surface being spaced slightly from the particle covered surface of said carrier member,
(d) means to apply an electrical potential between at least one shaped electrode of said electrode means and said carrier member, said potential being of sufficient magnitude to cause an ionizing field discharge between said shaped electrode and said carrier member so as to selectively charge to a first polarity the electroscopic particles opposite the surface areas of said shaped electrode at the time of potential application,
(e) a transfer web contiguous to at least a portion of said carrier member,
(f) means to apply an electrostatic field across said transfer web and said conductive member, said field being of a polarity and magnitude to transfer said selectively charged particles to said web, and
(g) means to move said conductive carrier member with respect to said particle depositing means, said shaped electrode and said transfer web so that it passes them in their named order.

**2.** Apparatus according to claim **1** in which said electrostatic field applying means comprises a transfer electrode closely adjacent to that surface of the transfer web which is furthest from said conductive carrier member and means to apply a potential to said transfer electrode, said potential being of a polarity opposite to said electroscopic particles by said shaped electrode.

**3.** Apparatus according to claim **1** in which said electrostatic field applying means comprises a corona generator spaced from and on that side of said transfer web furthest from said conductive member and means to apply a potential between said corona generator and said conductive member, said potential being of a magnitude sufficient to initiate a corona discharge from said corona generator and being of a polarity to deposit charge on said transfer web opposite in polarity to said selectively charged electroscopic particles.

**4.** Apparatus according to claim **1** further including means to uniformly charge said deposited layer of finely divided electroscopic particles on the surface of said conductive member prior to its selective charging by said shaped electrode and to a polarity opposite that of said first polarity charge applied by said shaped electrode.

**5.** Apparatus according to claim **4** in which said precharging means comprises a corona generator connected to a source of high potential.

**6.** Apparatus according to claim **1** in which said electrode means includes at least one alphanumeric character shaped electrode.

**7.** Apparatus according to claim **1** in which said electrode means is made up of a number of electrically separated conductive portions adapted to be individually connected to a source of high potential.

**8.** Apparatus according to claim **1** further including means to fix said transferred particles of said transfer web.

**9.** An electrostatic printing apparatus comprising:
(a) a grounded conductive carrier member at least the surface of which is movable,
(b) means to apply finely divided electroscopic marking particles to the movable surface of said conductive carrier member,
(c) electrode means including at least one conductive character shaped member spaced from about 2–7 mils from said particle covered carrier,
(d) means to apply a short duration electrical potential between said character shaped member and said conductive carrier member, said potential being of sufficent magnitude to cause an ionizing field discharge between said character shaped member and said carrier member so as to selectively charge to a first polarity the electroscopic particles opposite the surface area of said shaped electrode at the time of pulse application,
(e) a transfer web contiguous to at least a portion of said carrier member,
(f) means to apply an electrostatic field across said transfer web and said carrier member, said field being of a polarity to transfer said selectively charged particles to said transfer web,
(g) and means to move said smooth surfaced conductive member past said particle depositing means, said character shaped member and said transfer web in that order.

10. An electrostatic printing apparatus comprising:
(a) a conductive carrier member,
(b) means to deposit a layer of finely divided electroscopic particles on a surface of said conductive member,
(c) means to uniformly charge said deposited layer of finely divided electroscopic particles to a first polarity,
(d) electrode means including at least one electrode having an end with a shape representative of at least a portion of information to be printed, said electrode end being spaced slightly from said particle covered surface of said conductive member,
(e) means to apply an electrical potential between said shaped electrode end and said conductive member, said potential being of a sufficient magnitude to cause an ionizing field discharge between said shaped electrode end and said conductive member so as to selectively charge to a second polarity the electroscopic particles on said conductive member opposite the shaped surface area of said electrode end at the time of potential application,
(f) a transfer web contiguous to at least a portion of said conductive member,
(g) means to apply an electrostatic field across said transfer web and said conductive member said field being of a magnitude to transfer the particles charged to one of said polarities to said transfer web,
(h) and means to move said smooth surfaced conductive member with respect to said particle depositing means, said shaped electrode end and said transfer web so that it passes them in their named order.

11. A method of electrostatic printing comprising:
(a) applying an electrical potential between at least one shaped electrode having a surface area shaped in the form of at least a part of an image to be formed and a conductive carrier member coated with finely divided electroscopic particles, said potential being of sufficient magnitude to cause an ionizing field discharge between said shaped electrode and said conductive member so as to charge only those electroscopic particles opposite said shaped electrode to a first polarity,
(b) moving that portion of said conductive member on which resides said selectively charged particles with respect to a transfer web so that said particles are in contiguous relationship with said transfer web,
(c) applying an electrostatic field across said transfer web and said conductive member, said field being of a polarity to transfer said selectively charged particles to said transfer web, and
(d) moving said transfer web away from said conductive member whereby a particle image in the form of said shaped electrode is formed on said transfer web.

12. A method according to claim 11 including coating a layer of finely divided electroscopic particles on said relatively smooth surfaced conductive member and bringing said coated conductive member into proximity with said shaped electrode prior to the application of potential between said shaped electrode and said conductive member.

13. A method according to claim 12 including precharging said layer of finely divided electroscopic particles on said conductive member to a polarity opposite to that applied to said electroscopic particles by the application of potential between said shaped electrode and said conductive member.

14. A method according to claim 13 in which said precharging is accomplished triboelectrically while said particle layer is being deposited on said conductive member.

15. A method according to claim 11 including fixing said transferred particles on said transfer web after moving said web away from said conductive member.

16. A method of electrostatic printing comprising:
(a) applying an electrical potential between a relatively smooth surfaced conductive member coated with finely divided electroscopic marking particles and a selected group of electrodes in an electrode matrix spaced slightly from the surface of said conductive member, said potential being of sufficient magnitude to cause an ionizing field discharge between each of said selected electrodes and said conductive member so as to selectively charge the electroscopic particles opposite the surface area of said selected electrodes to a first polarity,
(b) moving at least that portion of said conductive member upon which said selectively charged particles reside with respect to a transfer web so that said selectively charged particles are contiguous with said transfer web, and
(c) applying an electrostatic field across said transfer web and said conductive member, said field being of a polarity to transfer said selectively charged particles to said transfer web.

17. A method according to claim 16 including coating a layer of finely divided electroscopic marking particles on said relatively smooth surfaced conductive member and bringing said coated conductive member into proximity with said electrode matrix prior to the application of potential between said electrode matrix and said conductive member.

18. A method according to claim 17 including precharging said layer of finely divided electroscopic marking particles on said conductive member to a polarity opposite to that applied to said particles by the application of potential between selected electrodes in said electrode matrix and said conductive member.

19. A method of electrostatic printing comprising:
(a) depositing a uniform layer of finely divided electroscopic particles on a conductive carrier,
(b) uniformly charging said finely divided electroscopic particles to a first polarity,
(c) applying an electrical potential between at least one shaped electrode having a surface area shaped in the form of at least a part of an image to be formed and said conductive carrier, said potential being of sufficient magnitude to cause an ionizing field discharge between said shaped electrode and said conductive carrier and of a polarity opposite to that of the initial charge polarity of said particles so as to charge only those electroscopic particles opposite said shaped electrode to a second polarity,
(d) moving that portion of said conductive carrier on which resides said selectively charged particles with respect to a transfer web so that said particles are in contiguous relationship with said transfer web, and
(e) applying an electrostatic field across said transfer web and said conductive carrier said field being of a magnitude to transfer the particles charged to one of said polarities to said transfer web.

20. A method according to claim 19 further including fixing said transferred particles on said transfer web.

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