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INK JET PRINTER

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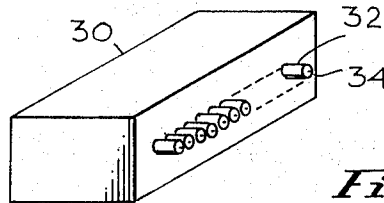
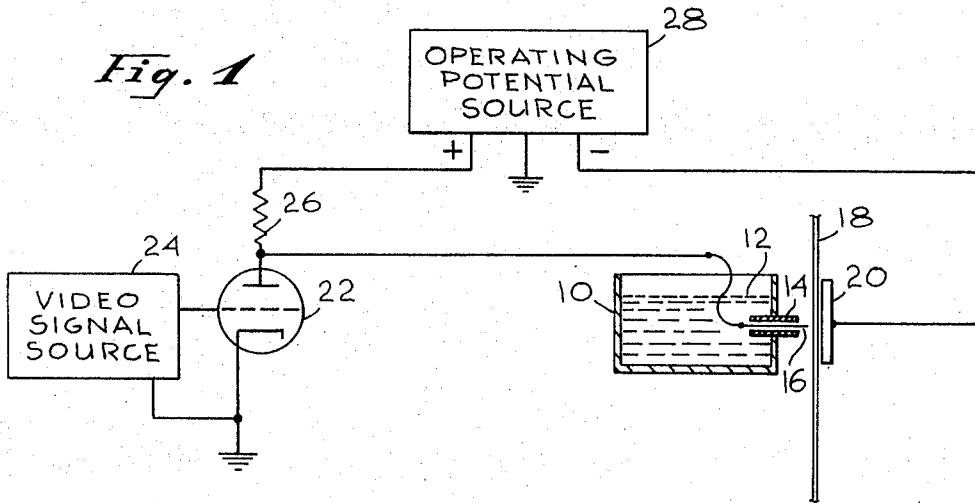


Fig. 2

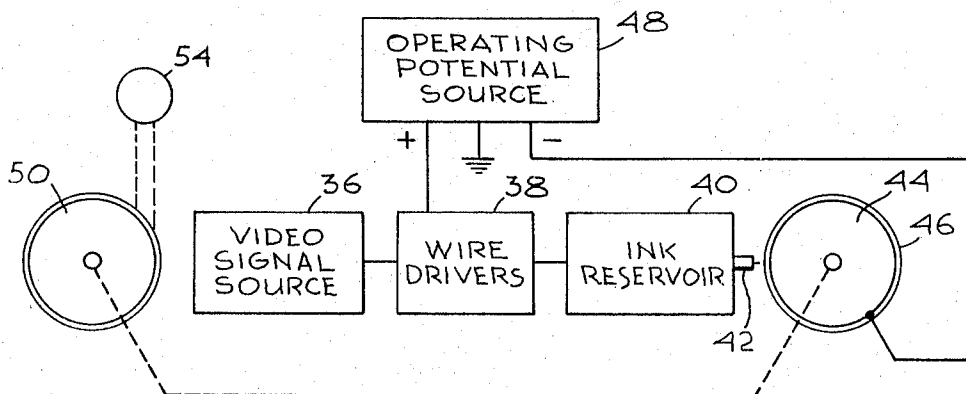


Fig. 3

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3,341,859

INK JET PRINTER

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6 Claims. (Cl. 346-140)

ABSTRACT OF THE DISCLOSURE

A container of ink has at least one capillary tube extending therefrom below the level of the ink jet therein. A conductive wire is placed within the capillary tube with the tip terminating at the end of the capillary tube. Capillary action prevents the ink from draining out of the reservoir. A writing medium is positioned opposite the end of the capillary tube and a conductive back bar is positioned behind the writing medium. When it is desired to print with the ink, a potential is applied between the wire and a back plate which is positioned behind the writing medium sufficient to draw the ink from the wire tip. The writing medium may be mounted on the back of a conductive drum or cylinder and rotated while the ink jetting potential is applied between the wire and the back of the drum.

This invention relates to apparatus for printing in ink in response to electrical signals and more particularly to an improved ink jet printing system.

A number of different systems have been devised for printing with drops of ink in response to electrical signals wherein ink is formed into a train of drops each of which bears a charge and each of which is thereafter either totally deflected or deflected with an amplitude determined upon the video signal being used to control the pattern of deposition of these ink drops on a writing medium. Such systems require expensive ink drop forming apparatus since in order to operate properly, the ink drops must be uniform in size and spacing, as well as must be formed synchronously with the video signals which are used as a control.

An object of this invention is the provision of an ink drop writing system which is less expensive to construct than those made heretofore.

Another object of the present invention is the provision of an ink drop writing system which performs satisfactorily without the necessity for uniformity in ink drop formation or synchronization thereof with the video control signals.

Yet another object of the present invention is the provision of a novel and unique ink drop writing system.

These and other objects of the present invention may be achieved in an arrangement wherein an ink reservoir has one or more capillary tubes positioned adjacent one another in a side of the reservoir below the level of the ink kept therein. A conductive wire is placed within each of these capillary tubes with the tips terminating at the termination of the capillary tube. Capillary action keeps the ink from draining out of the reservoir. A writing medium is positioned adjacent the ends of the capillary tubes and a conductive back bar is positioned behind the writing medium. A negative voltage is placed on the back bar which is not quite enough to draw the ink from the wire tips. When it is desired to print, positive voltages are selectively applied to the wires and the paper is moved. Ink will move from the tips of the wires to the paper in response to the application of a voltage potential of sufficient amplitude between the back bar and the wire. The selective application of voltages to the wires plus the

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motion of the paper enable the reproduction of information represented by the signals applied to the wires.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a schematic drawing of an embodiment of the invention;

FIGURE 2 is a representation of a multiple ink drop forming arrangement in accordance with this invention; and

FIGURE 3 is a block schematic drawing of an arrangement for multiple ink drop printing.

Referring now to FIGURE 1, an ink reservoir 10, which is shown in section in order to better explain this invention, contains ink 12 therein. A tube 14 is made of insulating material and is placed in the wall of the reservoir 10 below the level of the ink 12. The inner diameter of the tube is sufficiently small to establish capillary action which keeps the ink from draining out of the reservoir. A conductive wire 16 is placed within the tube and its tip is positioned substantially at the end of the tube 14. A writing medium 18 is positioned opposite the end of the wire and a back bar 20 is placed behind the paper 18.

In the operation of this invention, the tip of the wire 16 provides a point from which ink droplets are drawn electrostatically to the paper 18 when voltage having a sufficient amplitude is provided. The wire is connected to the anode of an amplifier which is shown as a tube 22. Video signals are applied between the control grid and cathode of the tube from a data signal source 24. A load resistor 26 connects the anode of the tube 22 to an operating potential source 28. The back bar 20 is also connected to the operating potential source and is biased sufficiently negative to maintain a small amount of ink on the tip of the wire when no signal is applied to the control grid of the tube 22, so that the apparatus is ready to print upon the application of a signal. Effectively, there is a voltage threshold which must be overcome between the wire 16 and the back bar 20 before the ink at the tip of the wire is transported across to the paper.

The manner of operating the system shown is to effectively ground the control grid of the tube 22 in the absence of an input signal from the video signal source 24. This renders the tube conductive whereby the potential difference between the back bar 20 and the end of the wire 16 may be held just below the threshold for transporting the ink drops to the paper. Upon the application of a negative signal to the tube control grid, the tube is rendered less conductive and the potential of the wires goes more positive thereby the threshold is exceeded. This enables ink drops to be transported from the wire 16 to the surface of the writing medium 18. The video signal source may provide video signals of the type which are used at a facsimile receiver. The writing medium 18 is moved relative to the tip of the wire 16 in a line-by-line manner to synchronize its motion with that of the facsimile apparatus at the transmitter where the video signal is being generated. Normally, this apparatus comprises a cylinder on which the writing medium is fastened. The cylinder is rotated and moved transversely to effectuate the line-by-line synchronization. Alternatively, the cylinder is rotated and the ink reservoir and wire are moved reciprocally. The back bar 20 may constitute the surface of the cylinder, if such surface is made conductive. Thus, in response to a sequence of signals from the data signal source the information represented thereby is written on

the writing medium 18 employing the arrangement shown in FIGURE 1.

While the arrangement shown in FIGURE 1 is representative of a single capillary tube with a writing wire extending therethrough, so that a single picture element at a time is written on the paper 18, it is perfectly feasible to have as many of the capillary tubes and writing wires and to separately control them, as is reasonably desired. For example, referring to FIGURE 2, there is shown an arrangement for the ink reservoir 30 with a line of eight capillary tubes 32 with writing wires 34 extending there-through. Each separate picture element may be written simultaneously with this arrangement. The capillary tubes and writing wires need not be placed adjacent one another, but can be spaced apart and controlled separately so that, for example, in those operations where the data is reproduced in columnar form, a line of data may be simultaneously written and the required paper motion may be simplified accordingly.

FIGURE 3 shows a block schematic arrangement for the embodiment of the invention representative of a plurality of the capillary tubes with wires in a line form. Here, a plurality of video signal sources 36 apply their separate video signals to separate wire drivers 38. Each one of the wire drivers may constitute a tube 22 or a transistor equivalent. The ink reservoir 40 is substantially identical with the ink reservoir 30 shown in FIGURE 2. The capillary tube 42 extending therefrom includes a wire, and is representative of a plurality of these tubes and wires, such as is shown in FIGURE 2. A rotating drum 44 has paper 46 attached to the surface thereof. The surface of the drum is conductive and acts as the back bar. An operating potential source 48 provides the required potentials to the wire drivers and to the surface of the drum.

While video signals normally occur sequentially, those skilled in the art will have no difficulty in storing them a line at a time and then presenting a line of signals, or such desired portions thereof to the wire drivers. The storage apparatus can constitute either a storage tube or magnetic core storage device.

The video signal sources 36 may comprise a plurality of photocells which are permitted to scan data on a writing medium 50 which is wrapped around the surface of a rotatable drum 52. Illumination is provided by a lamp 54. The drum 52 and the drum 44 may both be synchronized by a belt, as represented by the dotted line, if they are in proximity with one another, or where spaced apart, by well-known facsimile techniques, so that the data on the sheet 50 is reproduced on the sheet 46. Thus, the apparatus shown in FIGURE 3 may serve as an office copying machine, if it is desired.

There has accordingly been shown and described hereinabove a novel, useful and simple arrangement for producing with ink drops data represented by electrical signals.

What is claimed is:

1. Apparatus for reproducing with ink the information contained in video signals comprising walls forming a container for ink, a capillary tube extending through one wall of said container, a conductive wire in said capillary tube having one end substantially coextensive with the end of the capillary tube which is outside of the container, a conductive back plate positioned opposite said one end of said conductive wire, and means for applying a voltage between said one end of said wire and said back plate to move a drop of ink from said one end of said wire toward said back plate.

2. Apparatus for reproducing the information contained in video signals with ink on a writing medium comprising walls forming a container of said ink, a capillary tube extending through a wall of said container and being below the level of the ink in said container, a wire extending through said capillary tube having one end positioned at the end of said capillary tube which extends external to said wall, a conductive back plate positioned

opposite said wire, a writing medium positioned between said conductive back plate and said one end of said wire, and means responsive to said video signals to apply a potential between said wire and said conductive back bar sufficient to transfer ink from the end of said wire to said writing medium to enable the reproduction of the information contained in said video signal.

3. Apparatus for reproducing video signals in ink as recited in claim 2 wherein said capillary tube is made of insulating material and said wire extends therethrough, and said means for applying a potential between said one end of said wire and said back bar for transferring ink from said one end of said wire to said writing medium comprises an amplifier to which signals from said video source are applied and means coupling said amplifier between said back bar and said wire.

4. Apparatus for writing on a writing medium with ink the information represented by video signals comprising walls forming a container for said ink, a capillary tube made of non-conductive material extending through a wall of said container and being located below the level of ink in said container, a conductive wire extending through said capillary tube and having one end terminating substantially with the end of said capillary tube which extends outside of said container, a conductive back bar positioned opposite said one end of said wire, said writing medium extending between said back bar and said one end of said wire, means for applying a bias voltage between said one end of said wire and said conductive back bar having an amplitude below that required to transfer ink from said one end of said wire to said back bar, and means for increasing the amplitude of the voltage applied between said one end of said wire and said back bar above the required voltage to transfer ink to said back bar responsive to said video signals.

5. Apparatus for writing information contained in video signals with ink on a writing medium comprising walls forming a container for said ink, a non-conductive capillary tube extending through a wall of said container below the level of the ink contained therein, conductive wires extending through said capillary tube and having one end terminating substantially coextensively with the end of said capillary tube which is outside of said container, a conductive back bar positioned adjacent said one end of said wire, said writing medium passing between said conductive back bar and said end of said wire, a source of operating potential having a first and second output terminal providing two different voltage potentials, means connecting said first output terminal to said conductive back bar, an amplifying device, a load having one end connected to said second output terminal and the other end connected to said amplifying device, a third output terminal on said operating potential source providing a potential intermediate that provided by said first and second output terminals, means connecting said amplifying device to said third output terminal, and means for applying said video signals to said amplifying device for enabling a potential sufficient to transfer ink from said one end of said wire to said writing medium only in the presence of said video signal.

6. Apparatus as recited in claim 5 wherein said video signal source comprises a photocell device.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,341,859

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Roman A. Adams

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, lines 3 and 4, for "assignor to The A. B. Dick Company" read -- assignor to A. B. Dick Company --.

Signed and sealed this 5th day of November 1968.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents