

Description

TECHNICAL FIELD

The present invention relates to ink-jet printers, and, more particularly, to a subassembly in such printers known as a service station.

BACKGROUND ART

Service stations in ink-jet printers are intended to maintain a thermal ink-jet printhead in good working order for the service life of the printhead. As is well-known to those skilled in this art, the printhead is formed as part of a printing cartridge. The cartridge contains a reservoir of ink, and the printhead contains an assembly of passageways, firing elements (resistors) and nozzles for firing droplets of ink toward a printing medium, such as paper.

During the course of operation, it is possible for nozzles to become clogged with ink and for bubbles of air to be trapped in such a manner as to interfere with the correct operation of the printhead. Also, it is desired to prevent contaminants, such as paper dust, from affecting the operation of the nozzles and to prevent ink from drying in the nozzles when the printhead is at rest. Finally, it is desired to clear out soft viscous plugs of ink, which may form while the printhead is at rest. This should be done prior to initiation of printing, to ensure that all nozzles in the orifice plate of the printhead are firing properly.

A service station can address the afore-mentioned problems and requirements. While service stations are not per se novel in thermal ink-jet printing, it is a goal to provide a service station with easy operation which maximizes a number of functions in a minimum of space. The preferred service station has a number of functions, including:

1. clear clogged nozzles and remove bubbles;
2. cover nozzles when the printhead is not in use to prevent contamination thereof;
3. prevent ink from drying out in the nozzles when the printhead is not in use;
4. wipe contaminants picked up during printing off of nozzles; and
5. provide a location to fire nozzles into for clearing out the soft viscous plugs of ink.

DISCLOSURE OF INVENTION

In accordance with the invention, a service station for use in an ink-jet printer comprises:

- (a) pump means for priming the printhead,
- (b) a slidably mounted sled to actuate the service station and including means to seal the printhead, and

(c) wiping means for cleaning the printhead.

Use of a fixed wiper reduces the number of parts otherwise required to clean the printhead. Use of a sled eliminates solenoids. The sled is self-actuating, and requires no external control, other than through the action of the carriage motor which controls the motion of the carriage supporting the cartridge. Use of a ramp in conjunction with the sled permits positive sealing of the printhead with a cap and eliminates sliding of the cap across the orifice plate of the printhead.

An ink-jet printer which incorporates a cleaning and priming device is described in US-A-4567494. The cleaning and priming device includes a pump for priming the print head, and a primer carriage which is pivotally mounted on a four-bar pantograph assembly. However, this arrangement does not incorporate a slidably mounted sled, nor does it incorporate wiping means for cleaning the printhead.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view, partly in section, of an assembled service station in accordance with the invention;

FIG. 2a is a front elevational view, partly exploded, of a peristaltic pump in accordance with the invention;

FIG. 2b is a top plan view of a portion of the peristaltic pump of FIG. 2a;

FIG. 2c is a detail of a portion of the roller used in the peristaltic pump;

FIG. 3a is a front elevational view, partly in section, of a portion of the sled subassembly of the service station of the invention;

FIG. 3b is a front elevational view, partly in section, of the sled just after engagement thereof by the carriage and prior to capping of the printhead;

FIG. 3c is a view similar to that of FIG. 3b, but of the sled and carriage subsequent to capping of the printhead;

FIG. 4a is a top plan view of the wiper bracket of the service station assembly;

FIG. 4b is a front elevational view of the wiper bracket; and

FIG. 4c is cross-sectional view taken along the line 4-4 of FIG. 4a.

BEST MODES FOR CARRYING OUT THE INVENTION

Referring now to the drawings wherein like numerals of reference designate like elements throughout, an assembled service station 10 is depicted. The service station 10 comprises a peristaltic pump, denoted generally at 12, a sled 14,

and a wiper bracket 16. The service station 10 is shown in position capping a printhead 18 of a pen cartridge 20.

The service station 10 provides a region at one end of the bidirectional movement of a carriage 22, which holds the cartridge 20 in locked alignment. The carriage 22 is moved bidirectionally along a guide rod 24, typically by means of a belt (not shown), connected to a carriage motor (not shown), controlled by a microprocessor (not shown). These latter elements are conventional in the art and hence do not form a part of this invention.

The carriage 22, which can rotate about the guide rod 24, is urged against the surface of a paper guide 26 by virtue of its own weight, due to offset positioning (center of gravity) of the carriage on the front side of the guide rod. A low friction spacer 28 contacts the paper guide surface and keeps the printhead 18 spaced the appropriate distance from the print medium (not shown). In the arrangement depicted in FIG. 1, the print medium would be to the left of the service station 10, normal to the plane of the drawing. The spacer 28 may be a separate piece as shown in the drawing or a molded-in feature of the cartridge.

The peristaltic pump 12 comprises a tube 30, a roller 32, and a pump body 34. As seen more clearly in FIG. 2a, the peristaltic pump principle, which is conventional in the art, works by squeezing the tube 30 between the roller 32 and a wall 36. Advantageously, the wall 36 may be molded into the chassis of the printer. As used herein, the chassis constitutes the frame of the printer.

The roller 32 is provided with an axial hub 35, which rides in track 37 of the pump body 34.

The squeeze point of the pump 12 is moved along a portion of the length of the tube 90. In so doing, a pressure differential can be created to effect the priming operations on the printhead.

It will be noted that the pump 12 uses only one roller 32, rather than the conventional three rollers. Because the tube 30 is only squeezed by the roller 32 over 210° of motion, the pump allows the system to be vented without using an extra part, such as a solenoid venting valve tied into the tubing, as is commonly done in the prior art. The configuration of the invention allows the printhead 18 to vent to atmosphere as it caps (discussed in greater detail below), preventing a pressure rise as the cap collapses (see FIGS. 3b-c). Even a small pressure rise when capping is intolerable because it can force bubbles of air up into the printhead 18.

The use of one roller 32 also permits the tubing 30 to relax between rolling. Consequently, the tubing 30 will not get dragged into the pump 12 during operation thereof, and the tubing will not take a compression set.

As seen in FIG. 2a, one end of the tubing 30 is attached to the bottom of a cap chamber 38. The other end of the tubing 30 terminates in free space, positioned over an absorber pad (not shown). The absorber pad is used as a holding vessel while the ink evaporates into the air.

The vent to atmosphere is achieved by use of long tube 30 having a small inside diameter, about 762 μm (0.030 inch) to 1520 μm (0.060 inch) ID. Because of the small inside diameter, diffusion is very slow, yielding an effective vapor seal while still allowing the cap chamber 38 to be vented to atmosphere. This unique aspect of the configuration may be difficult to easily achieve in any other way.

The roller 32 in the pump 12 employs circumferential ridges 40 which help to center the tubing 30 in the area of highest pinching force. Consequently, the configuration is more tolerant of manufacturing variations.

The roller 32 is fixed on the pump body 34 and rotates once into position by activation of a multiplexer (not shown) by means of a bevel gear 42, which engages bevel gear 44 on the pump body.

The body 34 of the pump 12 is designed to allow a robot (or other automation) to assemble it. The robot can place the roller 32 and then snap the pump body 34 in place because it is assembled straight down from the top. There are no fasteners holding it in; molded-in snaps 43 trap everything in place by engaging in a boss 45 molded into the chassis.

Turning now to FIGS. 3a-c, as the printhead 18 moves toward the capped position (illustrated in FIG. 3c), a pen support 46 on the carriage 22 strikes an arm 48 on the sled 14 and aligns the cap 50 on the cap assembly 38 so that it caps around the pen's orifices in the orifice plate. The orifice plate is part of the printhead 18 and, due to its small dimensions, is not easily visible in the scale of the drawing depicted herein.

As the pen support 46 strikes the arm 48, the sled 14 simultaneously rises up on ramps 52 and presses the cap 50 up against the perimeter of the orifice plate of the printhead 18, sealing the orifices from the atmosphere. Advantageously, the ramps 52 may be molded into a wall of the printer chassis. Bosses 53 support the sled 14 on the ramps 52.

As the sled 14 rises on its ramps 52, a pen catcher 54 engages a slot 56 in the printhead. When the printhead subsequently leaves the service station 10, the pen catcher 54 ensures that the sled 14 is returned to its inactive position, depicted in FIG. 3b.

The purpose of the ramped sled motion is to prevent wear on the cap 50 so that it will not need to be replaced during the life of the printer. The motion also allows movement of the cartridge 18

into position to activate the pump 12 through a multiplexer means (not shown) and then move back out off the multiplexer while being capped the entire time. Thus, the sled configuration of the invention impacts product reliability (through reduced cap wearout) and multiplexer design (through allowing motion while capped).

Once engaged by the multiplexer, motion of the paper motor (not shown) is coupled by suitable gearing (not shown) to the pump body 34 via bevel gear 42 and bevel gear 44.

Prior to capping, the printhead 18 moves across a wiper 58 secured in the wiper bracket 16. The wiper 58 comprises a blade, the edge of which scrapes paper dust and other contaminants off the orifice plate of the printhead 18. The wiper 58, which advantageously comprises a resilient material such as nitrile rubber, is cleaned by pocket edges (not shown) in the bottom of the printhead 18. These pocket edges are formed on either side of the printhead 18, by a metallic tab/tape assembly.

A control algorithm has been developed for the service station of the invention. On initial power-up, all nozzles are fired 32 times into the cap assembly 38. All nozzles are also fired four times into a spittoon 60, shown in FIG. 4a, which is part of the wiper bracket subassembly 16, each time the cartridge 20 leaves the service station 10 and four times into the cap chamber 38 each time the cap 50 is engaged. All nozzles in the printhead 18 are also fired four times into the spittoon 60 every 60 seconds during printing.

These firings have two purposes. First, they are intended to clear any nozzle clogs which might develop before printing begins. This function is common to all ink-jet printers. Second, the droplets fired into the cap chamber 38 provide moisture to keep the printhead from drying up during capping. This function is not believed to be used on other ink-jet printers, and clearly provides an advantage, in that the printhead 18 provides its own moisture for humidification of inactive, capped nozzles.

The flow rate of ink through the nozzles for clearing printhead problems, such as viscous ink plugs and bubbles, is optimally about 1 to 5 cm³/min. A displacement of about 0.06 to 0.15 cm³ of ink is optimal for clearing such problems in the printhead.

INDUSTRIAL APPLICABILITY

The service station of the invention is useful in ink-jet printers, particularly in ink-jet printers employing thermal printheads.

Thus, there has been provided a service station for an ink-jet printer. It will be appreciated that various modifications and changes of an obvious

nature may be made without departing from the scope of the invention, as defined by the appended claims.

5 Claims

1. A service station (10) for use in an ink-jet printer, said printer including a bidirectionally movable carriage (22) supporting in secured alignment a print cartridge (20) having a printhead (18) for printing onto a print medium, said carriage driven by a controlled motor, said service station fixed at one end of travel of said print carriage and comprising:

- (a) pump means (12) for priming said printhead;
- (b) a slidably mounted sled (14) to actuate said service station and having means (50) to seal said printhead; and
- (c) wiping means (58) for cleaning said printhead.

2. The service station of Claim 1 wherein said pump means comprises a peristaltic pump (12) having a single roller (32) engaged in a pump body (34) maintained in a pump body support (37) and a tube (30), one end of which is connected to said sealing means and which passes between said roller and a wall (36) of said pump body support, said pump body driven by a gear drive (42, 44) associated with the movement of said carriage.

3. The service station of Claim 2 wherein said tube has an inside diameter sized to permit equalization of air pressure and to prevent substantial water vapor transport therethrough.

4. The service station of Claim 1 wherein said sled includes a cap means (50) for sealing orifice plates in said printhead, said cap means maintained on a cap chamber (38) supported on said sled, to which said pump means is operatively connected.

5. The service station of Claim 4 wherein said sled is movable supported on a ramp (52) and is provided with engageable means (48) associated with said carriage such that upon engagement by motion of said carriage, said sled moves up said ramp to seal said orifice plates by said cap.

6. The service station of claim 5 wherein said cartridge is provided with a slot (56) and said sled is provided with means (54) for engaging said slot during said sealing such that movement of said carriage out of said service sta-

into position to activate the pump 12 through a multiplexer means (not shown) and then move back out off the multiplexer while being capped the entire time. Thus, the sled configuration of the invention impacts product reliability (through reduced cap wearout) and multiplexer design (through allowing motion while capped).

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 - (a) pump means (12) for priming said printhead;
 - (b) a slidably mounted sled (14) to actuate said service station and having means (50) to seal said printhead; and
 - (c) wiping means (58) for cleaning said printhead.
2. The service station of Claim 1 wherein said pump means comprises a peristaltic pump (12) having a single roller (32) engaged in a pump body (34) maintained in a pump body support (37) and a tube (30), one end of which is connected to said sealing means and which passes between said roller and a wall (36) of said pump body support, said pump body driven by a gear drive (42, 44) associated with the movement of said carriage.
3. The service station of Claim 2 wherein said tube has an inside diameter sized to permit equalization of air pressure and to prevent substantial water vapor transport therethrough.
4. The service station of Claim 1 wherein said sled includes a cap means (50) for sealing orifice plates in said printhead, said cap means maintained on a cap chamber (38) supported on said sled, to which said pump means is operatively connected.
5. The service station of Claim 4 wherein said sled is movable supported on a ramp (52) and is provided with engageable means (48) associated with said carriage such that upon engagement by motion of said carriage, said sled moves up said ramp to seal said orifice plates by said cap.
6. The service station of claim 5 wherein said cartridge is provided with a slot (56) and said sled is provided with means (54) for engaging said slot during said sealing such that movement of said carriage out of said service sta-



tion returns said sled to its lower, unramped position.

7. The service station of Claim 1 wherein said wiping means is mounted on a wiper bracket (16) and is adapted to wipe debris from said printhead during movement of said carriage into said service station.
8. The service station of Claim 7 wherein said wiper bracket further includes a spitton (60) for receiving ink jetted from said cartridge during warm-up thereof.
9. The service station of Claim 1 wherein said pump means induces a flow rate of ink through said printhead of about 1 to 5 cm³/min and a displacement of ink through said printhead of about 0.06 to 0.15 cm³ to clear problems in said printhead.

Patentansprüche

1. Wartungsstation (10) zur Verwendung in einem Tintenstrahldrucker, wobei dieser Drucker einen in zwei Richtungen beweglichen Wagen (22) umfaßt, der gesichert ausgerichtet eine Druckkartusche (20) mit einem Druckkopf (18) zum Drucken auf ein Druckmedium trägt, dieser Wagen durch einen gesteuerten Motor angetrieben wird, die Wartungsstation an einem Ende der Wegstrecke des Druckwagens befestigt ist und umfaßt:
 - a) eine Pumpeinrichtung (12) zum Initiieren des Druckkopfes,
 - b) einen gleitbar montierten Schlitten (14), um die Wartungsstation zu bewegen, mit einer Einrichtung (50), um den Druckkopf abzudichten und
 - c) eine Wischeinrichtung (58) zum Reinigen des Druckkopfes.
2. Wartungsstation nach Anspruch 1, wobei die Pumpeinrichtung eine peristaltische Pumpe (12) mit einer einzigen Druckrolle (32), die an einem Pumpenkörper (34) gelagert ist, der in einem Pumpenkörperträger (37) gehalten wird, und einen Schlauch (30) umfaßt, dessen eines Ende mit der abdichtenden Einrichtung verbunden ist und welcher zwischen der Druckrolle und einer Wand (36) des Pumpenkörperträgers verläuft, wobei der Pumpenkörper durch einen Zahnradgetriebe (42,44) angetrieben wird, das der Bewegung des Wagens zugeordnet ist.
3. Wartungsstation nach Anspruch 2, wobei der Schlauch einen Innendurchmesser von einer

Größe aufweist, die einen Ausgleich des Luftdrucks gestattet und einen wesentlichen Transport von Wasserdampf durch ihn hindurch verhindert.

4. Wartungsstation nach Anspruch 1, wobei der Schlitten eine Abdeckungseinrichtung (50) enthält, um Düsenplatten in dem Druckkopf abzudichten, wobei die Abdeckungseinrichtung auf einer Abdeckungskammer (38) gehalten ist, die von dem Schlitten unterstützt ist und mit der die Pumpeinrichtung funktionell verbunden ist.
5. Wartungsstation nach Anspruch 4, wobei der Schlitten beweglich auf einer Rampe (52) getragen wird und mit einer Mitnehmer-Einrichtung (48) versehen ist, die mit dem Wagen so in Beziehung steht, daß bei einem Auflaufen des Wagens der Schlitten sich die Rampe hinaufbewegt, um die Düsenplatten durch die Abdeckung abzudichten.
6. Wartungsstation nach Anspruch 5, wobei die Kartusche mit einem Schlitz (56) versehen ist und der Schlitten mit einer Einrichtung (54) zum Eingreifen in den Schlitz während des Abdichtens versehen ist, so daß eine Bewegung des Wagens aus der Wartungsstation heraus den Schlitten in seine niedrigere, nicht hochgefahrte Position zurückkehren läßt.
7. Wartungsstation nach Anspruch 1, wobei die Wischeinrichtung auf einem Wischerträger (16) montiert ist und dafür ausgelegt ist, Überbleibsel von dem Druckkopf während der Bewegung des Wagens in die Wartungsstation abzuwischen.
8. Wartungsstation nach Anspruch 7, wobei der Wischerträger weiterhin ein Speibecken (60) zur Aufnahme von Tinte enthält, die von der Kartusche während des Warmlaufens derselben ausgespritzt wird.
9. Wartungsstation nach Anspruch 1, wobei die Pumpeinrichtung eine Tintendurchflußmenge durch den Druckkopf von ungefähr 1 bis 5 cm³/min und eine Verlagerung von Tinte im Druckkopf von ungefähr 0,06 bis 0,15 cm³ erzeugt, um Probleme in dem Druckkopf zu beseitigen.

Revendications

1. Station-service (10) destinée à être utilisée dans une imprimante à jet d'encre, ladite imprimante comprenant un chariot (22) mobile bidirectionnel supportant en alignement bloqué



une cartouche d'impression (20) qui possède une tête d'impression (18) destinée à imprimer sur un milieu d'impression, ledit chariot étant entraîné par un moteur commandé, ladite station-service étant fixée à une extrémité du trajet dudit chariot d'impression et comprenant

- (a) des moyens formant pompe (12) pour amorcer ladite tête d'impression ;
- (b) un traîneau (14) monté coulissant pour actionner ladite station-service et possédant des moyens (50) pour fermer ladite tête d'impression à joint étanche, et
- (c) des moyens d'essuyage (58) destinés à nettoyer ladite tête d'impression.

2. Station-service selon la revendication 1, dans laquelle lesdits moyens formant pompe comprennent une pompe péristaltique (12) possédant un galet unique (32) engagé dans un corps de pompe (34) maintenu dans un support (37) de corps de pompe et un tube (30) dont une extrémité est raccordée auxdits moyens de fermeture et qui passe entre ledit galet et une paroi (36) dudit support de pompe, ledit corps de pompe étant entraîné par un entraînement à engrenages (42, 44) associé au mouvement dudit chariot.
3. Station-service selon la revendication 2, dans laquelle ledit tube a un diamètre intérieur dimensionné pour permettre l'égalisation de la pression d'air et empêcher tout transport notable de vapeur d'eau dans ce tube.
4. Station-service selon la revendication 1, dans laquelle ledit traîneau comprend des moyens (50) formant chapeau pour fermer des plaques à orifices de ladite tête d'impression, lesdits moyens formant chapeau étant maintenus sur une chambre (38) de chapeau supportée par ledit traîneau, à laquelle lesdits moyens formant pompe sont raccordés fonctionnellement.
5. Station-service selon la revendication 4, dans laquelle ledit traîneau est supporté mobile sur une rampe (52) et est muni de moyens (48) pouvant être attaqués qui sont associés audit chariot de telle manière que, lorsqu'ils sont attaqués par le mouvement dudit chariot, ledit traîneau monte le long de la rampe pour fermer lesdites plaques à orifices au moyen dudit chapeau.
6. Station-service selon la revendication 5, dans laquelle ladite cartouche est munie d'une fente (56) et ledit traîneau est muni de moyens (54) destinés à coopérer avec ladite fente pendant

ladite fermeture de telle manière que le mouvement dudit chariot dans le sens qui sort de ladite station-service ramène ledit traîneau à sa position inférieure, non élevée par la rampe.

7. Station-service selon la revendication 1, dans laquelle lesdits moyens d'essuyage sont montés sur un support (16) d'organe d'essuyage et adaptés pour balayer les débris de ladite tête d'impression pendant le mouvement dudit chariot dans le sens qui pénètre dans ladite station-service.
8. Station-service selon la revendication 7, dans laquelle ledit support d'organe d'essuyage comprend en outre un crachoir (60) destiné à recevoir l'encre projetée par ladite cartouche pendant l'échauffement de celle-ci.
9. Station-service selon la revendication 1, dans laquelle lesdits moyens formant pompe font circuler un débit d'encre d'environ 1 à 5 cm³/min à travers ladite tête d'impression, et font passer un volume de déplacement d'encre d'environ 0,06 à 0,15 cm³ à travers ladite tête d'impression pour éliminer les problèmes affectant ladite tête d'impression.

