

Dec. 31, 1968

A. ORTLIEB

3,419,886

ELECTRIC PRINT-OUT APPARATUS

Filed March 9, 1965

Sheet 1 of 2

FIG. 1

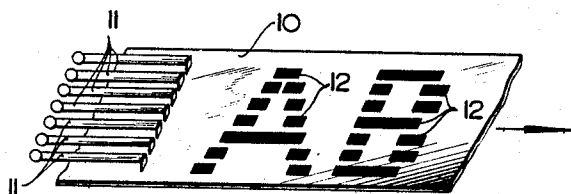


FIG. 2

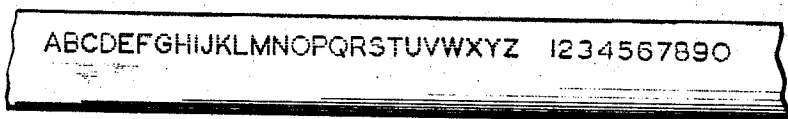


FIG. 3

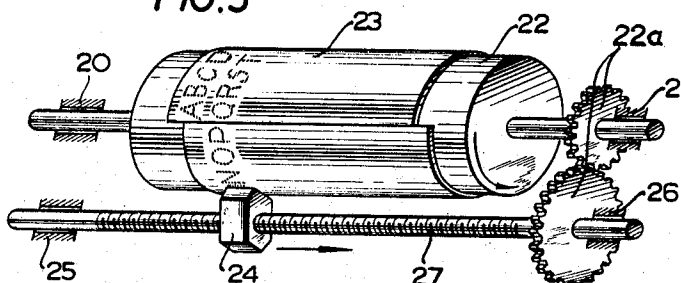
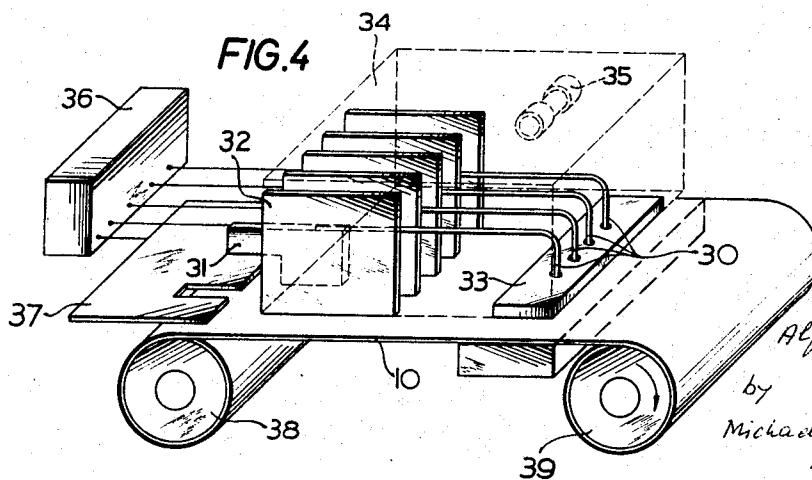


FIG. 4



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FIG. 5

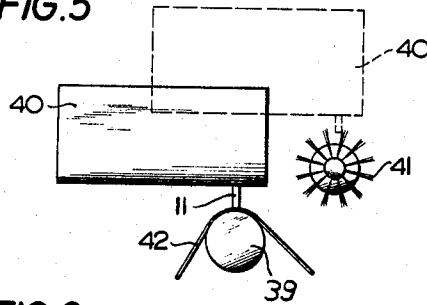


FIG. 6

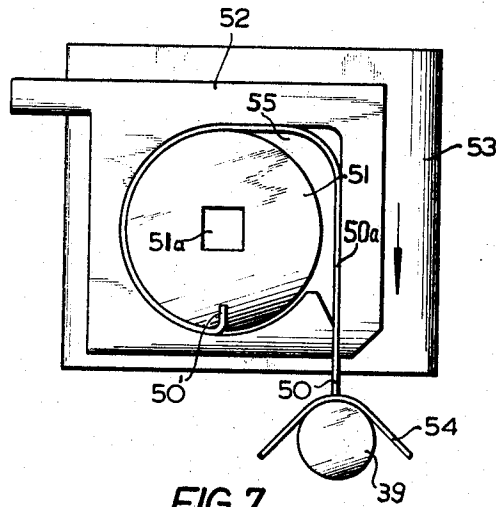
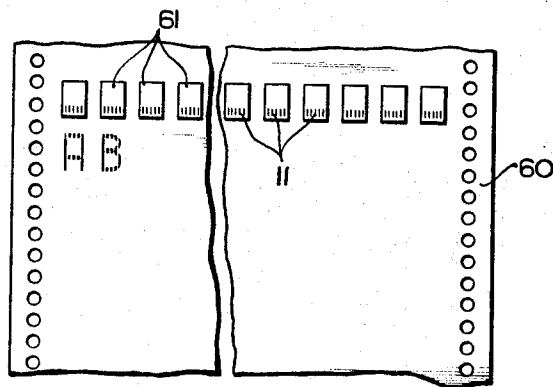


FIG. 7



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ELECTRIC PRINT-OUT APPARATUS

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Filed Mar. 9, 1965, Ser. No. 438,256

Claims priority, application Germany, Mar. 13, 1964,
B 75,891

9 Claims. (Cl. 346—74)

ABSTRACT OF THE DISCLOSURE

A print-out head including discs to whose peripheries electrode wires are secured adjacent a relatively moving record medium having a burnable layer. Information modulated voltages applied to the electrode wires effects a print-out in the burnable layer. The discs are rotatable to present additional electrode wire to the printing area as the electrode wire is consumed.

The present invention relates to an electric print-out apparatus, and more particularly to apparatus responsive to coded signals representing characters to energize electrodes to burn the outlines of the characters into a record carrier.

It is known that electronic computers and calculators operate at such a high speed that it is not possible to print out the results of computing operations at a speed corresponding to the extremely high speed at which the results are computed by the apparatus. Mechanical and electrochemical printing methods are far too slow. Electromagnetic and electrostatic methods in which a latent image is made visible by the application of a dye powder, which then has to be fixed, are complicated, expensive, and subject to disturbances.

It is one object of the invention to overcome the disadvantages of known print-out apparatus for coded information, and to provide an electric print-out apparatus which operates at high speed, is of simple construction, and has a long and trouble-free span of life.

Another object of the invention is to provide a high speed electric print-out apparatus with a set of electrodes, and to energize selectively electrodes at selected time intervals in accordance with coded signals to print out characters represented by the coded signals.

Another object of the invention is to form the characters which are printed out by burning the outline of the characters into a burnable layer provided on a carrier band.

Another object of the invention is to assure the burning of the layer by providing a metal layer which is extremely thin.

Another object of the invention is to operate the print-out electrodes by a low voltage.

Another object of the invention is to provide a print-out apparatus in which the characters are printed out in a single operation without requiring any further treatment of the record carrier.

With these objects in view, the present invention is concerned with a high speed print-out apparatus particularly suited for the printing of data which are computed at very high speed. One embodiment of the invention comprises supporting means for a record carrier having a thin burnable metal layer, such as a metal coating; burner electrode means including a set of electrodes cooperating with the layer; and control means adapted to receive coded signals representing characters such as letters, symbols and digits.

The control means, which include a matrix, are connected with the layer of the record carrier and with the electrodes. While the electrodes and the record carrier

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move relative to each other, the control means apply a voltage to the layer and to electrodes selected in accordance with coded signals and at time intervals determined by the coded signals so that areas of the burnable layer spaced in the direction of relative movement are burned in a pattern representing the characters.

The record carrier is a band or sheet of an insulating material provided with a metal layer having a thickness of less than 0.002 mm., and preferably of 0.0001 mm. The electrodes are arranged in a row perpendicular to the relative movement, and extend, for example, across a carrier band moving in longitudinal direction. Each of the electrodes burns an area having a width of between 0.1 mm. and 1 mm., when energized. A row of electrodes will burn several parallel tracks which are interrupted in accordance with the outline of the character to be printed out.

Due to the thinness of the layer which is burned, a voltage between 20 and 50 volts applied to the electrodes is sufficient.

In one embodiment of the invention, a single print-out head moving a row of electrodes is used for burning the outlines of the characters into a narrow carrier band which is driven by a drive roller in longitudinal direction and is unwound from a supply reel so that a line of characters is printed out in longitudinal direction of the carrier band.

In another embodiment of the invention, a carrier sheet having the burnable metal layer is placed on a rotating drum so that the electrodes of a single print-out head burn the outlines of characters on the carrier sheet in circumferential direction of the drum. The carrier sheet is helically laid about the drum so that during successive revolutions, axially spaced lines are printed out on the carrier sheet.

In another embodiment of the invention, a plurality of print-out heads is arranged in a row, and the rows of electrodes of all print-out heads are also aligned in a row. The record carrier is of sufficient width to accommodate all print-out heads and moves in a direction perpendicularly to the rows of electrodes. By simultaneously energizing selected electrodes of each row of electrodes of the several print-out heads, a line of characters is simultaneously recorded by the row of print-out heads in a direction transverse to the direction of movement of the record carrier sheet. This embodiment is particularly suited for the printing out of columns of numbers which are the results of computing operations carried out by an electronic computer.

An apparatus according to the present invention is capable of printing out 2,000 characters per second at a speed of the record carrier of 5 meters per second when a single print-out head is used. When a plurality of print-out heads are used, 120,000 characters have been printed out per second which, however, is not the maximum printing speed of apparatus according to the invention.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a fragmentary schematic view illustrating the principle of the operation according to the invention;

FIG. 2 is a fragmentary view illustrating a record carrier on which a line of characters has been printed out in accordance with the invention;

FIG. 3 is a fragmentary schematic perspective view illustrating an embodiment of the invention;

FIG. 4 is a fragmentary perspective view illustrating another embodiment of the invention;

FIG. 5 is a fragmentary schematic view illustrating an arrangement for cleaning the electrodes of the print-out head;

FIG. 6 is a fragmentary schematic sectional view illustrating a modification of the electrodes used in the apparatus of the present invention; and

FIG. 7 is a fragmentary schematic view illustrating a modified embodiment in which a plurality of print-out heads cooperates with the record carrier.

Referring now to the drawings, and more particularly to FIG. 1, a record carrier 10 has a base layer consisting of an insulating material, such as paper, and a top metal layer. The record carrier 10 is moved in the direction of the arrow under a set of electrodes 11 made of tungsten wire of a thickness of 0.2 mm. The ends of the electrodes cooperate with the metal layer, while a metal support plate, not shown, supports record carrier 10. When a voltage between 20 and 50 volts is applied to the electrodes 11 and to the support plate, the thin metal layer is burned. Since the electrodes move relative to the record carrier, the burned areas 12 extend in the direction of relative movement a distance corresponding to the time during which the voltage was applied. For example, to record the outline of the character A, all seven electrodes 11 were energized shortly after each other. Five of the electrodes were energized for the same time period whereupon the voltage was disconnected for different time periods so that the two side lines of the character A were formed. The third electrode from the bottom was energized continuously for a longer period of time to burn the cross bar of the character during movement of the record carrier 10, and the same is true for the uppermost electrode which, however, was energized for a short time to form the pointed end of the character. The character B was printed out in a similar manner by energizing selected electrodes for selected periods of time and at selected time intervals.

The selective energization of the electrodes is, for example, effected in the binary code by means of a matrix, which may be a magnet core or a diode matrix. The result data of an electronic computer which may represent letters, digits, or symbols, are translated by means of the matrix into coded signals respectively supplied to the electrodes 11 at time intervals and for selected time periods. The representation of data representing characters by means of a series of coded signals is well known to those skilled in the art, and not an object of the invention. In accordance with the present invention, the coded signals are not used for operating printing means, but are used for energizing electrodes to burn a layer of the record carrier so that the outlines of the characters appears in legible form on the record carrier.

Instead of a support plate underneath the record carrier 10, a transporting or drive roller may be placed directly under the row of electrodes, and support the region of the record carrier on which the electrodes 11 act. In this event, the drive roller is connected to the voltage.

In the embodiment of FIG. 4, a record carrier band 10 is wound off a supply reel 38 by a drive roller 39 so that the metal layer on the carrier band moves along the bottom face of a guide plate 33 consisting of insulating material and having a row of openings into which the end portions of a row of electrodes 30 project. The points of the electrodes 30, not visible in FIG. 4 are in resilient engagement with the metal layer on the top face of carrier band 10. The rear ends of the electrodes, of which only four are shown in FIG. 4, are secured to connector elements 31 to which electric conductors may be soldered. The connector elements and electrodes are separated from each other by insulating plates 32. Control means 36 including a matrix, not shown, apply a voltage between 20 and 50 volts to selected electrodes 30, as explained with reference to FIG. 1 and an abutment plate 37. When the

carrier band 10 is moved in a direction perpendicular to the row of electrodes 30, a continuous line of characters is printed out on the carrier band as shown in FIG. 2.

The burning of the metallic layer causes the vaporizing of the burned metal and formation of oxides on the electrodes. A housing 34 shown in broken lines envelopes the electrodes and has a bottom plate connected to guide plate 33 so that only the connectors 31 and the points of the electrodes 30 project out of the closed housing 34. A tubular inlet means 35 is attached to housing 34 through which compressed air is forced into the interior of the housing so that the air leaves the housing through the openings in guide member 33, flowing along the points of the electrodes 30 and against the metal layer of the carrier band. Consequently, metal deposits are blown off the points of the electrodes, and the same are cleaned and remain free of deposits. Furthermore, the electrodes are cooled by the flowing air, particularly in the hottest region of the points where sparks passing through the carrier band are formed.

In the embodiment of the invention as shown in FIG. 5, the cleaning of the electrode points 11 is effected by a brush 41 which preferably rotates. The entire print-out head 40 with the electrodes 11 can be raised to the position shown in broken lines for placing the points of the electrodes into the region of brush 41 by which they are cleaned. In the construction of FIG. 5, the guide plate 33, not shown in FIG. 5, is constructed of a material resistant to high temperature, for example of a ceramic material, since the electrode and the guide plate are not cooled as in the embodiment of FIG. 4.

In the embodiment of FIG. 3, the record carrier is not a band, but a sheet 23 which is laid about a support drum 22 having shaft portions supported in bearings 20, 21. The circumferential edges of the carrier sheet 23 are not circumferentially aligned, so that the carrier sheet is spiral shaped and forms a helix on drum 22. Carrier sheet 23 includes a base layer of paper, and an outer layer consisting of a thin metal coating. A print-out head has a row of electrodes 30 as described with reference to FIG. 4 which cooperate with the metal layer of the record carrier sheet 23. Print-out head 24 has a nut portion meshing with a threaded spindle 27 mounted in bearings 25 and 26 and rotated from drum 22 by gears 22a. In this manner, a line of characters is printed out on the record carrier 23 during each revolution of drum 22, and the lines of characters are parallel to the circumferentially extending top edge of the carrier sheet if the helix angle of the carrier sheet corresponds to the helix along the print-out head 24 moves under the control of the threaded spindle 27.

The energization of the electrodes 30 of the print-out head 24 is carried out in accordance with coded signals representing the characters to be printed out, as explained with reference to FIGS. 1 and 4.

As best seen in FIG. 4, the electrodes 30 have long horizontal parts and bent over end portions whose points are in sliding engagement with the record carrier. The horizontal parts provide the electrodes with a certain resiliency so that pressure can be exerted by the electrode points on the record carrier and on the support means below the same. Due to this pressure, and also due to the high relative speed between the electrodes and the record carrier, the points of the electrodes are worn off, and consequently it is advantageous to provide adjusting means for adjusting the electrodes when the point of the same are worn off to an extent at which the resiliency of the electrodes is insufficient to compensate the shortening of the electrode points.

An adjusting arrangement serving this purpose is shown in FIG. 6, and may be applied to any embodiment of the invention, irrespective of the manner in which the record carrier and the print-out head are supported and arranged.

Each electrode 30 is formed of a tungsten wire of a thickness of 0.2 mm. and wound on the periphery of a

circular disc having an axial thickness of 0.25 mm. The end portion 50' of each electrode 50 is secured to the respective disc 51. A guide frame 52 having a thickness of 0.25 mm. has a cutout receiving a corresponding disc 51 with an electrode 50, 50'. Cutouts 55 have the same shape, each cutout including a circular portion matching part of the periphery of the respective disc 51, and a portion spaced from disc 51 and having a straight edge against which the end portion 50a of each electrode 50 abuts. The drive roller 39 supports and transports the record carrier band 54 which is engaged by the end portions 50a of all electrodes 50. Drive roller 39 constitutes a support means for the record carrier 54 and is so positioned that the electrodes 50 are resiliently tensioned. When the points of the electrodes 50 are burned off and worn off, a square tool is inserted into a square hole 51a at the center of disc 51, and disc 51 is turned until the point of the electrode 50 again engages the record carrier 54 at the required pressure. Insulating plates 53 are located between adjacent frames 52 and discs 51 to electrically insulate the electrodes from each other. Insulating plates 53 have square cutouts aligned with cutouts 51a to permit the insertion of the adjusting tool.

If the carrier band is moved at a speed of 5 meters per second, a single print-out head as described with reference to FIGS. 3 and 4 can print out 2,000 characters per second by forming a continuous line along the length of the carrier band as shown in FIG. 2 or by printing successive lines on a carrier sheet 23 as described with reference to FIG. 3.

If a greater writing speed is desired, a row of print-out heads 61, each of which is provided with a row of electrodes 11 is mounted across a record carrier 60 which moves in the direction of the arrow. The electrodes of all print-out heads are aligned along a row. Each print-out head is used for printing out a single character, so that all print-out heads simultaneously print a line of characters across the record carrier 60. The control means by which the coded control signals representing the characters are provided are connected to the print-out heads 61 either simultaneously, or successively at such a speed that the printing out of all print-out heads is carried out substantially simultaneously. Due to the fact that the elongated burned areas extend in the embodiment of FIG. 7 along the height of the characters instead of across the characters as in the embodiment of FIGS. 1 and 3, the shape of the printed out characters is somewhat different, but the principle remains the same since the outline of the characters is formed by burned areas whose length in the direction of relative movement is determined by the length of the energization of the electrodes, and the time intervals between the energizations of the selected electrodes. The embodiment of FIG. 7 is capable of obtaining a print-out speed of 120,000 and more characters per second.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of print-out apparatus differing from the types described above.

While the invention has been illustrated and described as embodied in an electric print-out apparatus for burning characters into a metal layer of a record carrier, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. High speed print-out apparatus comprising, in combination, support means for a record carrier having a thin burnable layer; a print-out head including a plurality of aligned circular discs, a plurality of frame plates having aligned cutouts, insulating plates between adjacent frame plates and discs, and a set of electrode wires, each electrode wire having a portion secured to one of said discs and extending about part of the periphery thereof, and another portion guided in said cutout and having an end projecting out of said frame plate and positioned to cooperate with said layer, each of said discs being angularly adjustable for moving the end portions of said electrode wires toward said support means when the same are worn off; means for moving said record carrier relative to said electrodes; and control means adapted to receive coded signals representing characters such as letters, symbols and digits, and being connected to said support means and said electrode wires for applying a voltage to said record carrier and to electrode wires selected in accordance with said coded signals, for time periods and at time intervals determined by said coded signals so that areas of said layers spaced in the direction of movement of said record carrier are burnt in a pattern representing said characters.

2. An apparatus as claimed in claim 1 wherein said electrode wires are made of a resilient material.

3. An apparatus as claimed in claim 1 wherein said discs and electrode wires are disposed in a row; and means for mounting said record carrier for movement in a direction perpendicular to said row.

4. An apparatus as claimed in claim 1 comprising housing means enveloping said discs and electrode wires; and means for blowing compressed air into said housing means for cleaning said electrodes.

5. An apparatus as claimed in claim 1 comprising rotary cleaning brush means; and means for moving said electrode wires to a position cooperating with said brush means so as to be cleaned.

6. An apparatus as set forth in claim 1 wherein said control means provide a voltage between 20 and 50 volts for burning said layer; and wherein said layer is made of metal and has a thickness of less than 0.002 millimeter.

7. An apparatus as claimed in claim 1 wherein said other portions of said electrode wires are arranged in a row; and wherein each of said electrode wires has in the direction of said row a width between 0.1 millimeter and 1 millimeter so that areas of corresponding widths are burned in said layer.

8. A print-out apparatus as set forth in claim 1 wherein each cutout has a circular edge portion surrounding a portion of said electrode wire and a portion of the periphery of the respective disc, and a portion including a straight edge spaced from the periphery of the respective disc, said end portion of said electrode wire abutting said straight edge resiliently.

9. A print-out apparatus as set forth in claim 8 wherein each of said discs has an angular cutout at the center thereof adapted to be engaged by an adjusting tool for turning the respective disc whereby the respective electrode wire is advanced toward said record carrier.

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U.S. Cl. X.R.

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