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(54) **Capping device for an inkjet print head**

(57) A capping device (1) for capping an inkjet print-head during storage and transport can be made of a harder and more chemically resistant elastomer. The sealing lip (2) contacts the printhead while the sealing pressure is ensured by a deformable base structure (3).

Equal pressure is preferably ensured by the deflection of the geometry of the base structure. Cavities may be present underneath the sealing lip.

Due to the symmetrical design, sideways movement of the sealing lip during capping is avoided.

Elastomeric materials having a hardness up to 100 shore A can be used.

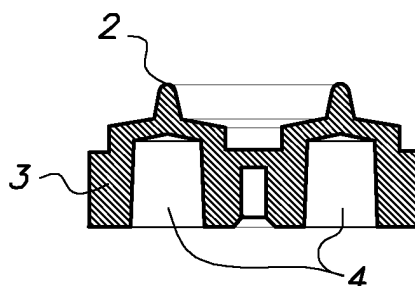


FIG. 3

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a device for capping of an inkjet printhead during storage and transport.

More specifically the invention is related to the design of such a capping.

BACKGROUND OF THE INVENTION

[0002] Nowadays inkjet printing systems are used in a wide array of apparatuses and in a wide array of applications such as fax, colour photo printing, industrial applications etc. In these printing systems inks, possibly of various colours, is ejected out of at least one array of nozzles located in a printhead to the receiving material. A long known problem in inkjet printers is that the nozzles through which the ink is projected to the receiving material are blocked by clogging of ink inside the nozzles and on the printhead. This renders certain nozzles inoperable and results in a defective print or deteriorated print quality.

To improve the clarity and contrast of the printed image, recent research has been focused to improvement of the used inks. To provide quicker, more waterfast printing with darker blacks and more vivid colours, pigment based inks have been developed. These pigment-based inks have a higher solid content than the earlier dye-based inks. Both types of ink dry quickly, which allows inkjet printing mechanisms to form high quality images.

In some industrial applications, such as making of printing plates using ink-jet processes, inks having special characteristics causing specific problems. E.g. UV curable inks exist to allow rapid hardening of inks by UV radiation after printing.

Different types of ink exist, having different chemical components. The combination of small nozzles and quick drying ink leaves the printheads susceptible to clogging, not only from dried ink and minute dust particles or paper fibres, but also from the solids within the new ink themselves.

Problems can be avoided by periodically cleaning the printhead by :

- Spitting to clear the nozzles,
- Vacuum assisted purging which helps to clear the nozzles,
- Application of solvents to dissolve dried ink
- Wiping to remove impurities

[0003] To prevent drying an external contamination the inkjet printhead is capped during non-operational periods. The printhead is thereby be sealed off from contaminants by a sealing enclosure. This also prevents the drying of the ink. The capping unit usually consists of a

rubber seal placed around the nozzle array.

[0004] Another aspect of high end inkjet printing applications is that an industrial inkjet printing apparatus usually has plural inkjet printheads. These inkjet printheads are tested on the manufacturing site and are shipped to the client with the ink or a special transport fluid in them.

The openings in the printhead for supplying ink and for enabling reflow of the ink to e.g. a header tank are closed off by plugs, but also the nozzles should be sealed off by a capping device in order to safely transport the printheads without risk of ink leakage and drying out of the ink, possibly rendering the printhead defective.

A similar problem exists when inkjet printheads are temporarily removed from a printer, e.g. having exchangeable printheads, and are to be stored for possibly a long time.

[0005] It is clear that there is a need for a good capping device for use in a printer as well as for use in storage or transport of ink-laden inkjet printheads. Especially when there is a need for applying a vacuum to the nozzle plate capping has to be very efficient.

[0006] In US-B1-6 481 825 a capping arrangement is described used for storage and transport of printhead.

Instead of an enclosing capping, a capping pressing directly upon the nozzle array is used. In order to avoid damage to the nozzle arrays a very soft rubber is used optionally covered with a flexible film to seal the rubber from the ink.

The proposed capping arrangement however poses several problems :

- The soft rubber is incompatible with certain ink compositions which may cause swelling of the rubber leading to uneven pressure on the nozzle array leading to defective capping and causing possible leaks of ink from the nozzles or drying of the ink on the nozzle plate.
- The flexible film normally sealing the rubber is easily damaged leading to the above mentioned problems.
- Because the use of direct pressure on the nozzle plate, damage of the nozzle plate is not unlikely, even when using a soft rubber for the capping.
- The soft rubber deforms when being pressed on the nozzle plate leading to lateral expansion of the rubber and leading to friction forces on the nozzle plate.
- When due to inefficient sealing the ink or transport fluids do dry, the capping can stick to the nozzle plate and when removing the soft rubber can tear so that the capping is damaged and the printhead is defective due to the rubber adhered thereto.

[0007] In US 5 917 515 a nozzle cap for capping a printhead and for applying a vacuum is described. The capping arrangement comprises : a nozzle cap, enclosing the nozzle array, cap support, coil spring, cap seat and elastic film. The nozzle cap and elastic film are pref-

erably integrally made of same elastic material.

Elasticity is obtained by use of a soft rubber. Cappings comprising soft rubber however tend to be more susceptible to loss of vacuum. Soft rubbers exhibit due to the pressing force against the nozzle plate a creep deformation leading to change in pressing force. Application of vacuum causes horizontal movement of the seal lip contacting the printhead over the printhead, possible causing damage. When soft rubbers are exposed to forces over a long period they tend to further deform.

[0008] It is clear from the above description that there is a need for an improved design for a capping used for transport and for prolonged storage and which is compatible with different kinds of inks which can be used in an inkjet printhead.

SUMMARY OF THE INVENTION

[0009] The above-mentioned advantageous effects are realized by a device having the specific features set out in claim 1. Specific features for preferred embodiments of the invention are set out in the dependent claims.

Further advantages and embodiments of the present invention will become apparent from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

- Fig. 1 shows a general view of a capping according to the present invention for a printhead.
- Fig. 2 shows a section of a capping wherein the deformable base structure is made from a soft rubber.
- Fig. 3 shows a section of a capping wherein the deformation of the base structure is enabled by the use of a cavity underneath the sealing lip.
- Fig. 4 illustrates the use of a transversal bridge structure in the capping base.
- Fig. 5 shows a possible convex structure.
- Fig. 6 shows an embodiment having supporting oblique walls
- Fig. 7 illustrates the symmetrical geometrical design of the supporting structure.

DETAILED DESCRIPTION OF THE INVENTION

[0011] While the present invention will hereinafter be described in connection with preferred embodiments thereof, it will be understood that it is not intended to limit the invention to those embodiments.

[0012] The greatest drawbacks situation can be avoided by using a harder rubber contacting the printhead which is substantially chemically inert and exhibits no creep phenomenon.

The problem to be solved is however to maintain the

elasticity of the capping while using a harder rubber. Desired properties are :

- the pressure force of the capping seal has to be low and constant over the whole compression distance.
- the sealing lip contacting the nozzle plate does not exhibit lateral movements over the nozzle plate. Not during capping and no movements due to creep caused by long periods of pressure forces or vacuum.
- during capping the sealing lip contacting the printhead exhibits no expansion due to compression.

[0013] The objects of the present invention are met by a capping device comprising a deformable base structure determining the sealing pressure of the sealing lip provided on the deformable base structure.

[0014] This can be obtained by different methods.

Fig. 1 shows a general view of a capping 1 for a printhead according to the present invention. A sealing lip 2 is provided for contacting the printhead. The sealing lip is supported by a deformable base structure 3.

Fig. 2 shows a section of a capping 1 along the line X in Fig. 1 wherein the deformable base structure 3 is made from a soft rubber, while the sealing lip 2 is relatively rigid. This means that the sealing lip 2 on top of the base structure 3 exhibits no significant deformation when it is pressed on the printhead.

The soft rubber of the base structure 3 ensures that the pressure on the head is relatively low and remains constant over a long distance.

Pressure force remains relatively constant over the compression distance due to the composition of the base structure 3.

[0015] A more preferable possibility is that the sealing pressure is determined by the geometry of the base structure 3.

Due to the geometrical characteristics of the base structure 3, it is easily deformable.

Preferably this is caused by bending of the structures of the base layer 3.

[0016] Fig. 3 shows a detail of the section of a preferred embodiment a capping 1 wherein the deformation of the base structure 3 is enabled by the use of a cavity 4 underneath the sealing lip 2.

The rubber of the base structure 3 under the sealing lip 2 is relatively thin and can bend over a considerable distance when the sealing lip 2 is pressed to a printhead. This ensures a relative constant force of the sealing lip 2 on the printhead, independent from the compression distance of the capping 1 on the head.

[0017] In the embodiment of Fig. 4 the deformation of the base structure 3 and thus the pressure of the capping seal 2 on the printhead is regulated by a transversal bridge structure 5 in the capping base structure 3. When

the capping 1 is pressed on the printhead, the bridges 5 bend and compression and tension forces are generated within the bridges 5.

[0018] Fig. 5 shows a possible convex structure 6 of the base structure 3 to ensure flexibility.

[0019] In Fig. 6 an embodiment is shown wherein two oblique supporting walls 7 support the sealing lip 2. The walls have preferably an angle of 15-90 degrees with the nozzle plate surface.

[0020] As illustrated in Fig. 7, another important aspect of the geometry of the base structure 3 is that deformation of the base structure 3 does not lead to lateral displacement of the sealing lip 2 over the printhead. The aim of the base structure 3 is to allow only displacement in a direction D transversal to the nozzle plate. Sideways movement is to be counteracted in order to avoid damage of the nozzle plate and to ensure long time good capping of the printhead.

This can be ensured by making a capping 1 wherein the geometry of the base structure 3 under the sealing lip exhibits symmetrical behavior, relative to the plane through the sealing lip 2 and perpendicular to the nozzle plate, and the direction of movement of sealing lip 2 during capping is thereby restricted substantially normal to the nozzle plate surface.

As illustrated in Fig. 7 this can be provided by having a perfect symmetrical geometry relative to the contact line of the sealing lip 2 indicated by the mirror plane P. Depending upon the conditions wherein the capping 1 will be used, it may be necessary to take into account the extra forces acting upon the sealing lip 2 caused by the vacuum which is placed inside the sealing ring formed by the sealing lip 2. The aim is to ensure symmetrical behavior.

[0021] In order to ensure bending of the base structure 3 it is also possible to provide locally extreme thinning of the supporting structures forming rubber hinges. This enables the use of even rubber having a higher hardness.

[0022] The advantage of a capping 1 according to the present invention are:

- The pressing force is constant over a relatively large distance during capping.
- due to use of the bridges, no sideways movement are possible.
- there is no need to use two or more different material for making the capping, resulting in a easier and cheaper fabrication of a capping.
- hard rubbers can be used to avoid chemical damage of the capping 1 by the ink.

[0023] The hardness of the used rubbers preferably is about 40 shore A but may be even 100 shore A. Above this hardness the rubber connections and walls tend to be too thin giving rise to problems of breaking of the hinges and non reproducibility of the design properties. The rubber also exhibits not enough flexibility to be able to

seal all surface irregularities of the printhead.

Example :

[0024] In Fig 1 a capping 1 used during transport for a printhead is shown having the section as illustrated in Fig 3. The capping 1 was fabricated using a rubber having a hardness of 60 shore A.

Due to the geometrical design the forces upon the pressure upon the printhead does not remarkably vary when the capping 1 is pressed upon the printhead.

Although the capping 1 is not intended to be used in overpressure or vacuum conditions, tests were made to check if sealing was sufficient.

A capping was mounted upon a printhead whereby it was compressed about 0.5mm. and pressure or vacuum conditions were applied.

[0025] No problems were encountered storing at relative pressures of +0.05 and -0.05 bar relative. It was further shown that a pressure of -0.5 was kept without leakage during 60 minutes. This indicates that sealing is sufficient.

After the tests no damage to the capping 1 or printhead could be detected.

[0026] Having described in detail preferred embodiments of the current invention, it will now be apparent to those skilled in the art that numerous modifications can be made therein without departing from the scope of the invention as defined in the appending claims.

Claims

1. A capping device (1) for capping an inkjet printhead having at least one nozzle array comprising :
 - a deformable base structure (2),
 - an sealing lip (2), on said base structure (3),
 characterized in that the sealing pressure of the sealing lip (2) on the printhead during capping is determined by the deformation of the base structure (3).
2. A capping device (1) according to claim 1 wherein the sealing pressure is determined by the deflection of the base structure (3) .
3. A capping device (1) according to claim 1 or 2 wherein underneath the rigid sealing lip (2) at least one cavity (4) is provided within the base structure (3).
4. A capping device (1) according to claim 1 or 2 wherein the sealing pressure is determined by the deflection of an elastomeric bridge (5), supporting the seal (2), being substantially parallel to the printhead surface.

5. A capping device (1) according to claim 1 or 2 wherein the sealing pressure is determined by the deflection of a elastomeric convex structure (6), supporting the seal (2).
5
6. A capping device (1) according to claim 1 or 2 wherein the sealing pressure is determined by the deflection of slanted walls (7), supporting the seal (2), having an angle of 15-90 degrees with the nozzle plate surface.
10
7. The capping device (1) according to any one of the preceding claims wherein the base structure (3) and the sealing lip (2) are integrally made of the same material.
15
8. A capping device (1) according any of the preceding claims wherein the sealing lip (2) is made of a material having a hardness between 40 and 100 shore A
20
9. A capping device (1) according to any one of the preceding claims wherein the geometry of the base structure (3) under the sealing lip exhibits symmetrical behavior ,relative to the sealing lip (2), and the direction (D) of movement of sealing lip (2) during capping is restricted substantially normal to the nozzle plate surface.
25
10. Inkjet printer comprising a capping device (1) according to any one of the preceding claims.
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11. The use of a capping device (1) according to any one of the preceding claims for capping an inkjet printhead during storage or transport of an inkjet printhead.
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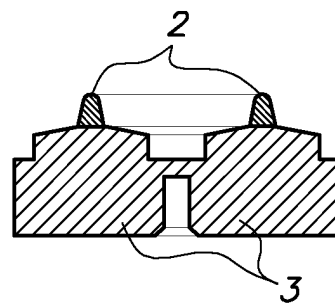
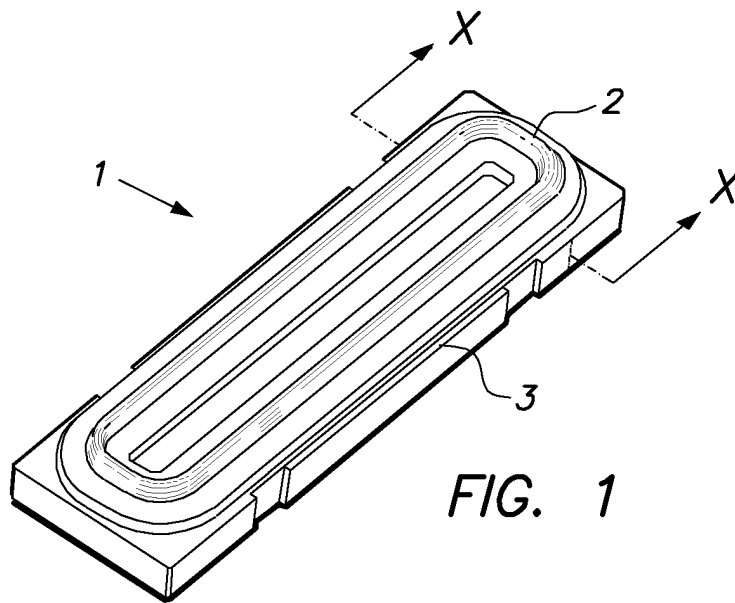


FIG. 2

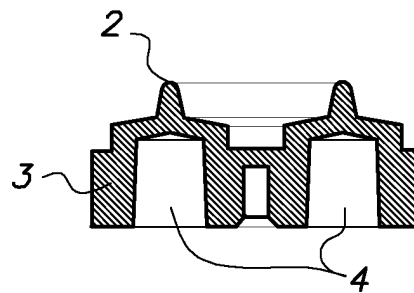


FIG. 3

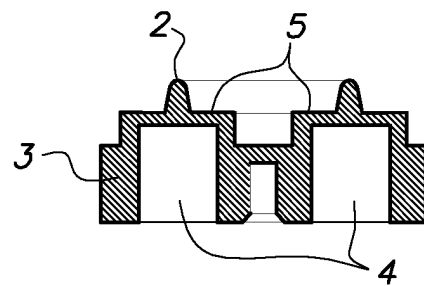


FIG. 4

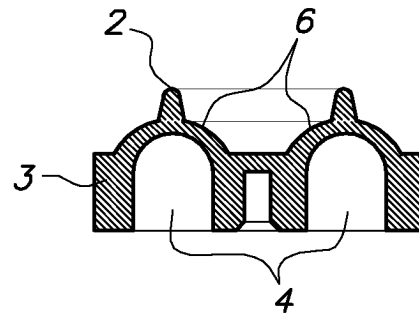


FIG. 5

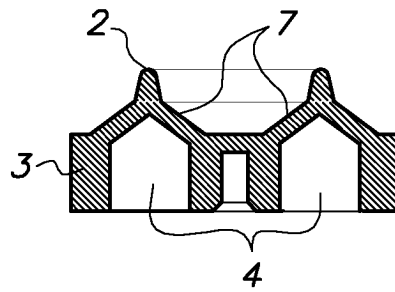


FIG. 6

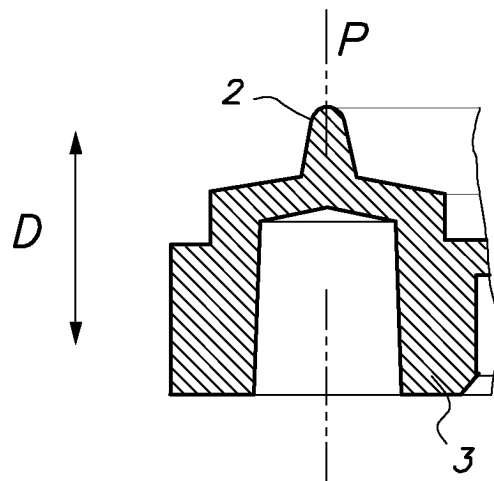


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 03 10 3458

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 967 081 A (HEWLETT PACKARD CO) 29 December 1999 (1999-12-29) * column 10, line 49 - column 11, line 57 * * figure 5 *	1-4,6,7, 9-11	B41J2/165
X	US 5 448 270 A (OSBORNE WILLIAM S) 5 September 1995 (1995-09-05) * column 2, line 25-61 * * column 3, line 43-56 * * figures 5,6 *	1-4,7, 9-11	
X	EP 0 552 030 A (CANON KK) 21 July 1993 (1993-07-21) * column 15, line 20 - column 16, line 18 * * figure 7 *	1-4,7, 9-11	
X	US 2003/081048 A1 (STONE CAL K ET AL) 1 May 2003 (2003-05-01) * paragraphs [0019]-[0024] * * figure 4 *	1-3,6,7, 10,11	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
X	US 5 963 228 A (PURWINS THOMAS J) 5 October 1999 (1999-10-05) * column 5, line 21-46 * * column 11, line 13 - column 12, line 61 * * figures 4,12-15 *	1,7,10, 11	B41J
A	US 5 757 395 A (LEONG NG KENG ET AL) 26 May 1998 (1998-05-26) * column 12, line 33-50 * * figures 2,3 *	1-3,8, 10,11	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 9 February 2004	Examiner Brännström, S
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 10 3458

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09-02-2004

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0967081	A	29-12-1999	US 6220689 B1	24-04-2001
			EP 0967081 A2	29-12-1999
			JP 2000043281 A	15-02-2000

US 5448270	A	05-09-1995	DE 69307053 D1	13-02-1997
			DE 69307053 T2	17-04-1997
			EP 0584960 A2	02-03-1994
			JP 6210861 A	02-08-1994

EP 0552030	A	21-07-1993	JP 3025089 B2	27-03-2000
			JP 5193148 A	03-08-1993
			JP 3100451 B2	16-10-2000
			JP 5193150 A	03-08-1993
			DE 69317679 D1	07-05-1998
			DE 69317679 T2	20-08-1998
			EP 0552030 A1	21-07-1993
			US 5517219 A	14-05-1996
			US 5883647 A	16-03-1999

US 2003081048	A1	01-05-2003	NONE	

US 5963228	A	05-10-1999	US 5635965 A	03-06-1997
			CN 1136501 A	27-11-1996
			DE 69509868 D1	01-07-1999
			DE 69509868 T2	30-09-1999
			EP 0724959 A1	07-08-1996
			JP 8230201 A	10-09-1996

US 5757395	A	26-05-1998	JP 9131898 A	20-05-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82