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NOZZLE COVER

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Fig. 1

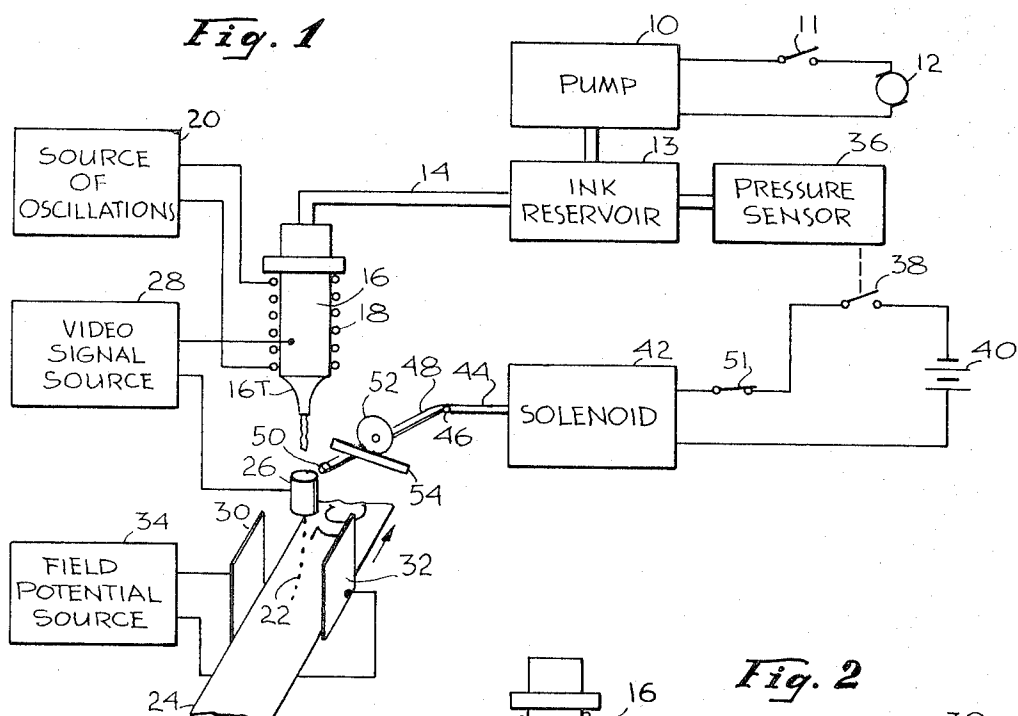


Fig. 2

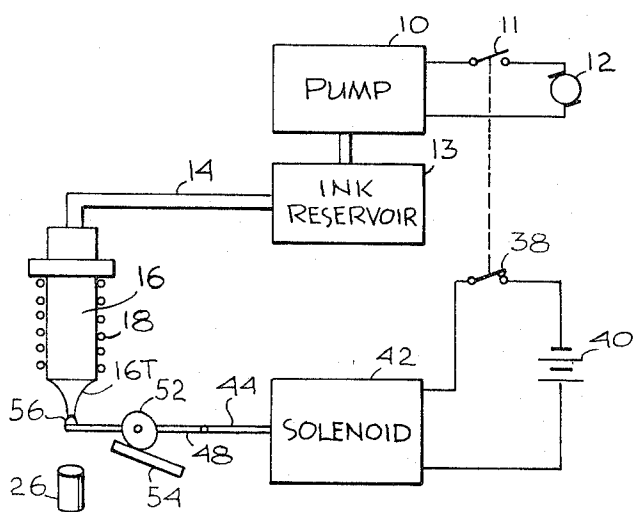
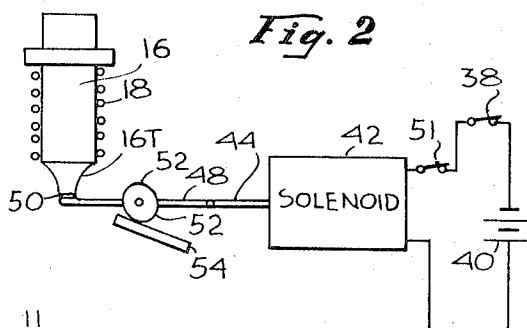


Fig. 3

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NOZZLE COVER

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This invention relates to apparatus for producing information represented by video signals using ink drops deposited on a writing medium, and more particularly to improvements therein.

Apparatus has been developed for making a record on a writing medium, of the information represented by video signals, by generating a stream of ink drops, directing these ink drops toward a writing medium and then deflecting these ink drops in their travel toward the writing medium in response to video signals, in a manner so that when the ink drops do reach the writing medium, they produce a visible image of the information contained in the video signals. The apparatus which is employed usually comprises an ink reservoir, in which there is ink under pressure. The ink reservoir feeds a pipe which is connected to a nozzle. Some mechanism such as an electromechanical transducer or other arrangement is employed to vibrate the nozzle at some suitable high frequency. The ink accordingly is ejected from the nozzle in a stream which shortly thereafter breaks into individual drops. These drops then pass through a charging tunnel wherein each one of them is given a charge in accordance with the value of the video signals. The drops thereafter pass through a steady electrical field on their way to writing paper.

One of the problems which arises when apparatus, such as has been described is to be used for intermittent or standby operation, is that the nozzle becomes clogged after a period of inactivity due to the drying of the ink just outside the orifice, and occasionally within the orifice itself. If the orifice is not completely blocked, usually it is partially blocked and the ink flow therethrough is restricted. This can be readily understood from the fact that the orifice sizes range from .001 inch to .0025 inch. Thus, when it is sought to start the operation of the apparatus, it cannot function due to the clogging of the orifice.

An object of this invention is to provide a novel arrangement whereby an ink drop writing apparatus is kept operable despite intermittent operation thereof.

Yet another object of the present invention is the provision of an arrangement for maintaining the nozzle of an ink drop writing apparatus unclogged.

Still another object of the present invention is the provision of a novel and unique arrangement for automatically closing the nozzle of an ink drop writing apparatus when it is no longer producing ink drops.

These and other objects of the invention are achieved in an arrangement whereby means are provided for sensing when the nozzle employed in the ink drop apparatus is no longer producing ink drops. At this time, means such as a solenoid, is actuated, to close the end of the nozzle either with a suitable means such as a pad of a suitable lubricant, or by some mechanical closure, such as a pin, whereby, when it is desired to reactivate the apparatus, the closures are automatically removed and the nozzles which have been maintained free and unclogged can immediately commence operation again.

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:

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FIGURE 1 is a schematic drawing of an embodiment of the invention illustrating how the nozzle may be protected with a coated pad;

FIGURE 2 is a schematic drawing showing the appearance of the apparatus when the pad actually covers the nozzle; and

FIGURE 3 is a schematic drawing of an embodiment of the invention illustrating how the nozzle is closed by another means.

Referring now to FIGURE 1, there is shown schematically apparatus for writing with ink drops responsive to video signals, in accordance with the prior art, in which an embodiment of this invention is included. Such apparatus will include a pump 10 which is connected through a switch 11 to a source of power 12. When switch 11 is closed, the pump is rendered operative and applies pressure to a container of ink 13, known as an ink reservoir. The ink reservoir is connected by a pipe 14 to a nozzle 16. The nozzle may be formed of magnetostrictive material around which is wound a coil 18. The nozzle is vibrated when signals from a source of oscillation 20 are applied to the coil 18.

The ink under pressure is forced through the vibrating nozzle 16 and as a result, at the tip 16T of the nozzle, drops of ink 22 are formed and are directed by the pressure in a path toward a moving web 24 of material, such as paper.

The ink drops 22 on their way toward the web pass through a charging tunnel 26. This tunnel comprises a conductive tube positioned so that the ink drops will pass substantially through the center thereof. Electrical signals from a video signal source 28 are applied between the nozzle 16 and the charging tunnel 26, with the result that the ink drops receive a charge which is proportionate to the amplitude of the video signals at the time that the ink drops are passing through the tunnel. After the drops pass through the tunnel, they pass through a fixed electric field which is established between two spaced conductive plates respectively 30, 32, across which a potential is applied from a field potential source 34.

The charged ink drops react with the electric field to be deflected thereby laterally, to an extent determined by the strength of the charge on the drops. In this manner, since the web 24 is moved at some synchronous rate with the video signals, an image is built up with the ink drops in accordance with the electrical signal employed for charging.

As thus far described, the system is known. It should be appreciated that with the sizes employed for the nozzle openings which range anywhere from one to five thousandths of an inch, when pressure is no longer applied to the ink reservoir, so that the ink is no longer emitted from the nozzle, the ink at the nozzle coagulates and can serve to either completely block the nozzle or diminish the stream which flows therethrough, the next time that the equipment is started up for use.

In accordance with this invention, there is provided a mechanism which senses when ink drops are being discontinued. The mechanism then covers the ink nozzle to prevent the drying and blocking action from taking place. While there are a number of different ways in which the termination of ink drop flow may be sensed to activate the nozzle covering mechanism, such as sensing when power is discontinued to be applied to the pump or source of oscillations, by way of illustration a preferred means comprises a pressure sensor 36 which is coupled to the ink reservoir 13 and which in response to the pressure in the ink reservoir dropping below the level required to cause ink to be emitted from the nozzle, closes a switch 38. When the pressure in the ink reservoir rises toward the value required to cause ink to flow, the pressure sensor

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operates to open the switch 38. Such pressure sensors and switch operators are well known, for example being used in automobile hydraulic brake lines for operating stop lights. For simplicity here they can comprise a resilient diaphragm with a metal contact at a portion of the surface thereof. The diaphragm is moved away from another contact when the pressure is applied to the ink reservoir and resiliently returned when the pressure on the ink reservoir is removed.

The switch 38 when operated serves to connect a source of potential 40 to a solenoid 42. The armature of the solenoid 44 has a pivot 46 on the end thereof whereby it is pivotably connected to an arm 48. At the end of the arm there is a pad 50, which is silicone coated. A wheel 52 is attached to the arm 48. When the solenoid 42 is actuated, the armature 44 moves forward causing the wheel to roll up a guide ramp 54. As shown in the partial schematic view of FIGURE 2, the wheel rolls up the guide ramp 54 under the thrust of the armature 44 to bring the silicone coated pad up to close the nozzle opening 16T. The silicone prevents the ink from drying and further serves as a lubricant for the tip of the nozzle.

It may be desirable to inactivate the solenoid 42 so that it retracts the arm 48 just prior to starting up the apparatus in order to avoid the possibility that the ink under pressure will hit the covering pad or point to force either of them out of the opening or to cause either of them to become coated with an unusual amount of ink. In order to take care of this eventuality, another switch 51 may be connected in series with the switch 38. The switch 51 is normally closed. It is opened just prior to the operation of the apparatus whereby the solenoid 42 will retract the covering for the nozzle. As soon as the pressure in the ink reservoir has reached a level where the pressure sensor 36 will open the switch 38, the switch 51 may be allowed to be closed.

FIGURE 3 is another partial schematic view illustrating another embodiment of the invention. Here, the same arrangement of the solenoid arm operation as was shown in FIGURE 1 is employed, and therefore since it functions in the same manner, it will bear the same reference numerals. However, instead of a silicone wetted pad, a needle 56 is employed which is pushed into the tip of the nozzle to both close it and clear away any ink particles that may accumulate. The needle is preferably not made of metal in order to avoid enlarging the opening at the tip 16T of the nozzle. The needle may preferably be made of a plastic material, such as nylon. Further, instead of a pressure sensor being used to actuate the switch 38, it is mechanically coupled to a switch 58 to be operated therewith. The switch 11 when closed applies power from an AC source 12 to the pump 10 to cause it to become operative. When switch 58 is closed it opens switch 38. When switch 58 is opened it closes switch 38. Switch 51 may not be required with this embodiment of the invention.

There has accordingly been described and shown hereinabove a novel, useful, and unique arrangement for permitting intermittent operation of ink drop printing apparatus with the assurance that the apparatus will commence operation promptly and will not have to be taken apart for the purpose of being cleaned if it is turned on after an interval of non-use.

What is claimed is:

1. In ink drop writing apparatus of the type wherein there is a nozzle, means for vibrating said nozzle, a source of ink under pressure, means for applying ink from said source under pressure to said vibrating nozzle to cause

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ink drops to be emitted from the tip of said vibrating nozzle, means for rendering said ink drop writing apparatus inoperative, and means operative responsive to operation of said means for rendering said ink drop apparatus inoperative for covering said nozzle tip for preventing clogging of said tip by dried ink.

2. Apparatus as recited in claim 1 wherein said means operative responsive to operation of said means for rendering said ink drop apparatus inoperative for covering the tip of said nozzle comprises an absorbent pad, means for preventing the drying of ink coating said absorbent pad, solenoid means actuatable responsive to operation of said means for rendering said ink drop apparatus inoperative for moving said pad from a location removed from the tip of said nozzle into closing contact with said nozzle tip.

3. Apparatus as recited in claim 1 wherein said means operative responsive to operation of said means for rendering said ink drop writing apparatus to cover said nozzle tip comprises needle means for insertion into the opening in said nozzle tip for closing said opening, solenoid means actuatable responsive to operation of said means for rendering said ink drop apparatus inoperative for carrying said needle means from a location away from said nozzle tip into operative contact with the said nozzle tip.

4. Apparatus as recited in claim 1 wherein said source of ink under pressure includes pump means for providing pressure for said ink in said source, and said means for rendering said ink drop writing apparatus inoperative includes means for rendering said pump means inoperative.

5. Apparatus as recited in claim 4 wherein said means operative responsive to operation of said means for rendering said ink drop apparatus inoperative for covering said nozzle tip for preventing clogging of said tip by dried ink includes inoperative solenoid means, a source of potential for operating said solenoid means, an inoperative switch for applying, when operative potential from said source to said solenoid means, means carried by said solenoid means when operative for covering said nozzle tip, and pressure transducer means for sensing the pressure of said source of ink under pressure for rendering said inoperative switch operative when said pressure drops below a predetermined value.

6. Apparatus as recited in claim 1 wherein said means operative responsive to operation of said means for preventing clogging of said tip by dried ink includes means for sensing the discontinuance of the application of ink from said source of ink under pressure to said nozzle, and means responsive to said means for sensing for covering said nozzle tip for preventing dried ink from clogging said nozzle tip.

7. Apparatus as recited in claim 6 wherein said means for sensing comprises an inoperative switch means, pressure transducer means for sensing the pressure in said source of ink under pressure for rendering said switch operative when said pressure is reduced below a predetermined value.

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