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(54) Ink reservoir with coated open-cell foam

(57) A thermal ink jet printhead cartridge employs open-cell malamine-formaldehyde foam in its ink reservoir. This foam is precoated with unsubstituted polyparaxylylene or polychloroparaxylylene to immobilize loose fiber and thereby prevent nozzle blockage.

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Description

Technical Field

This invention relates to ink reservoirs having an open-cell foam to meter the ink, and specifically to ink jet printhead cartridges having such reservoirs.

Background of the Invention

Open-cell foam is a reticulated structure substantially without side walls in which the structure is supported by pillars of the material forming the structure. It is commercially available in different forms.

Compressed, open-cell foam is used in ink jet printhead cartridges to contain the ink and to refill the drop ejection region after a drop has been formed and ejected. Its use has been described in U.S. 5,182,579 to Haruta et al and in U.S. 4,824,487 to Heffernan. While having many desirable properties, open cell polyurethane is subject to several serious shortcomings. Both patents discuss a concern with non-volatile residue formed during the manufacturing process which can cause printhead reliability problems. Furthermore, to obtain desirable properties for print quality, nondrool of ink, handling and other factors, the polyurethane must be heat set by compression between two hot plates during manufacture. This adds to the nonvolatile residue problem and cost. Furthermore, the amount of ink that can be stored in a given size piece of foam is limited by the total density of the foam, which after the compression operation results in about 91% void volume.

Certain commercially sold foams, which are melamine-formaldehyde open-cell foams, have a very low total density. This means that for a total size of foam, there is very large void volume, as much as 99%. This foam is desirable for ink jet printhead cartridge reservoirs because it can hold about 40-60% more ink than a comparably sized conventional foam. Furthermore, these open cell foams do not require a compression operation that reduces the void volume and adds cost to the material. U.S. Patent No. 4,929,969 to Morris discloses use of open cell, low density foam in ink reservoirs. It teaches the use of open cell foam typically in a "generally uncompressed state." While the absence of the compression step reduces the number of small loose fibers, there will still be loose fibers created during handling and cutting of foam by the manufacturer that can cause nozzle obstructions.

Open cell melamine-formaldehyde foam has very thin and fragile sidewalls. One consequence of that is that under normal stresses experienced in handling, cutting and inserting the foam into cartridges, the polymer strands that make up the foam sidewalls tend to break into small pieces that can clog the nozzles of the ink jet printhead when washed to the nozzles during normal printing. This has been evident in experiments. When cartridges employing the open cell melamine-formaldehyde foam instead of conventional, compressed foam were stripped down and examined microscopically, small fibers from the foam were observed downstream from the foam. The fibers are about 5 microns in diameter and readily pass through the filter, which protects the nozzle, which passes particles of about 15 microns. When finer filters of 5 microns are used there is high resistance to ink flow through the filter with subsequent obstruction of ink from the printhead to the paper. Obstruction from such pieces are unacceptable and would eliminate this foam from commercial use regardless of other advantages.

In accordance with this invention the open cell foam is coated with polyparaxylylene prior to insertion in the reservoir. U.S. Patent No. 4,299,866 to Clark et al discloses a process in which a foam is coated with polyparaxylylene, although incidently and not for any future use. U.S. Patent No. 4,973,504 to Romberg et al discloses an elastomeric member coated with polyparaxylylene. Illustrative teachings of other coating with polyparaxylylene for protective and encapsulation purposes are U.S. Patent Nos. 4,816,618 to Bongianni, 5,262,208 to Krapivina et al and 5,354,286 to Mesa et al.

Description of the Invention

Open-cell foam coated with Parylene™ substituted or unsubstituted polyparaxylylene to a thickness of 500 A to 5000 A (Angstroms) is employed to fill the ink reservoir of a drop on demand ink jet printhead cartridge. This immobilizes strands from the polymer of the foam. The reservoir holding the foam is filled with ink, and ink volume is increased by 40% over the same printhead having conventional foam.

Best Mode for Carrying Out the Invention

Parylene C is a dimer of monochlorine substituted paraxylylene and the polymer resulting from the vacuum coating from the dimers (polymonochloroparaxylylene). Parylene N is an unsubstituted paraxylylene dimer and the polymer resulting from vacuum coating from the dimers.

Open cell foam is employed from Ilbruck Schaunstofftechink known as WILTEC ® and also known as BASOTECT ® from BASF AG. The manufacture of such foam is based on melamine-formaldehyde condensation which is described in U.S. Patent No. 4,334,971 to Mahnke et al. The foam is coated with Parylene C or Parylene N to form polyparaxylylene coating to a thickness of 500 A to 5000 A in a Labcoter 2010 model coater for Parylene from Specialty Coating System. (Parylene D is a dichloro substituted polyparaxylylene, and can be expected to function equally well for the purpose of this invention.) This employs the standard coating mechanism of creating a prepolymer gas in an evacuated chamber which coats the item in the chamber. Foam is placed in the chamber and degassed. All internal walls

of the foam are coated from the gas as described.

The foam is then stuffed into the ink reservoir until it fills the ink reservoir of printhead cartridges for the ExecJet IIc drop on demand, ink jet printer sold commercially by the assignee of this invention. The reservoir is then filled by the standard inks for that printer. The printer operates by thermal vaporization of a portion of liquid ink at each nozzle, as is now standard.

Such heads were then functionally tested and run to life. They were then torn apart and examined for evidence of broken strands in the printhead cartridges. None of the cartridges with the coated form showed polymer strands, while equivalent printhead cartridges identical except for the foam not being coated did have strands. The printhead cartridges with coated foam are suitable for commercial use. These cartridges hold 40% more ink than a cartridge with the conventional, compressed foam. They may be filled with any suitable drop on demand, ink jet ink.

Claims

1. A drop on demand ink jet printhead cartridge having an ink reservoir containing an open-cell foam, said open-cell foam being coated with substituted or unsubstituted polyparaxylylene sufficient to immobilize substantially all polymer strands from said foam.

2. The cartridge as in claim 1 in which said polyparaxylylene is unsubstituted.

3. The cartridge as in claim 1 in which said paraxylylene comprises chlorine substituted paraxylene monomers.

4. The cartridge as in any preceding claim in which said polyparaxylylene is coated at a thickness in a range of about 500 A to 5000 A.

5. The cartridge as in any preceding claim in which said cartridge has a thermal printhead having nozzles which operate by thermal vaporization of a portion of liquid ink at said nozzles.

6. The cartridge as in any preceding claim in which the material of said open-cell foam is the condensation product of melamine and formaldehyde.