FIG-1

FIG-2

FIG-3b

FIG-3a

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APPARATUS FOR PRINTING
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ABSTRACT OF THE DISCLOSURE
A moving carrier penetrated by a beam of radiation whose cross section is changed by different templates to the outlines of different characters, carries color particles retained or released in accordance with the cross section of the beam so that images of selected characters can be successively transferred to a moving recording member and form a line thereon.

This invention relates to apparatus for printing and more particularly it relates to apparatus for printing letters and symbols with typewriters and the like.

The apparatus disclosed herein makes use of color particles which are magnetically influenceable and which are initially stored in a container. Carrier means are provided for transferring the particles from the container to a recording region. During the transfer, magnetic and/or electrostatic means are used to secure the particles to the carrier means.

At the recording region, the carrier means is subjected to a source of radiation which is shaped into the pattern of a writing character, thereby reducing the force with which some of the particles are held to the carrier means. Simultaneously with the reduction in holding force of the particles, magnetic and/or electrostatic means are used to attract the affected particles on to a recording member in the apparatus, the particles so transferred forming en masse a writing character. The particles transferred to the recording member are then permanently fixed thereon.

In this invention, the carrier means mentioned above comprise at least first and second carrier means which operate at different velocities. The first carrier means is used to transfer the particles from the storage container to the second carrier means, and the latter is used to transfer the particles to the recording region. The second carrier means has a layer thereon which is influenced by said source of radiation (which may be light) in such a manner as to reduce the holding force with which the particles are held to that portion of the layer which is subjected to the radiation. The particles whose holding force is reduced, form en masse the writing character. Suitable template means are positioned between the source of radiation and the second carrier means to provide for a selection of characters to be produced and transferred to the recording member.

A somewhat detailed outline of the steps used in the method of this invention is as follows:

(a) Electro-static and/or magnetic transmission of color particles from a storage container on a first carrier means which preferably transports the particles uniformly with a velocity V₁.

(b) Electro-static and/or magnetic holding of the color particle on this carrier means.

(c) Electro-static and/or magnetic transmission of the color particles from the first carrier upon a second carrier means which will carry them intermittently or uniformly with an average velocity V₂ into the recording area.

(d) Electro-static and/or magnetic holding of the color particles upon the second carrier means.

(e) Action of the radiation upon the photo-sensitive layer existing on the second carrier means in the recording region, for instance, by means of a local reduction of the resistance and conducting away thereby of the holding potential for the color particles, the particles so affected forming en masse a writing character.

(f) Influence of an electro-static and/or magnetic field essentially active in the recording region upon the color particles sticking to the second carrier means with reduced holding force.

(g) Transmission of these color particles so affected to the recording member.

(h) Electro-static and/or magnetic holding of the transmitted color particles in the shape of the writing character selected in each case, upon the recording member, namely in the recording region and beyond it in at least one further line position.

(i) Fixing of the writing character created as powder picture on the recording member by known devices preferably by the addition of heat.

An object of this invention is to produce a novel method and apparatus printing characters in devices such as typewriters and the like.

A further object of this invention is to produce an apparatus such as a typewriter in which the writing characters are developed with a minimum of noise.

Another object is to produce a method and apparatus which uses dust like color particles for forming the writing characters and which color particles are formed through using a low cost source of radiation in combination with magnetic and/or electrostatic means to produce an apparatus which can operate at high speeds.

A further object is to produce a method and apparatus as mentioned above in which some of the embodiments utilize a shifting recording member and others which utilize a stationary recording member to which the color particles are transferred.

These and other objects and advantages will be more fully understood by reference to the following detailed description and accompanying drawings wherein:

FIGURE 1 is a generally schematic view showing a first modification in which the first carrier means is in the form of a disc and the second carrier means is in the form of an endless belt having a portion which is parallel to and spaced from the recording region;

FIGURE 2 is an enlarged section in section of the construction of the second carrier means according to FIGURE 1;

FIGURE 3a is an arrangement in which the second carrier means is carried in the recording region over a stationary photo-conductive layer which may be actuated upon by a radiation action electrically and/or magnetically;

FIGURE 3b is an arrangement according to FIGURE 3a but with a protective layer;

FIGURE 4a is a side view of another embodiment in which the first carrier means which takes the color particle from storage as well as a second carrier means which takes the particle from the first carrier means and carries them into the recording region are constructed as turnable discs;

FIGURE 4b is an arrangement according to FIGURE 4a in front view;

FIGURE 5a is a portion of the second carrier means showing a foil carrier with tooth-shaped projecting carrier surfaces as seen from the recording area;

FIGURE 5b is the same carrier according to FIGURE 5a as seen from the radiation source;

FIGURE 6 is an arrangement in which the first carrier means is constructed as a disc and the second carrier...
The color particles 3 consist generally of a thermoplastic base material to which color has been added. The color addition if necessary may either show ferromagnetic properties themselves or separate ferromagnetic substances may be mixed into the basic bodies of the particles.

The electro-static holding and transfer forces may be exerted by potentials sparked upon the carrier means in a known manner or by the influence action of the potentials connected to the conducting layer of the carrier whereby the color particles, if needed, corresponding to their tribo-electric properties themselves may be provided with an additional negative or positive potential.

In the embodiment shown in FIGURE 1, the particles 3 on disc means 1 are carried at a velocity $V_t$ on the periphery thereof. The velocity of the belt means 4 is $V_s$ and is generally at right angles to $V_t$ when the particles are transferred to the belt means 4. In the preferred construction, velocity $V_s$ may be a multiple of the velocity $V_t$.

To transfer the writing characters to the recording member 6 there is shown a source of radiation 10 and template carrier means 11 which are provided for selectively profiling the rays from the source 10. The selection of the template means may be done by known electro-static means (not shown) which are controlled by a key system corresponding to a typewriter key system.

At the same time, by the use of such a key system, the switching on of the radiation source can be accomplished by known means so that the radiation source will be energized immediately after the template means is positioned to form the rays 12 passing therethrough into the desired writing character outline. During the changing of the template means, the recording member 6 may be shifted in known manner.

The duration of exposure of the source of radiation as well as the currents controlling the electro-magnet means 7, 8, and 9 and/or the electro-static potentials $E_a$, $E_b$, $E_c$ may be actuated automatically in cooperation with the stops of a typewriter keyboard by a known electronic time control, which need not be described in detail.

One example of the second carrier means 4 is shown in an enlarged scale in FIGURE 2. Here, $a_r$ is a radiation permeable foil body of flexible material. The surface of the foil body turned towards recording member 6 is provided with a layer $b_r$ of radiation permeable electrically conducting material which may be a vapor deposited molecular metal layer or the like, which in turn is covered with a thin photo-conducting layer $c_r$ of known kind.

At the borders of the carrier tape lying outside of the recording region the photo-conductive layer may, of course, be absent. Here the mentioned conductive layer can be strengthened galvanically so that it can be connected via suitable contact means, for instance, contact rollers with an external potential.

The operation according to the process of the arrangements heretofore described are the following:

By the influence of the transfer magnet 7 and/or an electro-static potential $E_a$, when turning disc 1 successively, a part of the dust-like color particles 3 whirled around in storage container 2 is transmitted in a thin layer upon a segment of the area of disc 1 turned towards belt means 4 and held there by electro-static force which are caused by potential $E_b$.

Due to the momentary inhomogeneity of the dust whirl the deposition of the color particles upon the recording track of disc 1 will show a certain irregularity which, however, changes its structure currently on account of the continuous movement of the device and the length of the entire recording track of disc 1.

Since the velocity $V_s$ ratio between the recording track
mentioned of the rotating disc 1 and the velocity $V_2$ of the belt means 4 may, for instance, assume a value $V_1/V_2 = 10$

it may easily be seen that when switching in the transfer magnet 8, the color particles of 10 unit areas of disc 1 will be transmitted upon each unit area of the belt means 4. This means, however, that the belt means or second carrier means 8, on account of the statistically changing distribution of the particles upon the recording track of the disc 1 is provided with a very uniform color dust layer which, in addition, is much denser and heavier than a layer which could be deposited upon the belt means by means of a one-time direct transference from the storage container.

The color particles 3 transmitted from disc means 1 to belt means 4 may be held thereon by a potential connected to the metal layer on the belt means and/or by an electro-static charge deposited on it by a sparking device of known construction. The holding forces for the belt means are selected so that in spite of switched in transfer magnet means 8 and/or the transfer potential $E_8$, the adhesion of the color particles on the belt means is sufficient to carry them along from the transfer region between the disc means 1 and belt means 4.

The movement of the belt means or second carrier means 4 with the color particles thereon into the recording region may either take place step by step or continuously, which is more advantageous for a high writing velocity and a simple construction of the drive. Known driving means (not shown) are provided for this purpose.

As soon as the carrier is provided with a sufficiently heavy and uniform layer of color powder according to the previously explained process, the first printing process is initiated on the keyboard. Hereby the writing symbol to be printed is selected in the template carrier 11 in a manner already suggested elsewhere and following it, the radiation source 10, for instance light source, is switched in. The profile bundle of rays 12 created hereby strikes carrier means 4 and penetrates the radiation permeable foil body 4a as well as the electrically conductive layer 4b and impinges upon the photosensitive layer 4c following in the layering. There in localized areas corresponding to the projected written image formed by the template means 11, it creates a reduction of the electrical resistance of the layer 4c. At these localized areas the electrical charge of the surface of the carrier means 4 flows off to the electrically conductive layer 4b, whereby the color particle 3 will now adhere with reduced force to the carrier means 4.

At the instant of the localized drop of the holding force, that is at the same time of the occurrence of radiation 12, the transmitting field of magnet means 9 and/or the electro-static field of the potential $E_9$ becomes active in such a manner that now all color particles adhering with reduced force to carrier means 4 are transmitted across the small air gaps of, for instance, 0.2 mm., instantaneously, upon the recording area 6 and present there a legible although not yet fixed powder image corresponding to the projected writing image or character.

The color particles transmitted in this manner upon the recording area 6 may be held fast upon the recording area by a magnetic pre-excitation by the field of an additional permanent magnet and/or by an electro-static pre-stress. Should this holding phase of the particles take place electro-statically, it may be practical to provide the electro-static field adjacent to the back side of the recording sheet 6 with an insulating layer so that uncontrolled potential conditions may not occur through varying conductivity of the recording sheet.

Since there will be relative movement between the recording member 6 and the recording region of the apparatus, it is necessary to make sure that the particles 3 transferred to the recording member will be held thereon until the particles 3 are permanently fixed thereeto. This can be accomplished by extending the pole area of magnet means 9 and/or the high tension electrode 9a in the direction of the formation of a line of writing characters transferred to recording member 6.

When the writing character is first transferred to the recording member 6 which may be a sheet of paper, the character is in the form of a powder image. With the means mentioned above it is possible to permit the character to remain in this powder form for several feeding steps of the member 6 before permanently fixing the image thereon. This enables typing errors to be eliminated without erasure of a permanent imprint. The removal may be accomplished by a brush, by a magnet, or by an electro-statically working device which attracts the powder image thereeto. It is also possible to remove a wrongly written symbol by a suction hose by which the powder is returned to the storage container.

The erasure devices mentioned above may be incorporated into a special erasing key on the keyboard so that the wrongly written character may be immediately removed by striking the erasing key.

To fix the transmitted writing character on the recording member, means are provided in a line section following the recording region to permanently fix the powder form writing characters on the recording member. The means may include heat means such as infra red radiation which will heat the powder image and liquify the thermo-plastic component of the color particles thereby fixing it to the recording member 6. Other means include a high frequency dielectric and/or magnetic alternating field which heats the color particles sufficiently for fixation.

Of course, a heating of the recording area by conduction is also possible. A heating area may be provided on the back side of the recording area 6 and adjacent to it which heats the writing surface locally each time to the permissible temperature. Another possibility would be that a hot air current likewise active only in one line section acts immediately upon the transmitted writing symbols. The turbulence of this air stream, of course, so be dimensioned that the holding forces which hold the powder image upon the recording area 6 will not be overcome.

In all cases mentioned, the fixation of the color particles by heat with a control of the heat transmission means depending upon the writing velocity can easily be accomplished.

If it is desired in the above described arrangement to drive the carrier means 4 as mentioned with a continuous velocity, then the feed path per second with a maximum writing velocity of 30 syringe particles of 103 mm. per second should correspond approximately to the 30 fold height of a writing symbol and therefore should be around 100 mm. so that when printing a writing symbol, gaps in the powder layer of the carrier caused by preceding recording will not detrimentally influence the new recording, but where it is not so important to get an absolutely faultless imprint, and especially when the average writing is done a much lower velocity, for example, one-half the speed 50 mm. per second will suffice.

Once the transmitting area is active, say, on account of switching on power means, the particles liberated in the manner described and migrating from carrier means 4 to recording area 6 are subjected to inertia in the direction of movement of the carrier as well as a magnetic acceleration in a direction perpendicular to the direction of this recording area. Hereby the motion component in the direction of the recording tape is retarded by the resistance of the surrounding air while the velocity perpendicular to the recording area is further increased by the accelerating field.

By assuming a distance between the carrier tape 4 and the recording area 6 of approximately 0.2 mm. and average transfer velocity of the color particles of 103 mm. per second, an approximate calculation of the de-
flection error results in a maximum value of approximately $10^{-2}$ mm. Such a small deflection is permissible particularly since it acts uniformly upon the entire symbol to be transmitted, and therefore merely produces a total displacement in the direction of the carrier movement which is hardly noticeable. Therefore, the carrier means 4 can advantageously be run continuously.

Another embodiment of this invention is shown in FIGURE 3a which shows a portion of the second carrier means in the reading region. The belt means mentioned herein comprises a ribbon 14 which is also electrically insulated. The ribbon or belt 14 is subjected to an electrostatic charge by a sparking device such as 13 shown in FIGURE 1, and the color particles 3 are accordingly held on the belt 14. At the recording region, a fixed guide plate member 15 is provided whose basic body is made up of electrically conducting and radiation permeable material 15a. On the side of material 15a adjacent to belt 14 there is provided a photo sensitive layer 15b. This embodiment works in a manner similar to that shown in FIGURE 1.

FIGURE 3b shows another embodiment similar to FIGURE 3a in which a protective layer 15c is positioned between the plastic belt 14 and the photo sensitive layer 15b. The protective layer 15c protects the sensitive layer 15b from the abrasive effects of belt 14 passing thereon.

The protective layer or plate 15c may be made from a bundle of thin mutually insulated wires which are glued together and which are polished on the side towards belt 14 and may be provided with the photo sensitive layer 15b on the other side. The photo sensitive layer 15b is then electrically connected to base plate 15a, which is in turn connected to electrostatic potential E.

In this construction, the light rays 12 pass through the light permeable layer 15a and impinge upon the layer 15b which is responsive thereto. The lowering of resistance of layer 15b is transferred to layer 15c which conducts exclusively perpendicular to its area extension to reduce the force with which particles 3 are held to ribbon belt 14. The particles formed into the writing character are then transferred to the recording member 6 by means 9 and/or 60 as previously explained.

Another embodiment of the invention is shown in FIGURES 4a and 4b, in which the first and second carrier means are disc means 23 and 21, respectively. The axis of rotation 22 of disc means 21 is located along the line of travel of the characters formed on the recording member 6, and the disc means 23 may be rotated continuously or in stepped timed relation to the keyboard of the typewriter as keys are struck by known means.

A portion of the peripheries of disc means 23 and 21 are in overlapping spaced parallel relation as shown in FIGURE 4a. The color particles 3 may be transferred to the disc means 23 by electro-magnetic means 7 and/or electrostatic means 7a in a manner similar to the other embodiments disclosed herein.

The second carrier disc means 21 has at least an annular area passing across the recording region, which area is radiation permeable and electrically conducting or is made from non-conductive material which is covered on the sides and towards the recording member 6 with a conductive radiation permeable layer as previously explained. A photo-sensitive layer 21c is also positioned thereon. The electrostatic potentials E are connected to the shaft of the disc means as shown at 24, for example.

The transmission of the color particles from the second carrier means 21 to the recording member 6 takes place in a manner similar to the process explained in FIGURE 1 through influence of magnet means 8 and/or the electrostatic system 8a upon the color particles 3 deposited upon disc means 23. It is practical even in this construction to choose the rotatable speed of the disc means 23 greater than that of disc means 21. Likewise, the color particles 3 transmitted to the disc 21 are selectively carried to the recording member 6 under the influence of the radiation bundle 12 in the same manner as previously explained.

In the embodiments mentioned up to now, it is possible with second carrier means (4, 14, and 21) to see the characters formed on the recording member only after the recording member has been moved sufficiently for the characters to clear the second carrier means. Errors in typing can be eliminated by moving the recording member a suitable number of spaces by a space key provided on the keyboard in known manner to enable the wrongly written character to be seen and erased as previously explained. With automatically operated typewriters which are fed by a control tape it is not necessary to see each letter as typed since the typewriter under such conditions is not subject to manual error.

If it is desired to see the powder image transferred to the recording member 6 immediately after transference thereof, means can be provided to permit this viewing. FIGURES 5a and 5b show one such form of the invention may take. The second carrier means 31 is in belt form and layer 31a is a radiation permeable strip which in its width represents the basic body of the carrier. A radiation permeable metal of metal 31b is deposited on the strip in tooth form as shown. The metal deposit is then covered at the narrows cross hatched areas 31c with a photo-conductive layer to which the color particles adhere, as shown at 31d.

The carrier 31 thus constructed is then discontinuously fed by a known stepping device which is controlled by the key system of the typewriter. The color particles 3 are transferred to the recording member by the same technique disclosed in relation to FIGURE 1.

FIGURE 5b shows the carrier 31 as seen from the side of the source of radiation and it is apparent that the character transferred to the recording member is immediately legible after each typing through one of the transparent surface 31a. The carrier 31 may be moved in steps corresponding to the height of the characters produced.

This same technique can be used for the second carrier means which are in disc form as shown in FIGURE 6. The disc means 36 can be layered and constructed in a manner similar to that shown in FIGURES 5a and 5b. The radiation permeable conductive layers are arranged in tooth-like areas 36b which are electrically conductive to the main disc area 36c, which are connected to a source of high potential E. The conductive surfaces 36b are covered with photo-responsive layers which correspond to areas 31c of FIGURE 5a.

The transmission of the color particles upon the individual intermittently progressive tooth areas 36b takes place as in the construction according to FIGURES 4a and 4b also in this case by a carrier 23 being constructed as a disc.

As may be recognized from FIGURE 6, the symbol written each time is immediately visible through the area 36a as soon as the known automatic feed means moves the disc one notch or one tooth space.

Another embodiment of the invention is shown in FIGURE 7, which avoids moving the second carrier means into the recording region. The particles 3 are transferred from the storage container 2 by disc means 23 to second carrier means 41 as previously explained. Second carrier means 41 is generally a plate-like carrier which may be electrically conductive and radiation permeable and which has a photo-sensitive layer 41c on the side thereof which is adjacent to the recording member 6. The carrier means 41 is electrically suspended from vibratory means 43 and 43 which may be piezo electric drive means or other known vibration means. The color particles which are transferred from disc means 23 to carrier means 41 are moved upwardly against gravity while being electrostatically held thereon by potential E. The
accelerating forces created by the vibration source and the holding effect created by potential E cause an upward migration of the color particles toward the photo-sensitive area 41c. Of course, the migration direction of the particles could be reversed if desired.

The vibration frequency selected can be chosen so high that undesirable noise and resonance within the machine are avoided. The frequency selected can therefore be in the ultrasonic range.

As compared to the standard vibration feeders in which the gravity component is always constant, the system suggested here for transporting color particles in a typewriter in a given case, may be arranged so that the electrostatic holding potential is modulated in relation to the exciter potential transmitted from the oscillating generators 43 and 43'. Assuming correct mutual phase location of the potentials—the action of the transporting component of the accelerating forces is assisted. It may be practical in this case to switch in transfer magnet means 9 or the electrostatic transmission field 9u in the manner of an impulse only for the duration of the influence of the radiation 12 upon the carrier 41 and superpose them upon the stationary field which holds the particles upon the recording area 6.

The color particles which are not used for forming a symbol when traveling through the recording area will find their way to the wiper end of bar 41, and from there will again be carried to the circulation process, that is, the storage container via a suction device 44.

In the different embodiments previously mentioned, the recording region containing the source of radiation 10 has remained stationary while the recording member has been progressing. The carriage upon which the recording member is mounted may be of light weight construction and can be moved along the direction of typing by known means.

If it is necessary to have the recording member remain stationary, another embodiment of this invention shown in FIGURE 8 may be utilized. In this embodiment, the recording member 6 remains stationary while the source of radiation 10, template means 11, and the recording head means generally designated 48 are moved along a direction which is parallel to the writing plane of recording member 6. The rays 12 from the radiation source 10 are shaped by template means 11, as previously explained, and are reflected off a mirror means 46 which is positioned in the recording head means 48 and are directed at right angles toward the recording member 6 and impinge upon the recording means 47. This grouping of elements is moved along the member 6 upon typing of the keys and known means are used to effect the step-wise shifting thereof.

In this arrangement, the recording head means can be made especially light and can be moved with a minimum of noise in shifting and returning to the initial position. In this construction instead of using a profile bundle of rays 12 as in previous embodiments, a bundle of rays deflected in the manner of a scanning pattern can be utilized without substantial change in the principles of this invention.

The recording means 47 may take the various forms of the previous embodiments explained herein. In order to obtain a uniform height of the recorded symbol over the entire writing plane on recording member 6, a known equalizing optical system may be provided between the mirror 46 and the recording means 47.

The radiation permeable conductive layer of the second carrier means mentioned in the previous embodiments may also consist of photo-technically deposited and possibly galvanically reinforced very fine grid means through whose mesh the rays act upon the photo-sensitive layer. In order to increase the sensitivity still further layers such as semi-conducting barrier lines or the like may be provided in addition to the photo-conductive layer to cooperate with the latter.

To complement this, it may further be provided that with a continuous transport of the color particles by one of the carrier means (4, 21, 31, 36 or 41) into the recording area, the time of acceleration of the particles could be only a fraction of the time of traveling of the particles across the entire recording area, that is perhaps across a height of a symbol field.

In order to assure the second carrier means such as 4, 14, 21, 31, 36 are adequately covered with color particles, means may be provided to remove the particles from the second carrier means after passing the recording region. These means may be suction means such as 44 in FIGURE 7, or other magnetic and/or electrostatic devices which return the unused particles to the container 2.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What is claimed is:

1. In an apparatus such as a typewriter for recording writing characters on a recording member comprising; a recording member, a storage container having magnetically influenceable color particles therein, first carrier means including a rotary circular disc member having a number of sectors about an axis spaced from said container and having a peripheral portion located in the region of said container, means for rotating said first carrier means so that an annular surface portion of the same moves past said container, means for transferring said particles from said container to said first carrier means and limiting said particles thereon to said annular surface portion, second carrier means, means for transferring said particles on said annular surface portion from said first carrier means to said second carrier means and holding said particles thereon, said apparatus having a recording region in front of said recording member, said second carrier means being adapted to move the said particles held thereto to said recording region, means for reducing the force with which said particles are held to said second carrier means in said recording region with the said some of said particles forming en masse a writing character, means at said recording region for simultaneously transferring said particles formed into said writing character onto said recording member and means for moving said recording member so that a line of characters is formed on the same.

2. The apparatus as claimed in claim 1 wherein said second carrier means is disposed to cross a section of said annular surface portion, and comprising means for moving said second carrier means transverse to the direction in which said annular surface portion moves.

3. The apparatus as claimed in claim 1 wherein said annular surface portion is spaced by a gap from said second carrier means, and in which the means for transferring said particles and the means for holding said particles on the first and second carrier means produce force fields for transferring the particles across said gap.

4. The apparatus as claimed in claim 1 in which said second carrier means has a photo-sensitive layer against which said particles are held electrostatically, and in which said means for reducing the force with which said particles are held to said second carrier means comprises, a light source, and selected template means between said light source and said photo-sensitive layer for shaping the rays of said light source impinging said photo-sensitive layer to form the image of a writing character thereon.

5. The apparatus as claimed in claim 1 in which said disc means are rotatable in a plane and said second carrier means comprises an endless belt means having at least a portion thereof adapted to travel in a plane parallel to said first named plane and in close proximity thereto.

6. The apparatus as claimed in claim 1 in which said first and second carrier means are disc means having axes of rotation which are parallel to each other and
which lie in a common plane, and in which the peripheries of said means are in spaced overlapping relation to permit the transfer of said particles from said first carrier means to said second carrier means.

7. The apparatus as claimed in claim 1 in which said first carrier means comprises disc means and said second carrier means comprises a planar member having one end parallel to and spaced from the periphery of said disc means, and vibrators to vibrate said planar member to move the particles thereon to said recording region.

8. In an apparatus such as a typewriter for recording writing characters on a recording member comprising:
   a recording member, a storage container having magnetically influenceable color particles therein, disc means adapted to be rotated in a fixed plane having a first side spaced from and adjacent to said container with said container being positioned near the periphery of said disc means, first magnetically operated means positioned on the second side of said disc means and opposite from said container for attracting said particles to said first side of said disc means from said container, means for electrostatically holding said particles on said first side, said means adapted to be moved over pulley means and forming a closed path with a portion of said path lying in a plane spaced from and parallel to said first side of said disc means and also spaced from said container, second magnetically operated means positioned on a side of said second side of said disc means, means for electrostatically holding said particles on said first side of said disc means, said apparatus having a recording region in front of said recording member with a portion of the path of said belt means lying in a plane spaced from and parallel to said recording member with said first side of said belt means being adjacent to said recording member, a source of radiation positioned at said recording region on the second side of said belt means, an electrically conducting layer on said guiding member on the side thereof towards said recording member, the said second side of said belt means contacting said conducting layer with said particles held on said first side of said belt means, means for electrically connecting said conducting layers with said guiding member, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said first side of said belt means, means of radiation being effective to penetrate through said guiding member and impinge upon said first side of said belt means, and thereby reduce the force with which some of said particles are held thereto, said particles whose holding force is reduced forming a visible character being recorded, third magnetically operated means being effective to simultaneously attract said particles forming said visible character to said recording member when the holding force thereof is reduced.

9. The apparatus as claimed in claim 8 in which said source of radiation is a light source and in which said third layer of said belt means is electrically responsive to light and further comprising heat means to permanently fuse said recording member the writing character formed thereon.

10. In an apparatus such as a typewriter for recording writing characters on a recording member comprising:
    a recording member, a storage container having magnetically influenceable color particles therein, disc means adapted to be rotated in a fixed plane having a first side spaced from and adjacent to said container with said container being positioned near the periphery of said disc means, first magnetically operated means positioned on the second side of said disc means and opposite from said container for attracting said particles to said first side of said disc means from said container, means for electrostatically holding said particles on said first side, said means adapted to be moved over pulley means and forming a closed path with a portion of said path lying in a plane spaced from and parallel to said first side of said disc means and also spaced from said container, second magnetically operated means positioned on a side of said second side of said disc means, means for electrostatically holding said particles on said first side of said disc means, said apparatus having a recording region in front of said recording member with a portion of the path of said belt means lying in a plane spaced from and parallel to said recording member with said first side of said belt means being adjacent to said recording member, a source of radiation positioned at said recording region on the second side of said belt means to direct the rays therefrom towards said recording member, means adapted to be positioned between said rays and said belt said disc means and also spaced from said container, second magnetically operated means positioned on a side of said first side of said disc means opposite from said first side of said disc means and adapted to attract said particles from said disc means to said first side of said belt means, means for electrostatically holding said particles on said first side of said belt means, said apparatus having a recording region in front of said recording member with a portion of the path of the said belt means lying in a plane spaced from and parallel to said recording member with said first side of said belt means being adjacent to said recording member, an electrically conducting layer on said guiding member on the side thereof towards said recording member, the said second side of said belt means contacting said conducting layer with said particles held on said first side of said belt means, means for electrically connecting said conducting layers with said guiding member, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said first side of said belt means, said source of radiation being effective to penetrate through said guiding member and impinge upon said first side of said belt means, and thereby reduce the force with which some of said particles are held thereto, said particles whose holding force is reduced forming a visible writing character being recorded, third magnetically operated means being effective to simultaneously attract said particles forming said visible writing character to said recording member when the holding force thereof is reduced, and heat means to permanently fix on said recording member the writing character formed thereon.

11. The apparatus as claimed in claim 10 in which said recording member is adapted to move in a direction at right angles to the direction of said belt means at said recording region.

12. In an apparatus such as a typewriter for recording writing characters on a recording member comprising:
    a recording member, a storage container having magnetically influenceable color particles therein, disc means adapted to be rotated in a fixed plane having a first side spaced from and adjacent to said container with said container being positioned near the periphery of said disc means, first magnetically operated means positioned on the second side of said disc means and opposite from said container for attracting said particles to said first side of said disc means from said container, means for electrostatically holding said particles on said first side, said means adapted to be moved over pulley means and forming a closed path with a portion of said path lying in a plane spaced from and parallel to said first side of said disc means and also spaced from said container, second magnetically operated means positioned on a side of said second side of said disc means, means for electrostatically holding said particles on said first side of said disc means, said apparatus having a recording region in front of said recording member with a portion of the path of said belt means lying in a plane spaced from and parallel to said recording member with said first side of said belt means being adjacent to said recording member, a source of radiation positioned at said recording region on the second side of said belt means to direct the rays therefrom towards said recording member, means adapted to be positioned between said rays and said belt said disc means and also spaced from said container, second magnetically operated means positioned on a side of said first side of said disc means opposite from said first side of said disc means and adapted to attract said particles from said disc means to said first side of said belt means, means for electrostatically holding said particles on said first side of said belt means, said apparatus having a recording region in front of said recording member with a portion of the path of said belt means lying in a plane spaced from and parallel to said recording member with said first side of said belt means being adjacent to said recording member, an electrically conducting layer on said guiding member on the side thereof towards said recording member, the said second side of said belt means contacting said conducting layer with said particles held on said first side of said belt means, means for electrically connecting said conducting layers with said guiding member, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said first side of said belt means, said source of radiation being effective to penetrate through said guiding member and impinge upon said first side of said belt means, and thereby reduce the force with which some of said particles are held thereto, said particles whose holding force is reduced forming a visible writing character being recorded, third magnetically operated means being effective to simultaneously attract said particles forming said visible writing character to said recording member when the holding force thereof is reduced, and heat means to permanently fix on said recording member the writing character formed thereon.
of said belt means, means for electrostatically holding said particles on said first side of said belt means, said apparatus having a recording region in front of said recor- ding member, in the second portion of the path of said belt means lying in a plane spaced from said recording member with said first side of said belt means being adjacent to said recording member, a source of radiation positioned at said recording region on the second side of said belt means to direct the rays therefrom towards said recording member, means adapted to be positioned between said rays and said belt means to form the rays into the pattern of a selected writing character, said belt comprising a flexible, electrically insulating tape, a radiation permeable guiding member positioned at said recording region parallel to said second portion of the path of said belt means, an electrically conducting layer on said guiding member on the side thereof towards said recording member, a protective plate means positioned on said electrically conducting layer with said belt means passing over said plate means, said plate means comprising a plurality of mutually insulated wires secured together having a polished surface over which said said belt means passes, means for electrically connecting said conducting layer with said guiding member, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said first side of said belt means, said source of radiation being effective to penetrate through the said recording member and impinge upon said conducting layer and thereby re- duce the force with which some of said particles are held to said belt means, said particles whose holding force is reduced forming en masse a writing character, said third magnetically operated means being effective to simultaneous- ously attract said particles forming said writing character to said recording member when the holding force thereof is reduced, and heat means to permanently fix on said recording member the writing character formed thereon.

13. In an apparatus such as a typewriter for recording writing characters on a recording member comprising; a recording member adapted to be shifted along a line of travel as the characters are transferred thereto, a storage container having magnetically influenceable particles therein, first disc means adapted to be rotated in a fixed plane having a first side spaced from and adjacent to said container with said container being positioned near the periphery of said disc means, first magnetically operated means positioned on the second side of said disc means and opposite from said container for attracting said parti- cles to said first side of said disc means from said con- tainer, means for electro-statically holding said particles on said first side of said disc means, a recording region at which said recording member is positioned, second disc means adapted to be rotated in a fixed plane parallel to the plane of said first disc means, with the pe- riphery thereof in overlapping relation with the periphery of said first disc means, said second disc means having first and second sides with the first side being spaced from the first side of said disc means, second magnetically operated means positioned on the second side of said second disc means where the peripheries overlap and adapted to transfer the said particles from said first disc means to the first side of said second disc means, second magnetically operated means for electrostatically holding said particles on said first side of said second disc means, a recording region positioned at said recording region on the second side of said second disc means and adapted to direct the rays therefrom toward said recording member, means adapted to be positioned between said rays and said second disc means to form the rays into the pattern of a selected writing character, said second disc means having an axis of rotation at right angles to the said line of travel of said recording member and comprising, a first layer which is electrically conducting and is permeable to said source of radiation and located on the second side thereof, a second layer which is sensitive to said radiation source and which lies on said first side and on which said particles are held, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said second disc means, said source of radia- tion being effective to penetrate said first layer and im- pine upon said second layer and thereby reduce the force with which some of said particles are held thereto, said particles whose holding force is reduced forming en masse a writing character, said third magnetically operated means being effective to simultaneously attract said particles forming said character to said recording member when the holding force thereof is reduced, and heat means to permanently fix on said recording member the writing character formed thereon.

14. The apparatus as claimed in claim 13 further com- prising means to drive said second disc means intermittently in timed relation with the travel of said recording member.

15. The apparatus as claimed in claim 14 further com- prising means to control said source of radiation to emit said rays during the interval between movements of said second disc means.

16. The apparatus as claimed in claim 15 in which said first layer of said second disc means is substantially trans- parent and said second layer which is sensitive to said source of radiation is in tooth-like form on the periphery of said second disc means with transparent sections be- tween the tooth sections formed to enable the character formed to be visible when the recording member shifts in preparation for receiving a new character thereon.

17. The apparatus as claimed in claim 16 in which said first disc means is electrically conducting.

18. The apparatus as claimed in claim 17 further com- prising bearing means for said first disc means and in which said means for electrostatically holding said parti- cles on said first disc means is electrically connected to said bearing means to complete the connection to said first disc means.

19. The apparatus as claimed in claim 18 further com- prising second bearing means for said second disc means, said tooth-like areas of said second layer of said second disc means being electrically connected to said second means for electrostatically holding the particles on said second disc means through said second bearing means.

20. In an apparatus such as a typewriter for recording, writing characters on a recording member comprising; a recording member, a storage container having magnetically influenceable color particles therein, disc means adapted to be rotated in a fixed plane having a first side spaced from and adjacent to said container with said con- tainer being positioned near the periphery of said disc means, first magnetically operated means positioned on the second side of said disc means and opposite from said container for attracting said parti- cles from said first side of said disc means from said con- tainer, means for electrostatically holding said particles on said first side of said disc means, a recording region at which said recording member is positioned, said second disc means having first and second sides with the first side being spaced from the first side of said disc means, said second disc means having an axis of rotation at right angles to the said line of travel of said recording member and comprising, a first layer which is electrically conducting and is permeable to said source of radiation and located on the second side thereof, a second layer which is sensitive to said radiation source and which lies on said first side and on which said particles are held, third magnetically operated means positioned at said recording region on a side of said recording member op-posite from said second disc means, said source of radiation being effective to penetrate said first layer and im- pine upon said second layer and thereby reduce the force with which some of said particles are held thereto, said particles whose holding force is reduced forming en masse a writing character, said third magnetically operated means being effective to simultaneously attract said particles forming said writing character to said recording member when the holding force thereof is reduced, and heat means to permanently fix on said recording member the writing character formed thereon.
to be positioned between said rays and said belt means to form the rays into the pattern of a selected writing character, said belt comprising a flexible, electrically insulating tape, a radiation permeable guiding member positioned at said recording region parallel to said second portion of the path of said belt means, an electrically conducting layer on said guiding member on the side thereof towards said recording member, the said second side of said belt means contacting said conducting layer with said particles held on said first side of said belt means, means for electrically connecting said conducting layers with said guiding member, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said first side of said belt means, said source of radiation being effective to penetrate through said guiding member and impinge upon said conducting layer and thereby reduce the force with which some of said particles are held to said belt means, said particles whose holding force is reduced forming en masse a writing character, said third magnetically operated means being effective to simultaneously attract said particles forming said writing character to said recording member when the holding force thereof is reduced, heat means to permanently fix on said recording member the writing character formed thereon, said first disc means being electrically conducting, bearing means in which said first disc means are mounted, said means for electrically holding said particles on said first side of said first disc means being electrically connected to said first disc means through said bearing means.

21. In an apparatus such as a typewriter for recording writing characters on a recording member comprising; a recording member, a storage container having magnetically influenceable color particles therein, disc means adapted to be rotated in a fixed plane having a first side spaced from and adjacent to said container with said container being positioned near the periphery of said disc means, first magnetically operated means positioned on the second side of said disc means and opposite from said container for attracting said particles to said first side of said disc means from said container, means for electrostatically holding said particles on said first side, belt means having first and second sides and adapted to be moved over pulley means and forming a closed path with a portion of said path lying in a plane spaced from and parallel to said first side of said disc means and also spaced from said container, second magnetically operated means positioned on a side of said belt means opposite from said first side of said disc means and adapted to attract said particles from said disc means to said first side of said belt means, means for electrostatically holding said particles on said first side of said belt means, said apparatus having a recording region in front of said recording member with a second portion of the path of said belt means lying in a plane spaced from and parallel to said recording member with said first side of said belt means being adjacent to said recording member, a source of radiation positioned at said recording region on the second side of said belt means to direct the rays therefrom towards said recording member, means adapted to be positioned between said rays and said belt means to form the rays into the pattern of a selected writing character, said belt means comprising a first layer which is flexible, electrically insulating and permeable to said source of radiation and located on said second side of said belt means, a third layer which is electrically conducting and sensitive to said radiation and located on said first side of said belt means and a second layer which is a radiation absorbing layer composed of said particles held on said second layer positioned between said first and third layers, said particles being held to said third layer, third magnetically operated means positioned at said recording region on a side of said recording member opposite from said first side of said belt means, said source of radiation being effective to penetrate through said first and second layers and impinge upon said third layer and thereby reduce the force with which some of said particles are held thereto, said particles whose holding force is reduced forming en masse a writing character, said third magnetically operated means being effective to simultaneously attract said particles forming said writing character to said recording member when the holding force thereof is reduced, said recording member being adapted to be shifted along a line of travel as the characters are transferred thereto, said line of travel being at right angles to the direction of said belt means at said recording region, said first and second layers of said belt means being substantially transparent and said third layer being in tooth form with the spaces between the teeth being large enough to enable the character transferred to said recording member to be seen after the belt means has been moved a distance equal to the width of one of said tooth forms.

22. The apparatus as claimed in claim 21 further comprising pulley means over which said belt means travel, said first side of said belt means being electrically connected to said means for electrostatically holding said particles on said first side of said belt means through said pulley means.

23. The apparatus as claimed in claim 20 in which said first magnetically operated means is adaptable to operate periodically and in timed relation with said second magnetically operated means for electrostatically holding said particles on said first side of said first disc means so that the holding power thereof is altered to assist the transference of particles to said belt means from said first disc means.

24. The apparatus as claimed in claim 12 in which said mutually insulated wires are arranged parallel to one another and in alignment with the length of said belt means.

25. The apparatus as claimed in claim 1 wherein said second carrier means is a radiation permeable means, and comprising vibration means for supporting and vibrating said second carrier means to move the particles thereon to said recording region.

26. In an apparatus such as a typewriter for recording writing characters on a recording member comprising; a stationary recording member having a writing plane, a source of radiation having rays directed parallel to said writing plane, template means adapted to be positioned in front of said source to form the rays into a pattern of a selected writing character, said source of radiation and template means being adapted to be moved with a recording head means, recording head means adapted to be moved along a line in front of said recording member to progressively transfer writing characters to said writing plane and comprising, a storage container having color particles therein, first carrier means, means for rotating said first carrier means so that an annular surface portion of the same moves past said container, means for transferring said particles from said container to said first carrier means and means for holding said particles thereon on said annular surface portion, second carrier means, means for transferring said particles on said annular surface portion from said first carrier means to said second carrier means and holding said particles thereon, said second carrier means having a layer thereon which is influenced by said rays to effect a change in the particles so that said particles are held to said second carrier means with the said some of said particles forming en masse a writing character, mirror means positioned in said recording head to direct said rays passing through said template means toward said layer on said second carrier means, and means on a side of said recording member opposite to said recording head means for simul-
taneously attracting the said particles formed into said writing character on to said recording member at said writing plane when the holding force of the particles formed into said character is reduced, heat means adjacent to said recording member for fixing on said recording member the particles transferred thereto and means for moving said recording member so that a line of characters is formed on the same.

28. The apparatus as claimed in claim 27 in which said mirror means is positioned in said recording head means at an angle to direct the rays therefrom at right angles to said writing plane.

29. A typewriting apparatus comprising a recording sheet; means for moving said recording sheet in one direction; a storage means having color particles therein; radiation permeable carrier means movable along a path between said storage means and a recording region through which said recording sheet moves, said carrier means including a first rotary carrier having an annular surface portion passing said storage means during each revolution of said first carrier, a second movable carrier passing a section of said annular surface portion and also passing through said recording region spaced by a gap from said recording sheet; means for transferring particles from said first carrier to said second carrier at a point of the same spaced from said recording area; means for transferring particles from said storage means to said first carrier; means for producing a beam of radiation passing through said second carrier in said recording region; a photosensitive layer in said recording region; a selected template means having an outline for representing a selected character and located in said recording region so that a beam of said radiation passes through said template means and said second carrier to said photosensitive layer for causing said second means to release said particles along the outline of said character; and means for transferring the released particles across said gap from said second carrier to said recording sheet so that by exchanging of said template means, different characters are successively formed along a line extending in said one direction on said recording sheet.

30. A typewriting apparatus as claimed in claim 29, wherein said first carrier is a disk rotating at a high speed about an axis spaced from said container so that a circumferential portion of said disk has said annular surface; and means for moving said second carrier at a lower speed than the peripheral speed of said annular surface portion past a section of the latter.

31. A typewriting apparatus as claimed in claim 29, wherein said second carrier is transparent and has a photosensitive layer having projections and recesses; and including means for moving said recording sheet and said second carrier in synchronized steps in crossing directions so that said projections hold said particles while passing through the beam of radiation, and so that characters formed of particles transferred from said projections to said recording sheet are visible through said recesses.

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