

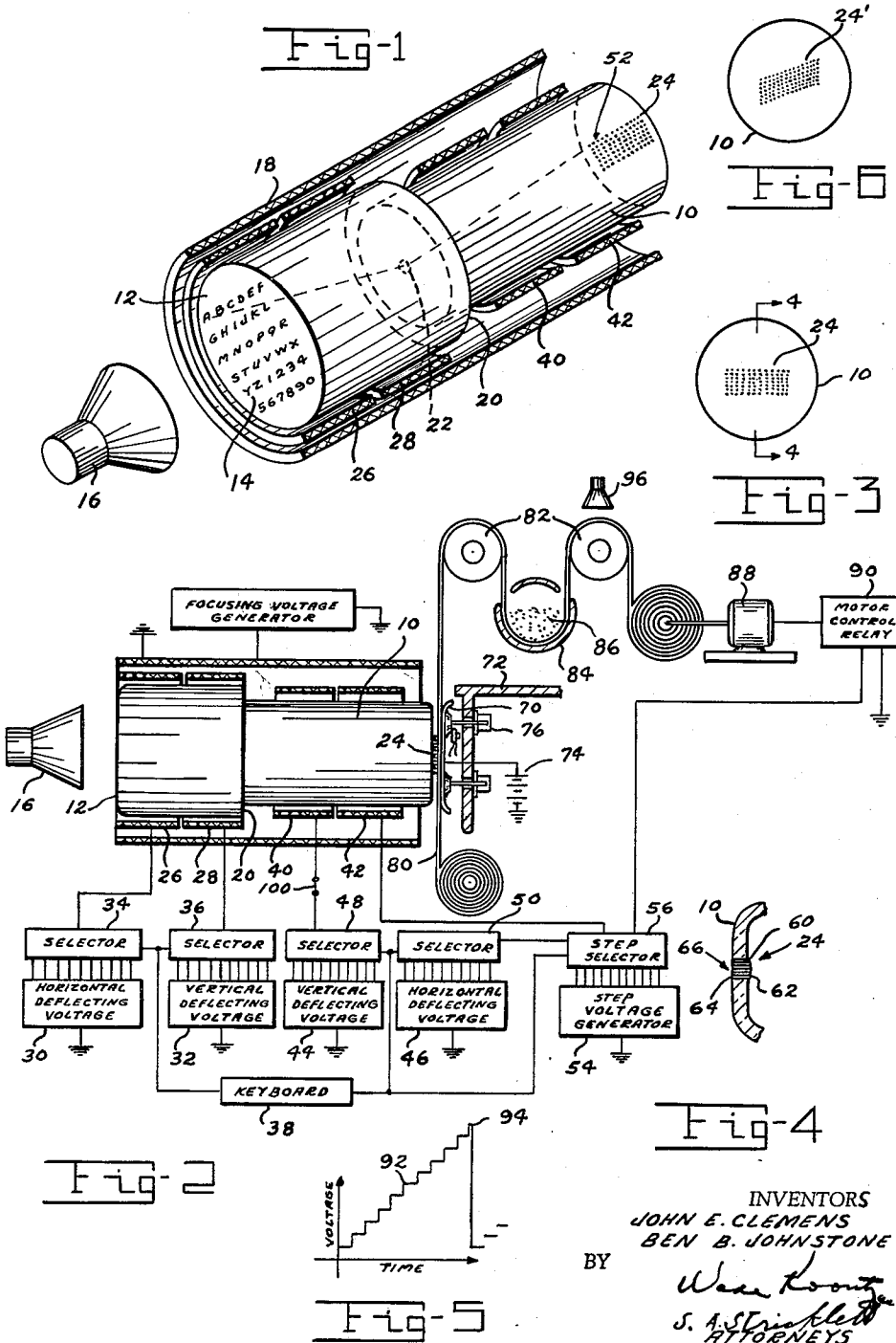
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HIGH SPEED PRINTER

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HIGH SPEED PRINTER

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The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to us of any royalty thereon.

This invention is a continuation in part of Serial Number 535,767, filed September 21, 1955 now Patent No. 2,859,377.

This invention relates to a high speed printer and particularly to a printing system without type, halftones, etchings or the like and in which the characters are transmitted as electric charges to a charge receiving strip after which the characters are fixed by any suitable means.

Considerable difficulty has heretofore been encountered in high speed printing because of the necessity of mechanically moving printing devices such as type or the like and the time element involved in drying of inks or other printing materials. Also, when light is used as the printing medium difficulty is encountered in developing and fixing the characters so applied.

In the device according to the present invention a plurality of characters are applied to a photocathode to cause photo emission of electrons from the characters and focusing means are provided to produce electron beams corresponding to each of the characters. A focusing or stop plate is provided for receiving the electron beams and an aperture is provided in the stop plate so that any particular beam may pass therethrough and electrostatic or electromagnetic devices are applied to shift the beams to focus any selector character beam on the aperture. A read-out electrode is placed in spaced opposition to the stop plate and a character beam passing through the aperture in the stop plate is deflected by suitable electronic or magnetic deflecting devices so that the beam will be focused on a particular portion of the read-out electrode. The deflecting potentials are modified in step by step relation to successively position the selected character beams in adjacent progressive relation across the read-out electrode. The read-out electrode is constructed of a plurality of closely spaced conductors such as fine wires arranged in insulated parallel relation to each other and having one end exposed on the interior of the tube to be contacted by the electron character beam and the other end extending outside of the tube to produce a corona discharge because of the voltage generated by the contact of the electron beams with the inner ends of the conductors. A suitable charge receiving strip, usually a sheet of paper, is passed in proximity to the outer ends of the conductors forming the read-out electrode and the corona discharge from the conductors activated by the electron character beam will cause a charge to be deposited on the charge receiving surface and this strip is then passed through a suitable reproducing means such as an xerographic powder which may be fixed by any suitable means such as the application of heat thereto.

It is accordingly an object of the invention to provide a high speed printing device.

It is a further object of the invention to provide an electronic printing device.

It is a further object of the invention to provide a printing device having character selecting means for transmitting characters from a photocathode surface to a charge producing surface.

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It is a further object of the invention to provide a high speed printer in which successive characters are sequentially spaced in side by side relation on a read-out electrode.

Other objects and advantages of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view partially cut away and in section of the printing tube according to the invention;

FIG. 2 is a schematic illustration of a printing system according to the invention;

FIG. 3 is an end view of the tube showing a construction of the read-out electrode;

FIG. 4 is a section taken substantially on the plane indicated by the line 4—4 of FIG. 3 and showing the manner of installing the read-out electrode in the end of the tube;

FIG. 5 is a diagrammatic illustration of a step voltage useful in the operation of the printing system; and

FIG. 6 is a modified read-out electrode.

In an exemplary embodiment of the invention the printer comprises an electronic tube 10 herein shown as substantially cylindrical in shape and having a photocathode 12 at one end on which are produced a plurality of characters 14 herein shown as letters and numerals, although, it will be apparent that characters of any kind may be produced on the photocathode 12. These characters may be produced in any desired manner such as a mask having the characters therein or by applying illumination only to the characters themselves or by any other desired method. The photocathode 12 has its characters activated by means of a light source 16 so that electrons will be emitted from the characters. A focusing element herein shown as an electromagnet coil 18 is arranged around the tube 10 to focus all electrons emitted from the characters into substantially parallel character shaped electron beams. A stop plate 20 is arranged intermediate tube 10 for intercepting the electron beams and has an aperture 22 preferably substantially centrally thereof with the aperture being of sufficient size to transmit a character beam.

The read-out or printing electrode 24 is placed at the opposite end of the tube 10 to be activated by the character beam transmitted through the aperture 22. Horizontal and vertical reflecting means which may be either electrostatic or electromagnetic and herein shown as electromagnetic coils 26 and 28 are effective to control the electron beams between the photocathode 12 and the stop plate 20. Suitable horizontal reflecting voltage sources 30 and 32 are connected to selectors 34 and 36 which are responsive to the operation of a character selecting device herein shown as a keyboard 38 to select a potential for both horizontal and vertical reflector means 26 and 28 to deflect the beams so that the electron beam of the selected character will pass through the aperture 22.

Deflector devices 40 and 42 are arranged between the stop plate 20 and the read-out electrode 24 so that any beam passing through the aperture 22 will be focused on a predetermined portion of the read-out electrode 24. For this purpose the vertical deflecting potential source 44 and a horizontal deflecting potential source 46 are controlled by selectors 48 and 50 responsive to the character selecting device 38 so that any character selected and directed through the aperture 22 will be properly focussed on the predetermined portion such as 52 of the read-out electrode 24.

A source of step voltage 54 is connected by step selector 56 in series circuit relation with the selector 54 so that the operation of the character selector 38 will progressively apply step potential to modify or modulate the usual reflection voltage to place each successive character in

adjacent step by step position across the read-out electrode.

The voltage sources 30, 32, 44, 46 and 54 may be of any suitable variety but preferably are voltage dividers connected across a suitable high potential and having taps extending to the respective selector device. Since the characters are placed at various positions on the photocathode it is obvious that each character will have a particular potential, both vertical and horizontal, to cause impingement on the aperture 22. The selectors 34, 36, 48, 50 and 56 likewise will be of any desired character but preferably are grid controlled discharge devices that permit high speed application of the deflecting potentials.

The read-out electrode 24 is preferably constructed of a plurality of conductors such as fine wires 60 arranged in substantially parallel insulated relation to each other and extending through the outer wall of the tube 10 so that the inner ends 62 are exposed to the electron beam within the tube and the outer ends 64 extend outside the tube 10. Preferably the outer surface 66 containing the ends 64 is ground relatively smooth so that there will be low friction with any material contacting the exterior ends of the conductors 60. In order to prevent interference between adjacent conductors 60 a layer of high resistance conducting materials such as aquadag connects each of the conductors 60 to ground.

A grounded support plate 70 is supported by a frame 72 in spaced relation to the read-out electrode 24 and if desired an additional potential source 74 may be connected between the plate 70 and ground in which case the plate 70 is supported on the frame 72 by means of suitable insulators 76.

A charge receiving strip 80 is supported between the plate 70 and the read-out electrode 24, preferably in slightly spaced relation from the electrode 24, so that there will be no friction between the strip 80 and the ends 64 of the conductors 60. The conductor 80 will pass over suitable guide rollers 82 and through a container 84 having suitable fixing material such as xerograph powder 86 therein. The strip 80 is controlled by means of a drive motor 88 controlled by a relay 90 which is in turn controlled by the step voltage 92 produced by the generator 54 and selected by the selector 56. When the maximum voltage 94 is reached the voltage actuates relay 90 causing the motor 88 to advance the strip 80 one step and simultaneously resets the selector 56 to reduce the step voltage 92 to its lowest step to return the beam position to the initial or zero position on the read-out electrode.

The selector device 38 herein shown as a keyboard will usually be a high speed device such as the receiver of a high speed telegraph, the output of a computer, or other high speed operating devices. Because of the electron nature of the device the printer has capabilities of a million characters per second.

When the characters are appearing at a constant speed such as results from the operation of a high speed telegraph or a read-out system the motor control may be simplified to cause a constant speed of the charge receiving strip 80 and in which case the read-out electrode 24 will be constructed as a slantwise arranged position instead of horizontal as when the strip 80 is moved in step relation. When the electrode 24' is utilized a modulating potential preferably a saw-toothed waveform potential is applied at point 100 in series with the selector 48 so that the successive characters will be vertically positioned as well as horizontally positioned.

In the operation of the printing device according to the invention the selector 38 will be connected to a source of characters such as a computer or other read-out device and the individual characters will operate the selector device so that the selectors 34, 36, 48 and 50 will apply the proper potentials to focus the desired character on the read-out electrode. The impingement of the electron

beam on the conductors of the electrode 24 will cause the conductors impinged by the particular beam to receive a potential which will cause a corona discharge to the outer end 64 of the conductor 60 which will apply a charge to the surface of the charge receiving strip 80 and the charge strip 80 will pass through the material 86 so that the charged surface will cause a portion of the material 86 to adhere thereto after which the strip with the adhering material is passed near a suitable fixer such as the heater 96 which causes the adhering material to be fixed in any known manner. Because of the low inertia of the character shaped electron beams and the rapidity of action of electronic devices the printer is capable of operating at a rate in the order of a million characters per second.

For purpose of exemplification a particular embodiment of the invention has been shown and described according to the best present understanding thereof. However, it will be apparent to those skilled in the art that various changes and modifications of structure and the component parts thereof may be readily resorted to without departing from the true spirit and scope of the invention.

What is claimed is:

1. A character display device comprising a tube, a photocathode at one end of said tube, means for producing electron emitting character images on said photocathode, focusing means for focusing the electrons emitted by said images into electron image beams, a read-out surface in opposed spaced relation to said photocathode, a stop plate interposed between said photocathode and said read-out surface, said stop plate having a beam transmitting aperture therein, first horizontal and vertical deflecting elements arranged to control the electron beams between said photocathode and said stop plate, second horizontal and vertical deflecting elements arranged to control the electron beam between said stop plate and said read-out surface, a variable potential source for said deflecting elements, a potential selector for each of said deflecting elements, a character selecting device connected in controlling relation to said selectors, said selectors being operative in response to actuation of said character selecting device to energize said first deflecting elements to project the electron beam corresponding to the selected character through the aperture in said stop plate and to energize said second deflecting elements to project a beam passing through said aperture on a predetermined position on said read-out surface.

2. A character display device comprising a tube, a photocathode at one end of said tube, means for producing electron emitting character images on said photocathode, focusing means for focusing the electrons emitted by said images into electron image beams, a read-out surface in opposed spaced relation to said photocathode, a stop plate interposed between said photocathode and said read-out surface, said stop plate having a beam transmitting aperture therein, first horizontal and vertical deflecting elements arranged to control the electron beams between said photocathode and said stop plate, second horizontal and vertical deflecting elements arranged to control the electron beam between said stop plate and said read-out surface, a variable potential source for said deflecting elements, a potential selector for each of said deflecting elements, a character selecting device connected in controlling relation to said selectors, said selectors being operative in response to actuation of said character selecting device to energize said first deflecting elements to project the electron beam corresponding to the selected character through the aperture in said stop plate and to energize said second deflecting elements to project a beam passing through said aperture on a predetermined position on said read-out surface, a step potential generator connected to modify said second horizontal deflecting potential.

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3. A character display device comprising a tube, a photocathode at one end of said tube, means for producing electron emitting character images on said photocathode, focusing means for focusing the electrons emitted by said images into electron image beams, a read-out surface in opposed spaced relation to said photocathode, a stop plate interposed between said photocathode and said read-out surface, said stop plate having a beam transmitting aperture therein, first horizontal and vertical deflecting elements arranged to control the electron beams between said photocathode and said stop plate, second horizontal and vertical deflecting elements arranged to control the electron beam between said stop plate and said read-out surface, a variable potential source for said deflecting elements, a potential selector for each of said deflecting elements, a character selecting device connected in controlling relation to said selectors, said selectors being operative in response to actuation of said character selecting device to energize said first deflecting elements to project the electron beam corresponding to the selected character through the aperture in said stop plate and to energize said second deflecting elements to project a beam passing through said aperture on a predetermined position on said read-out surface, a step potential generator, a step potential selector responsive to actuation of said character selecting device to sequentially connect the step potentials of said step potential generator in modifying relation to the potential applied to the second horizontal deflecting element whereby successively selected characters are progressively positioned across said read-out surface.

4. A character display device comprising an electronic tube, a photocathode at one end of said tube, a read-out electrode opposed to and spaced from said photocathode, means providing a plurality of character shaped elec-

tron beams from said photocathode, a character selecting device, horizontal and vertical deflecting means responsive to said selecting device to focus the selected electron beam on a preselected portion of said read-out electrode, a step potential generator, a step potential selector responsive to actuation of said character selecting device, connections including said step potential selector to apply the step potential of said generator to the horizontal deflecting means to progressively shift sequentially selected character beams to successive positions on said read-out electrode.

5. A character display device comprising an electronic tube, a photocathode at one end of said tube, a read-out electrode opposed to and spaced from said photocathode, means providing a plurality of character shaped electron beams from said photocathode, a character selecting device, vertical and horizontal beam deflecting means in said tube, sources of variable horizontal and vertical deflection voltages, selector means controlled by said character selecting device for applying selected vertical and horizontal deflection voltages to said vertical and horizontal deflecting means to focus the selected electron beam on a preselected portion of said read-out electrode, a step potential generator, a step potential selector responsive to actuation of said character selecting device, connections to apply the step potential of said generator to modify the deflecting characteristic of the horizontal deflecting means to successively shift the point of contact of the selected beam with the read-out electrode.

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