

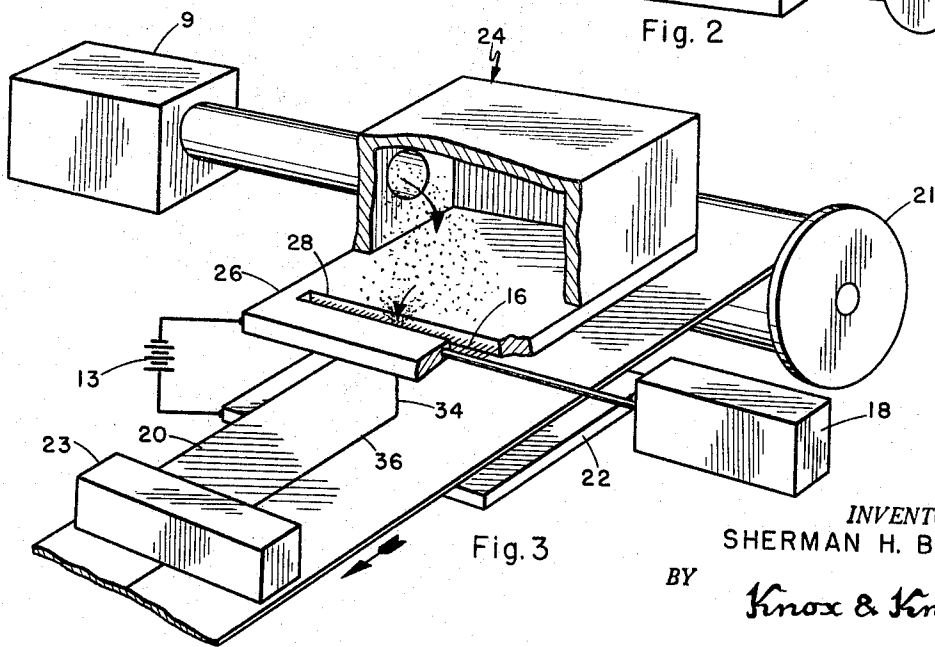
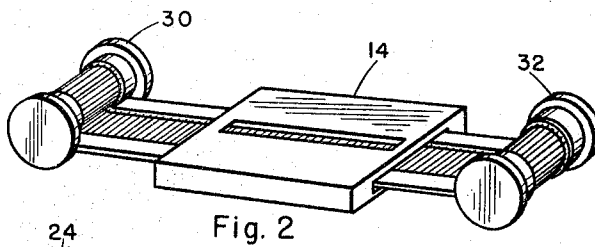
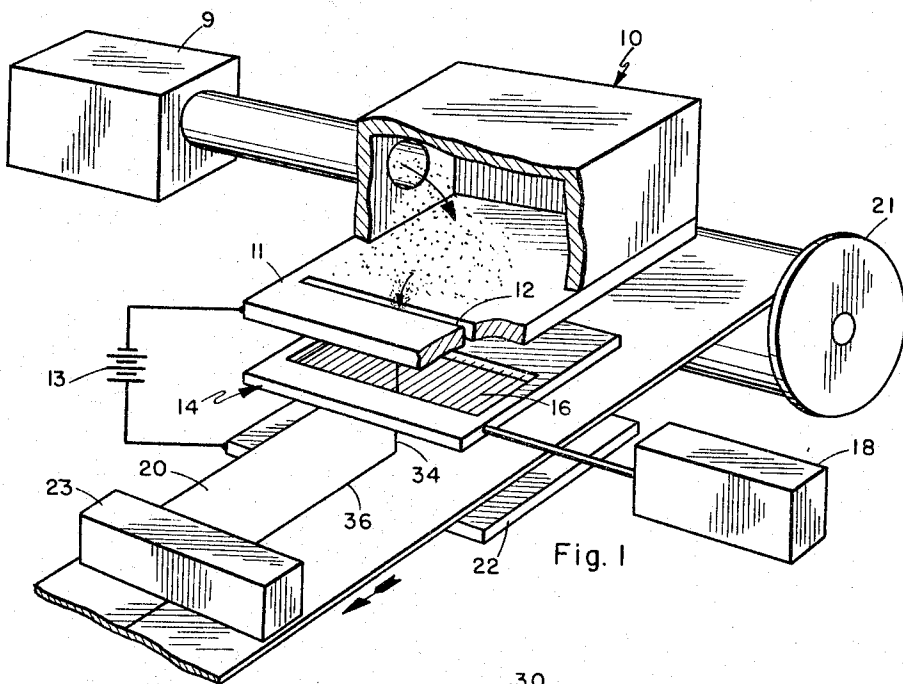
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ELECTROSTATIC PRINTER

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ELECTROSTATIC PRINTER

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This invention relates to a printer, and more particularly to a printer of the electrostatic type.

It is often desired to print messages, pictures, maps, and other kinds of information that is received from another location. For example, coded messages from the stock exchange must be decoded and printed for the benefit of clients; pictures from a distant location must often be reproduced for use by police or newspapers; and maps from a satellite must be printed for later study.

The usual printing techniques are unsuitable, because they are designed to produce many copies of the same thing, and their setup time is too time consuming for the above problem. The typing method of reproduction, while satisfactory for messages, cannot reproduce pictures or maps.

One of the more satisfactory types of reproduction is electrostatic printing, which satisfactorily handles the above problems of messages, pictures, and maps. This type of printing operates on the principle that electrical charges are formed into a pattern corresponding to the message, picture, or map. These charges produce an electrostatic field that attracts charged electroscopic particles, which are then fused to form a permanent reproduction.

Most prior-art processes of electrostatic printing, while quite satisfactory, requires either a special paper that is quite expensive or a photosensitive material that is expensive and deteriorates with continued usage. Frequently, too, there is a frictional relation between the photoconductive material and the paper, which further deteriorates the photoconductive material.

It is therefore the principal object of my invention to provide an improved printer.

The achievement of the object and others will be realized from the following specification, taken in conjunction with the drawings, of which

FIGURE 1 shows a partially exploded view of my basic inventive concept;

FIGURE 2 shows another embodiment thereof; and FIGURE 3 shows still another embodiment.

Broadly speaking, my invention contemplates a novel method and apparatus for electrostatic printing, wherein printing particles are deposited onto an untreated sheet of paper in accordance with incoming electrical signals. I do not use photoconductive materials, electrical charge patterns, or special papers that must be capable of retaining charge patterns on their surfaces. Instead a simple mechanical device, with no moving parts, controls the deposition of the printing particles onto a strip of moving paper. In this way, my invention overcomes the shortcomings and expenses of prior-art electrostatic printing techniques.

My invention may be understood from FIGURE 1, the various elements being shown as spaced farther apart than they would actually be. In FIGURE 1, reference character 9 indicates a source of minute charged, or electroscopic particles of the type used in electrostatic printing. These particles may be charged in several ways, the "triboelectric" effect being quite satisfactory. To use the effect, the particles are blown through a nozzle made of a material that is widely spaced on the triboelectric list from the material that forms the particles. In this

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way the particle's charge, magnitude, and polarity may be readily controlled. Other methods are well known in the art, and therefore will not be discussed in detail. From source 9, the particles enter a container 10.

The base 11 of container 10 has a slot 12, through which particles may pass in a manner to be later explained. Container 10 is maintained at a suitable potential by source 13, preferably at the same potential as the particles.

Positioned below slot 12 is a frame 14 of insulating material, and having a grille 16 of wires spanning its opening, which is directly below slot 12. Connected to grille 16 is a switching means 18, which normally maintains the wires of grille 16 at a potential such that the particles cannot escape through slot 12. When suitably energized, switching means 18 produces switching signals that caused selected wires to change their potential, and permit the local passage of particles.

A printing medium, such as a strip of paper 20 passes below grille 16, the paper moving, for example, in the direction indicated by the arrow. Paper 20 may be fed from a paper storage reel 21 and after being printed may be cut into conveniently sized sheets or stored on another reel in any suitable manner. In accordance with my invention, paper 20 does not have to be treated in any special way, and may therefore be relatively cheap.

Below paper strip 20 is a base plate 22, which is connected to the other end of potential source 13.

The apparatus as thus far described assumes that the particles have a negative charge, and the electric field would direct them through opening 12 toward the positively charged baseplate 22, when permitted to do so by the switching signals applied to the wires of grille 16. Of course, reversed or different potentials, polarities, and switching signals may be used depending upon various conditions.

My invention operates as follows: Assume for the sake of simplicity, that a centrally positioned longitudinal line is to be printed on paper strip 20. To do this, switching means 18 energizes the central wire, or the two central wires of grille 16 to a potential that permits particles from container 10 to be attracted through slot 12 at that location toward baseplate 22. Since the other wires of grille 16 prevent the passage of particles through the slot, this produces a centrally positioning vertical "pencil" of particles 34. This centrally positioned pencil of particles impinges on the moving strip of paper, and produces a centrally positioned longitudinal line 36 on the strip of paper, as shown in FIGURE 1.

If a transverse line, rather than a longitudinal line, were desired, switching means 18 would momentarily energize all the wires of grille 16, so that a "thin" sheet of particles traverses the entire length of the slot under the attraction of the potential applied to baseplate 22. This momentary sheet of particles would impinge upon the moving sheet of paper, and produce a single transverse line.

If a letter, for example a "T" is to be formed, a combination of the above switching signals is used to form a transverse bar and a longitudinal stem. Other characters such as letters, numerals, and symbols are formed in substantially the same way; the necessary switching signals being readily obtained from available switching apparatus 18.

Switching means 18 may take any of several available forms. For example, switching means 18 may be a cathode ray tube having a plurality of pins through its faceplate. Incoming signals are applied to the deflection system of the tube, and cause the cathode ray beam to im-

pinge upon selected pins of the faceplate; these pins being connected to respective wires of grille 16. Alternatively, switching means 18 may comprise a logic circuit of the type used in computers. Other switching circuits, well known in the art, may also be used.

Thus under the influence of switching signals produced by switching means 18, printing particles are deposited on paper 20 in the form of characters, letters, numbers, symbols, or areas that form pictures or maps.

Once the printing particles have been deposited onto the paper, they merely rest there of their own weight. In order to make the reproduction permanent, the paper and the particles pass by a heater 23. This melts the particles, causing the material thereof to permeate the paper, and to fuse with the melted material of adjacent particles. When the paper and melted material cools, a permanent reproduction results.

While the foregoing description has been given in terms of letter "T" that is so large that it covers the entire width of the paper, in actuality many characters may be printed on a single line. For example, three wires of grill 16 can form a "T"; although five would be preferable, since it has been found that practically any character may be formed by an arrangement that provides a width of five units.

It will be understood that better resolution, smaller characters, and more characters per line will result as the slot is made narrower, and as the wires are brought closer together.

There may be times when due to uncontrollable circumstances, such as voltage fluctuations, that particles impinge upon and stick to the individual wires of grille 16. This would eventually necessitate that the apparatus be disassembled; that the wires be cleaned; and that the equipment be reassembled. Rather than doing this, the frame 14 may be moved in the direction of the paper. Since the slot 12 is quite narrow, any appreciable movement of frame 14 would bring other unused portions of wires 16 into position under slot 12.

Alternatively, the modification of FIGURE 2 may be used. Here, the wires of grille 16, instead of being permanently affixed to frame 14 of FIGURE 1, are formed into a strip, and stored on any suitable device such as storage reel 30.

When the wires in use become coated with particles to such an extent as to impair their operation, take-up reel 32 is rotated until a new set of wires appear in the opening of frame 14. Any suitable detent or positioning apparatus may be used to assure that the new wires make electrical contact with the contacts of switching means 18.

In the interest of making my printer as compact and as space-saving as possible, the embodiment of FIGURE 3 may be used. Here container 24 has a bottom 26 of insulative material, and contains a slot 28. A grille 16 of wires fits into insulative bottom 26, and extends across the width of slot 28. Thus the embodiment of my invention shown in FIGURE 3 actually has fewer parts, and is somewhat simpler. The other elements of FIGURE 3 are similar to those of FIGURE 1, and the operation is substantially the same.

Of course, the embodiment of FIGURE 2 may be used in that of FIGURE 3, if desired.

It may thus be seen that my invention has many advantages over prior-art apparatus. Firstly, it is simple, with practically no moving parts. Secondly, it may be easily made, since there are no close tolerances required. Thirdly, it does not require special paper or photoconductive materials. Finally, operating costs are minimal due to the eliminator of special papers, expendable prior-art elements, wastage of particles, special materials for developing, electronic components, and costly maintenance.

It is understood that minor variation from the form of the invention disclosed herein may be made without departure from the spirit and scope of the invention, and

that the specification and drawings are to be considered as merely illustrative rather than limiting.

I claim:

1. The combination comprising:
 - a container for charged electroscopic particles, said container having an opening;
 - a plate outside the container and opposite said opening; means to impose an electrical potential between said container and plate for directing said particles through said opening;
 - a grille interposed between said plate and opening; means for varying the potential of selected portions of said grille, for controlling the passage of said particles, whereby only particles at a selected area may impinge on a printing medium placed in the space between said grille and plate.
2. The combination comprising:
 - a container for charged printing particles, said container having an opening;
 - means for directing said particles through said opening to a printing medium;
 - and control means, comprising a grille of wires between said container and said medium, for controlling the passage of said particles, whereby the area of said medium to be struck by said particles may be controlled.
3. The combination comprising:
 - a container for charged printing particles, said container having a slot-like opening;
 - means for directing said particles through said opening to a printing medium, said directing means comprising means for establishing an electric field;
 - and control means, comprising a grille of wires positioned transverse to the longitudinal axis of said slot-like opening between said container and said medium, for controlling the portion of said slot-like opening traversed by said particles.
4. The combination of claim 3 including
 - means for moving said grille of wires longitudinally for causing a new portion of said wires to extend across said slot-like opening.
5. The combination of claim 3 including
 - means for moving said grille of wires transversely for causing new wires to extend across said slot-like opening.
6. The combination comprising:
 - a container for charged printing particles, said container having a slot opening;
 - a base plate spaced from said slot opening so that a printing medium, comprising a movable strip of paper, may be positioned between said container and said base plate;
 - a source of substantially constant potential connected between said container and said base plate;
 - control means, comprising a grille of wires positioned transverse to said slot between said opening and said medium, for determining the portion of said slot to be traversed by said particles;
 - means for providing switching signals;
 - and means for applying selected said switching signals to selected wires of said grille.
7. An electrostatic printer comprising:
 - means for producing charged printing particles;
 - a container for said charged printing particles, said container having a slot-shaped opening;
 - a base plate spaced from said slot-shaped opening so that a movable strip of paper may be positioned between said slot and said base plate;
 - a source of substantially constant potential having two terminals;
 - a connection between one said terminal and said container;
 - a connection between said other terminal and said base plate, whereby an electrostatic field is established between said container and said base plate;

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control means between said container and said paper for controlling the passage of said particles through said opening toward said paper, and causing only selected said particles to leave said container, said means comprising a grille of wires perpendicular to said slot;

and means for applying switching signals to selected wires of said grille.

8. The combination of claim 7 wherein said wires are on a separate frame.

9. The combination of claim 7 wherein said wires are part of the structure forming said slot opening.

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References Cited by the Examiner

UNITED STATES PATENTS

2,595,617	5/1952	Toulon	178—7.5
2,691,345	10/1954	Huebner	346—74 X
2,716,826	9/1955	Huebner	346—74 X
2,994,575	8/1961	Colterjohn et al.	346—74
3,001,848	9/1961	Walkup	346—74
3,161,882	12/1964	Mullin	346—74

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