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(54) **Inkjet printer and a hose for use in the said printer**

Tintenstrahldrucker und Schlauch für Verwendung in diesem Drucker

Imprimante à jet d'encre et tuyau pour ladite imprimante

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- **PATENT ABSTRACTS OF JAPAN vol. 014, no. 327 (M-0998), 13 July 1990 (1990-07-13) & JP 02 111555 A (FUJITSU LTD), 24 April 1990 (1990-04-24)**
- **PATENT ABSTRACTS OF JAPAN vol. 012, no. 171 (M-700), 21 May 1988 (1988-05-21) & JP 62 288045 A (SEIKO EPSON CORP), 14 December 1987 (1987-12-14)**

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Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The invention pertains to an inkjet printer comprising a print head mounted on a carriage and an off-carriage ink reservoir, the carriage being arranged for moving the print head relative to a receiving medium, the printer comprising a hose connecting the print head to the reservoir to enable supply of ink from the reservoir to the print head, the hose having a multi-layered wall. The invention also pertains to a hose for use in the inkjet printer.

[0002] Such a printer is known from US patent 5,988,801. The known printer includes a medium transporting system for transporting the receiving medium along a medium path to a print area and a scanning carriage for holding the print head. The carriage can be scanned along a scanning axis transverse to the media path at the print area. The printer includes a fixed ink supply station including an ink reservoir. In order to connect the movable print head to the reservoir, the printer comprises a fluid conduit for the flow of ink, the conduit comprising a flexible hose having a multi-layered wall routed such that a flexible loop is formed therein. The multi-layered wall provides for a sufficient barrier to water vapour transmission and oxygen permeability. This kind of separate fixed ink supply arrangement is typical for large format printers, e.g. for plotting engineering drawings and printing colour posters. For these applications there is a requirement for the use of much larger volumes of ink than the volumes that can be contained within the print heads themselves. Therefore, separate ink reservoir systems have been developed which provide an external stationary ink supply that is connected to the scanning print head via a hose. The external ink reservoir is known for example as "off-axis", "off-board", or "off-carriage". In the known printer typical problems with these off-axis ink reservoirs, such as mechanical damage of the hose due to an induced kink, vapour losses from the hose, air diffusion into the hose etc. have been resolved adequately by providing a flexible multi-layered wall, each layer having it's own dedicated task to avoid the known problems. This has been outlined in great detail in the above identified US patent, starting in column 3, line 64 end ending in column 7, line 53. However, the known inkjet printer has an important disadvantage. The durability of the hose is relatively poor. After a few months of operation of a typical large format printer, the air and vapour tightness of the hose can decrease to an inadequate level. It is also known that the layers can separate which may cause mechanical damage to the hose, resulting in inadequate water vapour and air tightness. This way, the problems known before, such as the change of ink properties, degrading print quality, print head starvation etc. again arise. Replacement of the bad hose often implies replacement of the complete tubing system, which is relatively expensive.

[0003] CH 674763 A5 discloses a flexible medium transport hose for thermically isolating a fluid from the surroundings. The hose comprises several layers, two of which may possibly be made of poly-ethylene and these two layers may be surrounded by a layer made of polyurethane foam.

[0004] JP 2004 142406 A discloses a ink supply tube for making an ink tank of the ink jet printer communicate with a printing part. The ink supply tube is composed of three layers. The intermediate layer is a mixture of vinylidene chloride-based polymer and an ethylene-vinyl acetate-carbon monoxide copolymer. In one of the examples the ethylene-vinyl acetate-carbon monoxide copolymer has been replaced by a thermoplastic polyurethane. It is disclosed that this replacement by a thermoplastic polyurethane not only has no effect of decline of the elasticity modulus, but also deteriorated the gas barrier properties of the intermediate layer.

[0005] It is an object of the present invention to overcome or at least mitigate this problem. To this end, a hose according to claim 1 has been invented . Surprisingly it has been found that this way a very durable hose can be attained, which hose can be advantageously used to connect the print head to the ink reservoir. This hose meets all necessary requirements for an ink hose, such as water and air tightness, flexibility, sufficient smoothness, and is easy to make due to the good processing properties of the various compounds used. Next to that, the hose can keep it's good properties even when the hose is used for up to a year or longer. It appears that there is no need for any extra layers besides the intermediate polyurethane compound containing layer and the LDPE compound containing layers. Thus, in principal a three layer wall can fulfil the necessary requirements. However, additional layers may be provided, for example between the polyurethane compound containing layer and one of the LDPE compound containing layers, or as an extra layer provided on the in-or outside of the hose, in order to meet extra or more stringent requirements. It is noted that the layers may be constituted completely out of a sole polyurethane material or a low density polyethylene material respectively.

[0006] In an embodiment the polyurethane layer comprises a thermoplastic polyurethane compound. It appears that this improves the processing properties of the urethane compound markedly i.a. because curing processes for the polyurethane layer can be avoided this way.

[0007] In another embodiment, the polyurethane compound containing layer is transparent for light with a wavelength between 400 en 750 nm. In this embodiment, the hose can be made transparent, at least such that coloured ink in the hose can be seen with the naked human eye. This provides the advantage that the presence, or even more importantly, the non-presence of ink can be seen when just looking at the hose. This is an important advantage in the process of trouble-shooting when the print head is malfunctioning.

[0008] In an embodiment the polyurethane compound has an elongation at break of more than 500%, as measured by the test method according to DIN 53504-S2. It

appears that such a compound enables the hose to be more flexible and decreases the risk of kinks in the hose. This advantage is even more pronounced when it is combined with the in itself already advantageous application of a polyethylene compound having an elongation at break of more than 1000%. In a further embodiment, the polyethylene compounds have a melt index of more than 5 g/10 min, as measured by the test method according to ASTM D 1238 (190°C/2.16 kg). This appears to further increase the advantages of the present hose.

[0009] The invention also pertains to an inkjet printer according to claim 8.

[0010] The invention will now be explained in more detail with reference to the following figures.

Figure 1 schematically shows a cross-sectional view of a hose for transporting fluid ink.

Figure 2 is a perspective view of an inkjet printer suitable for incorporating the present invention.

Figure 1

[0011] Figure 1 schematically shows a cross-sectional view of a hose for transporting fluid ink. This hose as an internal diameter of 2.25 mm and an external diameter of 4.15 mm. Layer 70 consist essentially of LDPE (Low density polyethylene), in particular the material "Exact Plastomer 8210" available from DEX-Plastomers, a DSM/ExxonMobil Chemical joint venture registered in the Netherlands. This layer has a thickness of 0.9 mm. Layer 74 consists essentially of a 0.2 mm thick polyurethane compound, in particular the compound "Elastollan 1180 A", a thermoplastic polyether-polyurethane, available from Elastogran GmbH (belonging to the BASF group), Lemförde, Germany. Layer 78 has a thickness of 0.8 mm and consist essentially of LDPE, in particular the material "Exact Plastomer 8210". Such a hose can be made by well known co-extrusion processes such as for example known from Hensen, Knappe, Potente: Kunststof-Extrusionstechnik I, München: Carl Hanser Verlag, 1989.

Figure 2

[0012] Figure 2 is a perspective view of an inkjet printer suitable for incorporating the present invention. As such, the printer is known from US 5,988,801 and described therein in full detail. Generally, the printer 10 includes a tray 12A for holding an input supply of paper or other print media. When a printing operation is initiated, a sheet of paper is fed into the printer using a sheet feeder, and then brought around in a U direction to travel in the opposite direction toward output tray 12B. The sheet is stopped in a print zone 14, and a scanning carriage 16, containing one or more print heads 18, is then scanned across the sheet for printing a swath of ink thereon. After a single scan or multiple scans, the sheet is then incrementally shifted using a stepper motor and feed rollers (not shown in figure 2) to a next position within the print zone 14, and carriage 16 again scans across the sheet for printing a next swath of ink. When printing on the sheet is complete, the sheet is forwarded to a position above the tray 12B, held in that position to ensure the ink is dry, and then released. Alternate embodiments of the printer include those with an output tray located at the back of the printer 10, where the sheet of paper is fed through print zone 14 without being fed back in a U direction.

The carriage 16 scanning mechanism may be conventional, and generally includes a slide rod 22, along which carriage 16 slides, and a coded strip 24 which is optically detected by a photo detector in carriage 16 for precisely positioning carriage 16. A stepper motor (not shown), connected to carriage 16 using a conventional drive belt and pulley arrangement, is used for transporting carriage 16 across print zone 14.

Other features of the inkjet printer 10 relate to the ink delivery system for delivering ink to the print heads 18 from an off-carriage ink supply station 30 containing replaceable ink reservoirs 31, 32, 33 and 34. For colour printers, there will typically be a separate station for black ink, yellow ink, magenta ink, and cyan ink. Since black ink tends to be depleted most rapidly, the black ink reservoir 34 has a larger capacity than the capacities of the other ink reservoirs 31-33.

Novel features of the present invention pertain to the tubing set 36 that comprises four hoses 38, 40, 42 and 44 that transport ink from the four off-carriage ink reservoirs to the four print heads 18. In accordance with the present invention the hoses have three-layer walls as described with reference to figure 1. These hoses provide for the necessary flexibility and air and vapour tightness, and have a prolonged durability when compared with the hoses as known from the prior art. It is noted that installation of the printer, which includes connecting the reservoirs to the print heads by fitting the tube system, occasionally goes together with causing a kink in one or more of the hoses. In order to avoid the need for a replacement of the complete tubing system ab initio, the corresponding hose can be re-enforced at the location of the kink by fitting a spiral spring or the like around the hose. This prevents the hose from getting buckled easily at the location of the original kink.

Claims

1. A multi-layered hose (38) for use in an inkjet printer (10) to connect an ink reservoir (31) to a print head (18) that is movably arranged with respect to the ink reservoir, the hose comprising an Intermediate layer (74), which layer consists essentially of a polyurethane compound, between low density poly-ethylene compound containing layers (70,78).

2. The multi-layered hose (38), according to claim 1, wherein the polyurethane compound comprises a

thermoplastic polyurethane compound.

3. The multi-layered hose (38), according to claim 1, wherein the polyurethane compound Is a thermoplastic polyether-polyurethane compound.

4. (amended) The multi-layered hose (38), according to any of the preceding claims, wherein the polyurethane compound containing layer is transparent for light with a wavelength between 400 and 780 nm.

5. The multi-layered hose (38), according to any of the preceding claims, wherein the polyurethane compound has an elongation at break of more than 500%.

6. The multi-layered hose (38), according to any of the preceding claims, wherein the polyethylene compounds have an elongation at break of more than 1000%.

7. The muitl-layered hose (38) according to claim 6, wherein the polyethylene compounds have a melt index of more than 5 g/10 min.

8. (amended) An inkjet printer (10) comprising an off-carriage Ink reservoir (31) and a print head (18) mounted on a carriage (16), the carriage being arranged for moving the print head relative to a receiving medium, the printer comprising the multi-layered hose (38) according to claim 1 the muitl-layered hose connecting the print head to the reservoir to enable supply of ink from the reservoir to the print head.

Patentansprüche

1. Mehrlagiger Schlauch (38) zum Gebrauch in einem Tintenstrahldrucker (10), zur Verbindung eines Tintenreservoirs (31) mit einem Druckkopf (18), der relativ zu dem Tintenreservoir beweglich angeordnet ist, wobei der Schlauch zwischen Lagen (70, 78), die LD-Polyethylenverbindungen enthalten, eine Zwischenlage (74) aufweist, die im wesentlichen aus einer Polyurethanverbindung besteht.

2. Mehrlagiger Schlauch (38) nach Anspruch 1, bei dem die Polyurethanverbindung eine thermoplastische Polyurethanverbindung enthält.

3. Mehrlagiger Schlauch (38) nach Anspruch 1, bei der die Polyurethanverbindung eine thermoplastische Polyether-Polyurethanverbindung ist.

4. Mehrlagiger Schlauch (38) nach einem der vorstehenden Ansprüche, bei dem die Lage, die die Polyurethanverbindung enthält, für Licht mit einer Wellenlänge zwischen 400 und 780 nm transparent ist.

5. Mehrlagiger Schlauch (38) nach einem der vorstehenden Ansprüche, bei dem die Polyurethanverbindung eine Bruchdehnung von mehr als 500% hat.

6. Mehrlagiger Schlauch (38) nach einem der vorstehenden Ansprüche, bei dem die Polyurethylenverbindungen eine Bruchdehnung von mehr als 1000% haben.

7. Mehrlagiger Schlauch (38) nach Anspruch 6, bei dem die Polyethylenverbindungen einen Schmelzindex von mehr als 5 g/10 min haben.

8. Tintenstrahldrucker (10) mit einem abseits eines Wagens angeordneten Tintenreservoir (31) und einem auf dem Wagen (16) montierten Druckkopf (18), wobei der Wagen dazu ausgebildet ist, den Druckkopf relativ zu einem Aufzeichnungsmedium zu bewegen, welcher Drucker einen mehrlagigen Schlauch (38) nach Anspruch 1 aufweist, der den Druckkopf mit dem Reservoir verbindet, um die Zufuhr von Tinte von dem Reservoir zu dem Druckkopf zu ermöglichen.

Revendications

1. Tuyau multicouche (38) à utiliser dans une imprimante à jet d'encre (10) pour raccorder un réservoir d'encre (31) à une tête d'impression (18) qui est disposée de façon amovible par rapport au réservoir d'encre, le tuyau comprenant une couche intermédiaire (74), laquelle couche se compose essentiellement d'un composé de poly(uréthane), entre des couches (70, 78) contenant un composé de poly (éthylène) à basse densité.

2. Tuyau multicouche (38) selon la revendication 1, dans lequel le composé poly(uréthane) comprend un composé poly(uréthane) thermoplastique.

3. Tuyau multicouche (38) selon la revendication 1, dans lequel le composé de poly(uréthane) est un composé de poly(éther)-poly(uréthane) thermoplastique.

4. Tuyau multicouche (38) selon l'une quelconque des revendications précédentes, dans lequel la couche contenant un composé de poly(uréthane) est transparente à la lumière ayant une longueur d'onde comprise entre 400 et 780 nm.

5. Tuyau multicouche (38) selon l'une quelconque des revendications précédentes, dans lequel le composé de poly(uréthane) a un allongement à la rupture de plus de 500 %.

6. Tuyau multicouche (38) selon l'une quelconque des

revendications précédentes, dans lequel le composé de poly(éthylène) a un allongement à la rupture de plus de 1 000 %.

7. Tuyau multicouche (38) selon la revendication 6, dans lequel les composés de poly(éthylène) ont un indice de fusion de plus de 5 g/10 min.

8. Imprimante à jet d'encre (10) comprenant un réservoir d'encre (31) hors-chariot et une tête d'impression (18) montée sur un chariot (16), le chariot étant agencé afin de déplacer la tête d'impression par rapport à un milieu récepteur, l'imprimante comprenant le tuyau multicouche (38) selon la revendication 1, le tuyau multicouche raccordant la tête d'impression au réservoir pour permettre une alimentation en encre du réservoir à la tête d'impression.

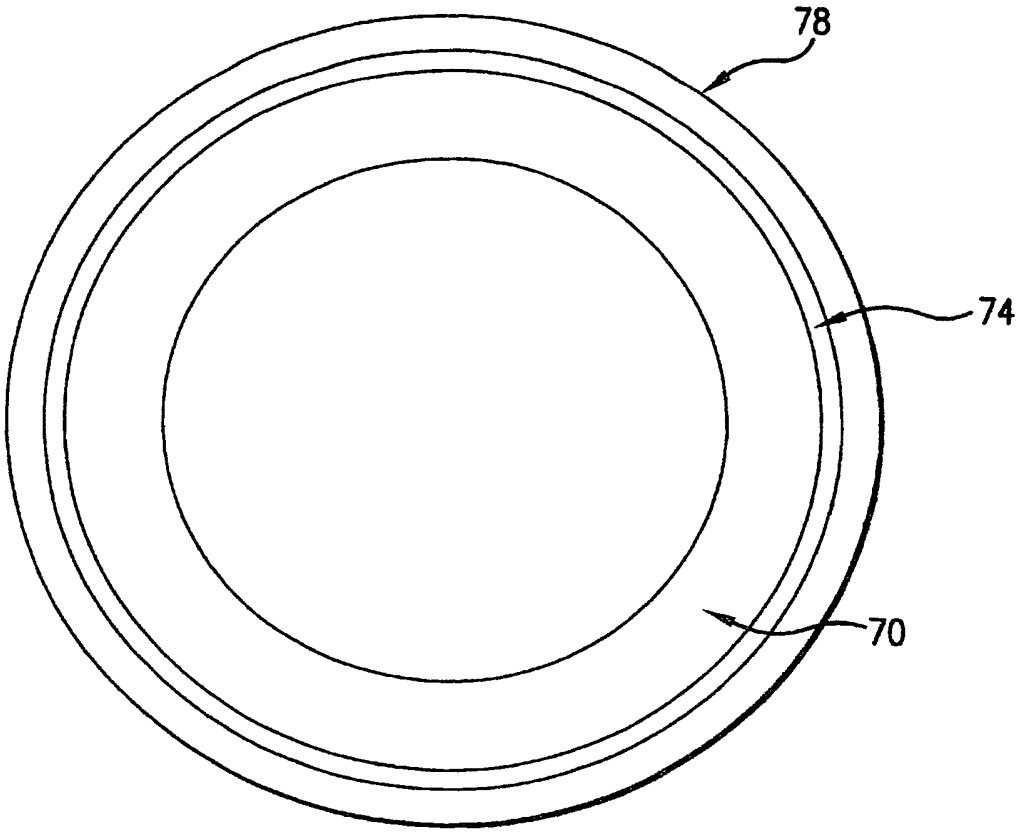

FIG. 1

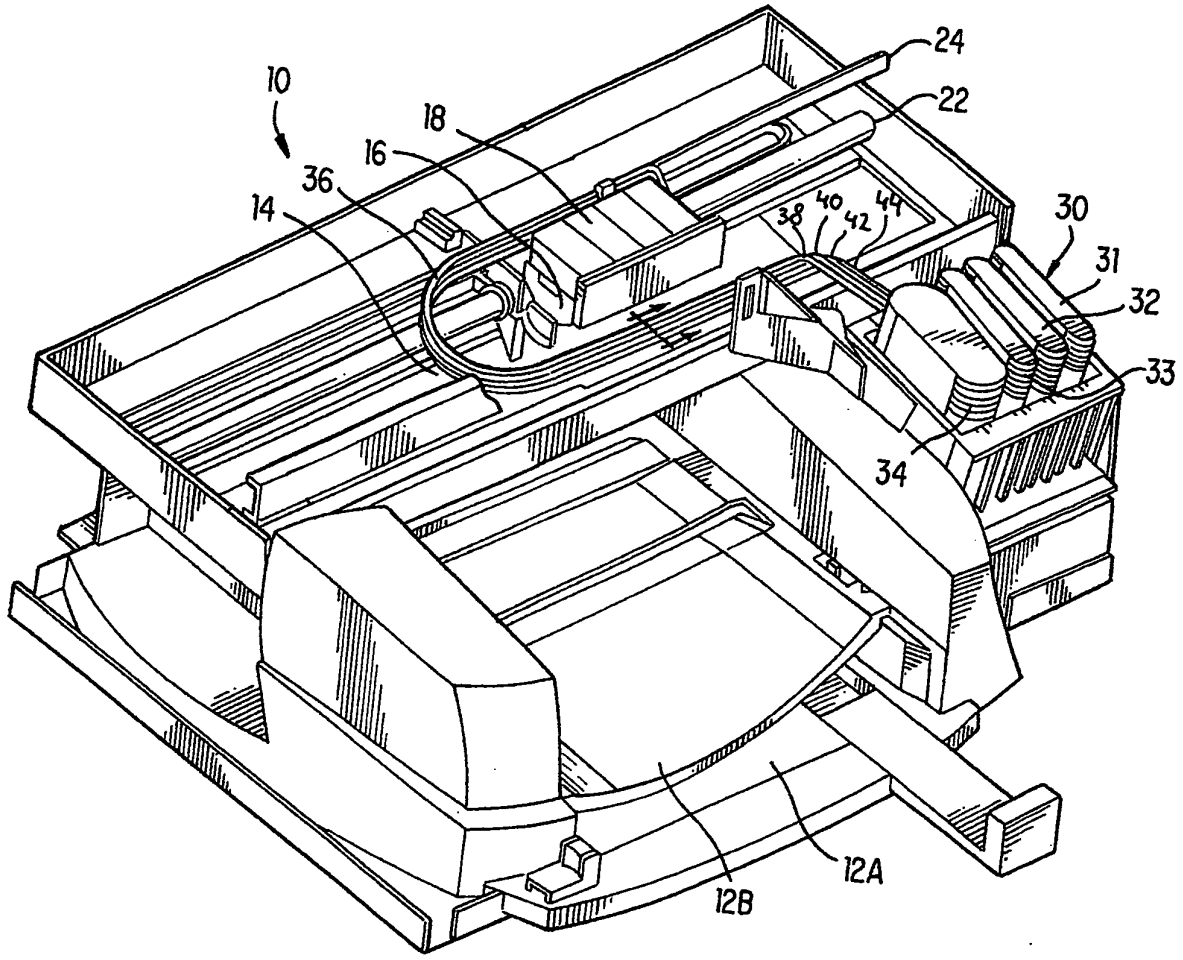

FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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- CH 674763 A5 **[0003]**
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