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(54) **Lid heater for a continuous ink-jet printer**

Lippenheizelement für kontinuierlich arbeitenden Tintenstrahldrucker

Dispositif de chauffage d'une lèvre pour une imprimante à jet d'encre continu

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**Description**Technical Field

**[0001]** The present invention relates to continuous ink jet printing and, more particularly, to a heater element formed into the eyelid of a continuous ink jet printhead.

Background Art

**[0002]** Ink jet printing systems are known in which a printhead defines one or more rows of orifices which receive an electrically conductive recording fluid from a pressurized fluid supply manifold and eject the fluid in rows of parallel streams. Printers using such printheads accomplish graphic reproduction by selectively charging and deflecting the drops in each of the streams and depositing at least some of the drops on a print receiving medium, while others of the drops strike a drop catcher device.

**[0003]** When the ink jet printhead is not in operation, means must be provided to seal the printhead so that ink does not dry in the catcher face area, or weep from the jets and soil the apparatus or adjacent work surfaces. It is desirable, therefore, to attach an eyelid device to a printhead, e.g. as shown in US-A-5 475 410. The eyelid contains and directs the fluid flow through the catcher during the startup sequence of the continuous ink jet printer. The startup sequence establishes the jets, dries the high voltage electrodes, and turns on charging voltage.

**[0004]** The eyelid diverts the flow of ink from a resonator back into the printhead while the printer is running but not printing. The eyelid can be opened any time after the charging voltage is applied. Typically, the eyelid remains closed while waiting for other printers to come on line, the paper to be loaded, during operator breaks, and other interruptions of a normal production run. The eyelid stays closed to protect documents or equipment below the printhead in the case of crooked jets or other printhead errors which are not detected automatically.

**[0005]** Current printhead design has been optimized to reduce evaporation rates in order to minimize ink concentration changes in the system. The optimization reduces the airflow through the catcher to a minimum. The reduced catcher flow does not completely remove air in the region around the jets when the eyelid is closed, so this air becomes saturated with water vapor due to localized evaporation from ink drops. The air temperature approaches the ink temperature, which is 5 to 10°C above the eyelid seal temperature. The saturated air then condenses on the eyelid. Over time, the condensate will fill the volume and drip out of the eyelid, or cause shorts to the high voltage electrode.

**[0006]** Attempts to solve this eyelid condensate problem by increasing the airflow and/or decreasing the ink temperature have been unsuccessful, due to airflow limitations of the catcher.

**[0007]** It is seen then that there exists a need for a means for eliminating the formation of condensate on the eyelid of a continuous ink jet printhead.

5 Summary of the Invention

**[0008]** This need is met by the integrated eyelid heater element according to the present invention, wherein the surface temperature of the eyelid seal assembly is maintained above the local ambient air temperature to eliminate the formation of condensate.

**[0009]** In accordance with one aspect of the present invention, an eyelid assembly in a continuous ink jet printhead comprises an eyelid for containing and directing fluid flow through a catcher throat and a heater element formed into the eyelid to prevent condensate on the eyelid.

**[0010]** Accordingly, it is an object of the present invention to prevent the formation of condensate on the surface of a printhead eyelid. It is a further object of the present invention to integrate a heater element into the eyelid seal assembly to maintain the surface temperature of the eyelid above the local ambient air temperature. Finally, it is an advantage of the present invention that the heater can be molded into the eyelid seal to minimize power requirements.

**[0011]** Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

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Brief Description of the Drawings**[0012]**

35 Fig. 1 illustrates the printhead portion of a continuous ink jet printing system, including an eyelid and eyelid heater, in accordance with the present invention; and

40 Fig. 2 shows an isometric view of the eyelid and catcher assembly portion of the printhead of Fig. 1, to illustrate ink flow and condensate formation.

Detailed Description of the Preferred Embodiments

45 **[0013]** Referring to the drawings, there is illustrated in Fig. 1 an eyelid device 1, required for a continuous flow ink jet printer. The eyelid device 1 typically comprises an actuator element 1a and a seal element 1b. The actuator 1a opens when printing begins to allow print drops to exit printhead 10. The eyelid seal 1b contains and directs the fluid flow 2d, as illustrated in Fig. 2, through catcher throat 2a during the startup sequence. The startup sequence establishes the ink jets 3 from the droplet generator 4, dries the high voltage electrodes 2b, and turns on a charging voltage. The eyelid can be opened any time after the charging voltage is applied. Typically, the eyelid remains closed while waiting for other printers to come on line, the paper to be loaded, during operator

breaks, and other interruptions of a normal production run. The eyelid stays closed to protect documents or equipment below the printhead in the case of crooked jets or other printhead errors which are not detected automatically.

**[0014]** Printhead design has been optimized to reduce evaporation rates in order to minimize ink concentration changes in the system. However, this optimization also has the effect of reducing airflow through the catcher to a minimum. The reduced catcher flow is not capable of completely removing air in region 5 around the jets when the eyelid is closed. This air becomes saturated with water vapor due to localized evaporation from ink drops, causing the air temperature to approach the ink temperature, which is 5 to 10°C above the eyelid seal temperature. The saturated air condenses on the eyelid, particularly on surface 1c of Fig. 2. Over time, the condensate fills the volume and drips out of the eyelid, or causes shorts to the high voltage electrode.

**[0015]** In accordance with the present invention, an eyelid heater 6 is provided to prevent condensate on the surface of the eyelid, particularly surface 1c of the eyelid, parallel to the catcher face, which has ink impacting on it. In a preferred embodiment of the present invention, the heater 6 comprises a flex circuit with the heater element 6b located in the face of the flex circuit; a flange on the upper surface which extends beyond the molded portion, to fix the flex circuit in the correct position in the mold cavity during the molding process; and electrical connections 6a.

**[0016]** Eyelid assembly 1, comprising actuator 1a and eyelid seal 1b, seal the printhead 10 when the printhead is not in operation, so that ink does not dry in the catcher face area, or weep from the jets. The seal 1b preferably comprises a silicone rubber eyelid seal. The heater element 6 is integrated into the eyelid seal 1b to maintain the surface temperature of the eyelid above the local air temperature and eliminate the formation of condensate on the eyelid 1. Molding the heater element into the eyelid seal also has the desirable effect of minimizing power requirements. The molding reduces the power requirements by eliminating the energy which is wasted by heating the actuator element. The actuator, which is aluminum, conducts heat very well, as aluminum has a high thermal conductivity; whereas the seal, which is silicone rubber, does not conduct heat well, as silicone rubber has a low thermal conductivity. If the heater 6 is placed external to the silicone, rather than molded into the seal as in the present invention, the energy must pass through the interface to the silicone, and through the silicone, to reach the face that needs to be heated. This increases the power requirements from 1.5 W to a range from 6 W to 10 W.

**[0017]** In a preferred embodiment of the present invention, the integral eyelid and heater assembly also comprises an integral connector 6a to allow easy removal of the eyelid for servicing.

### Industrial Applicability and Advantages

**[0018]** The present invention is useful in the field of ink jet printing, and has the advantage of preventing the formation of condensate on the surface of a printhead eyelid. It is a further advantage of the present invention that it integrates a heater element into the eyelid seal assembly to maintain the surface temperature of the eyelid above the local ambient air temperature. Finally, it is an advantage of the present invention that the heater can be molded into the eyelid seal to minimize power requirements.

**[0019]** Having described the invention in detail and by reference to the preferred embodiment thereof, it will be apparent that other modifications and variations are possible without departing from the scope of the invention defined in the appended claims.

### 20 Claims

1. An eyelid assembly in a continuous ink jet printhead comprises:

25 an eyelid for allowing print drops to exit the printhead;  
an eyelid seal associated with the eyelid for containing and directing fluid flow through a catcher throat; and  
30 a heater integral with the eyelid seal to prevent condensate on the eyelid.

2. An eyelid assembly as claimed in claim 1 wherein the eyelid seal comprises a silicone rubber eyelid seal.

3. An eyelid assembly as claimed in claim 1 wherein the heater comprises:

40 a flex circuit having a flex circuit face;  
a heater element located in the face of the flex circuit;  
a flange to fix the flex circuit in position; and  
45 electrical connections.

4. An eyelid assembly as claimed in claim 3 wherein the heater element maintains temperature of the flex circuit face at approximately five degrees Celsius above local ambient temperature.

5. An eyelid assembly as claimed in claim 3 wherein the heater element is molded into the eyelid seal.

### 55 Patentansprüche

1. Schutzklappenanordnung in einem kontinuierlich arbeitenden Tintenstrahldruckkopf, enthaltend:

- eine Schutzklappe, um Drucktropfen zu ermöglichen, den Druckkopf zu verlassen, eine Schutzklappendichtung, die mit der Schutzklappe zusammenwirkt, um eine Fluidströmung aufzunehmen und durch einen Fanghals zu führen, und  
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eine Heizeinrichtung, die integral mit der Schutzklappendichtung ausgebildet ist, um eine Kondensation an der Schutzklappe zu verhindern. 10
2. Schutzklappenanordnung nach Anspruch 1, wobei die Schutzklappendichtung eine Silikonkautschuk-Schutzklappendichtung ist.
3. Schutzklappenanordnung nach Anspruch 1, bei der die Heizeinrichtung enthält:  
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eine flexible Schaltung mit einer flexiblen Schaltungsfläche,  
ein Heizelement, welches in der Fläche der flexiblen Schaltung angeordnet ist,  
einen Flansch, um die flexible Schaltung in einer Position zu befestigen, und  
25 elektrische Verbindungsmittel. 25
4. Schutzklappenanordnung nach Anspruch 3, bei der das Heizelement die Temperatur der flexiblen Schaltungsfläche bei ca. 5 °C oberhalb der örtlichen Umgebungstemperatur hält. 30
5. Schutzklappenanordnung nach Anspruch 3, bei der das Heizelement in der Schutzklappendichtung eingeformt ist. 35

## Revendications

1. Ensemble de paupière dans une tête d'impression à jet d'encre continu, comprenant: 40  
une paupière pour laisser les gouttelettes d'impression sortir de la tête d'impression;  
un élément d'étanchéité de paupière associé à la paupière pour contenir et diriger un écoulement de fluide dans une gorge du dispositif collecteur; et  
45 un élément de chauffage solidaire du dispositif d'étanchéité de la paupière pour éviter le condensat sur la paupière. 50
2. Ensemble de paupière selon la revendication 1, selon lequel l'élément d'étanchéité de la paupière comprend un élément d'étanchéité de paupière en caoutchouc de silicone. 55
3. Ensemble de paupière selon la revendication 1, selon lequel l'élément de chauffage comprend:
- un circuit imprimé souple comportant une face de circuit imprimé souple;  
un élément de chauffage placé dans la face du circuit imprimé souple;  
un rebord pour fixer le circuit imprimé souple en position; et  
des connexions électriques.
4. Ensemble de paupière selon la revendication 3, selon lequel l'élément de chauffage maintient la température de la face du circuit imprimé souple à une valeur supérieure de cinq degrés Celsius environ à celle de la température ambiante locale.
5. Ensemble de paupière selon la revendication 3, selon lequel l'élément de chauffage est moulé pour former l'élément d'étanchéité de la paupière.

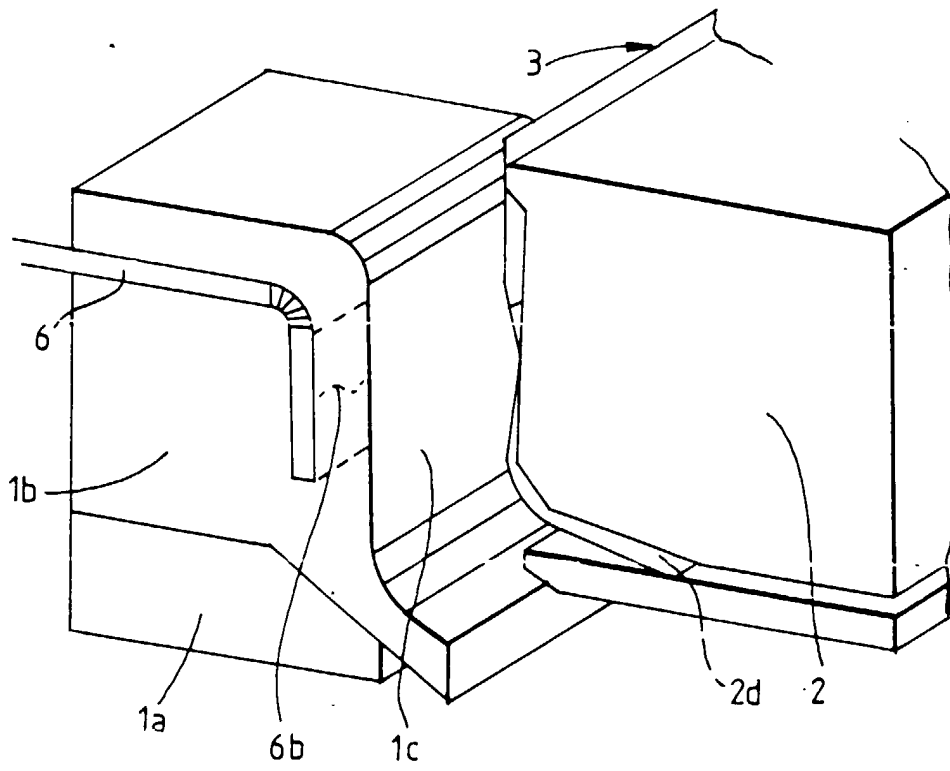
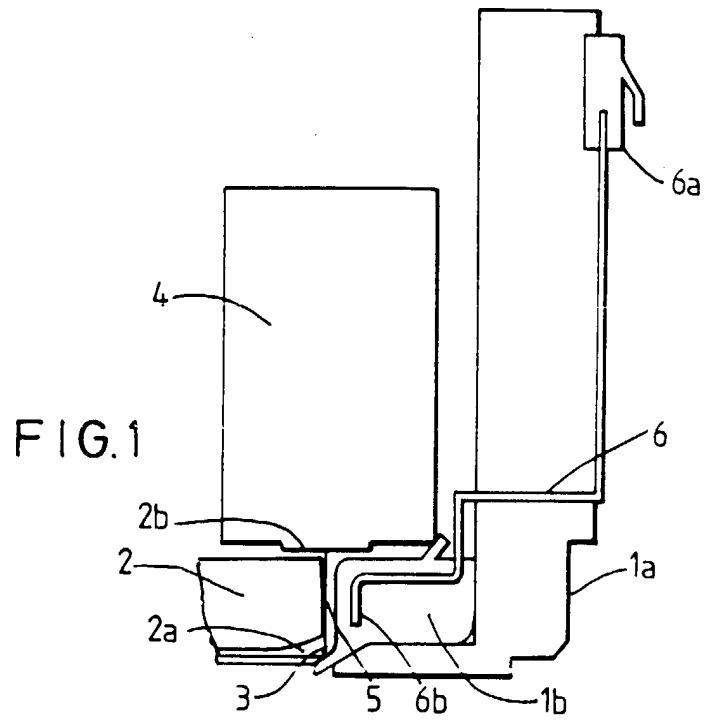


FIG. 2