(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 661 159 A1**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **93310609.8**

(51) Int. Cl.[6]: **B41J 2/175**, B65D 81/26

(22) Date of filing: **29.12.93**

(43) Date of publication of application:
05.07.95 Bulletin 95/27

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: **BRIDGESTONE CORPORATION**
10-1, Kyobashi 1-Chome
Chuo-Ku
Tokyo 104 (JP)

(72) Inventor: **Yasunaga, Kuniaki, c/o Bridgestone Corp.**
1, Kashio-cho,
Totsuka-ku
Yokohama-shi,
Kanagawa-ken (JP)
Inventor: **Hasegawa, Hajime, c/o Bridgestone Corp.**
1, Kashio-cho,
Totsuka-ku
Yokohama-shi,
Kanagawa-ken (JP)
Inventor: **Kimijima, Isao**
360-3, Akiba-cho,
Totsuka-ku
Yokohama-shi,
Kanagawa-ken (JP)

(74) Representative: **Stoner, Gerard Patrick et al**
MEWBURN ELLIS
York House
23 Kingsway
London WC2B 6HP (GB)

(54) **Foam-filled aqueous liquid container.**

(57) A container (10) has a flexible polyurethane foam (20) received therein for storing and retaining an aqueous liquid. The polyurethane foam is swellable with the liquid so that the foam may come in close contact with the inner wall of the container. The polyurethane foam preferably has a swelling factor with water of 5 to 60% by volume. Typically, the liquid is aqueous ink and the container is an ink reservoir for storing and supplying an aqueous ink to a printing head.

EP 0 661 159 A1

Field of the Invention

This invention relates to an aqueous liquid container, and more particularly, to a container having a liquid retainer received therein for storing an aqueous liquid, typically an ink retainer for storing an aqueous ink for providing an ink supply to a printing head.

BACKGROUND OF THE INVENTION

Most liquid containers are stationary, but some are used in a movable state. As a container is moved back and forth in a horizontal direction or up and down in a vertical direction, the liquid in the container is waved, giving rise to a sloshing phenomenon in the container. If liquid in the container is waving and sloshing, it is difficult to discharge the liquid from the container at a constant flow rate.

One known solution to this problem is to place a flexible polyurethane foam in a container as a liquid retainer for preventing waving motion of liquid. For example, Japanese Patent Publication No. 2103/1967 discloses such a container. A flexible polyurethane foam is placed in the container for accommodating liquid. Even if the container is used under dynamic conditions, substantial motion of the liquid therein is avoided.

This technique, however, has several drawbacks. In general, flexible polyurethane foams used in such application have about 5 to 20 cells/25 mm. If such a polyurethane foam having a volume corresponding to the interior volume of the container is placed in the container, the foam has relatively weak capillary action and a poor liquid retention capacity. The container thus allows for more or less motion of liquid in dynamic operating conditions so that no consistent delivery of liquid therefrom is expected. This container does not provide a full solution to the above-mentioned problem.

The problem becomes serious particularly with ink retainers used for feeding ink to printing heads. The field of business machine printers now sees a switch from the wire dot and thermal transfer printing systems to the ink jet and laser beam printing systems. In the ink jet printing system, aqueous ink is generally used and an ink retainer is typically inserted in a container in order to retain the ink uniformly in the container. Without such an ink retainer, the container is difficult to feed ink at a constant rate because the feed rate of ink can vary with the residual amount of ink in the container. In the printing system wherein the ink container is moved together with the printing head, the ink always waves and sloshes in the container, hindering constant ink supply.

For such ink containers, ink retainers are essentially needed and generally made of flexible polyurethane foams. In particular, while polyurethane foams as produced possess thin cell membranes, those polyurethane foams from which cell membranes have been removed as by heating are often used. Typically such polyurethane foams are received in the containers in a compressed state. As a result of compression, the foams have an increased density of cells which is advantageous as an ink retainer.

Regrettably, from the standpoint of manufacturing process, it is rather difficult to compress and insert polyurethane foams into containers. Often foams are received in partially turned over or wrinkled form and only a few foams are inserted into the container in a complete form. If the polyurethane foam received in the container is locally deformed, such deformation can form a path for ink. In some cases, such deformation can form a shortcut air flowpath from a vent to an exit port of the container for allowing air to directly reach the exit port, inhibiting further ink supply despite the ink being reserved in the container.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a novel and improved liquid storing container having a flexible polyurethane foam received therein for not only retaining liquid, but also preventing liquid from sloshing when the container is moved so that liquid can be delivered from the container at a constant flow rate.

According to the present invention, there is provided a container having an inner wall defining an interior volume. A flexible polyurethane foam is received in the container for storing an aqueous liquid. The polyurethane foam is swellable with the liquid. When swollen, the polyurethane foam comes in close contact with the container inner wall.

More particularly, the flexible polyurethane foam to be inserted into the container is swellable with an aqueous liquid to be charged. When the polyurethane foam is initially inserted into the container, the foam need not closely contact the container inner wall. A gap may be left between the foam and the container inner wall, that is, the foam may have a volume slightly smaller than the container interior volume. This looseness facilitates insertion of the foam into the container. The invention is not limited to such a foam of smaller dimensions and a foam which is compressed upon insertion into a container is also acceptable herein.

When the aqueous liquid is introduced into the container, the foam is impregnated and swollen with the liquid so that the foam expands into close contact with the container inner wall. The swollen

foam fully occupies the container inner volume and remains uniform. There is left no gap or empty space in the container. The ink-swollen or impregnated foam is effective for not only retaining liquid, but also preventing liquid from sloshing when the container is moved. It is then possible to deliver liquid from the container at a constant flow rate. Therefore, the container of the invention is particularly useful as an ink retainer container for providing a constant ink supply to the printing heat.

BRIEF DESCRIPTION OF THE DRAWING

The only figure, FIG. 1 is a partially cut-away perspective view of a container according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The liquid storage container of the present invention is illustrated in FIG. 1 as comprising a container casing 10 and a liquid retainer 20 placed therein for absorbing and retaining an aqueous liquid.

The material and shape of the container casing 10 may be selected in accordance with a particular purpose of the container. In one preferred embodiment wherein the container is an ink container from which ink is supplied to the printing head, the container casing is of a box shape having an air vent 30 at the top and an ink exit port 32 at the bottom as shown in FIG. 1 and made of any plastic material such as polypropylene.

The liquid retainer 20 is made of flexible polypolyurethane foam which is swellable with an aqueous liquid to be contained in the container, for example, aqueous ink. The swellable polyurethane foam may be a hydrophilic polyurethane foam if the liquid with which the container is to be charged is aqueous, typically aqueous ink. Such a hydrophilic polyurethane foam is generally obtained by using a polyol having a higher proportion of ethylene oxide added than propylene oxide as one starting reactant for the manufacture of polypolyurethane.

A desired swelling factor is obtained by properly selecting various parameters of the polyurethane foam manufacturing process. At least one polyether polyol in which the average weight ratio of ethylene oxide (EO) to propylene oxide (PO) ranges from 20:80 to 50:50 is used as one starting reactant. To 100 parts by weight of the polyether polyol is added 2 to 5 parts by weight of water as a blowing agent. The resulting polyurethane foam will have a desired swelling factor.

More particularly, the polyol component used is a mixture of a first polyether polyol which is obtained by ring-opening polymerization of propylene oxide with glycerin and a second polyether polyol which is obtained by ring-opening polymerization of ethylene oxide and propylene oxide in a weight ratio of 75:25 with glycerin, the first and second polyether polyols being mixed in a weight ratio of from 74:26 to 33:67.

The isocyanate component is preferably selected from tolylene diisocyanate and xylylene diisocyanate. To 100 parts by weight of the polyol component is added 20 to 60 parts by weight of the isocyanate component. A catalyst and a foam stabilizer are also added. The catalysts used herein include amine catalysts such as triethylenediamine and pentamethyldiethylenetriamine and tin catalysts such as stannous octoate and dibutyltin dilaurate and are used in an amount of 0.01 to 1.0 parts by weight. The foam stabilizers include silicone foam stabilizers such as dimethylpolysiloxane having polyether polyol added thereto and are used in an amount of 0.1 to 2.0 parts by weight. Water is added to this mixture as a foaming agent whereupon polyurethane reaction takes place to produce a flexible polypolyurethane foam.

If the polyurethane foam takes up a large amount of aqueous liquid within itself, the container lowers its liquid supply efficiency. In this regard, the polyurethane foam should preferably have a swelling factor of 5 to 60% by volume, more preferably 10 to 40% by volume with the aqueous liquid. With a swelling factor of less than 5% by volume, the polyurethane foam must be shaped to closely conform to the container interior to impose difficulty in inserting the foam into the container, and after admission of aqueous liquid, an empty space can be left unoccupied by the swollen foam. polyurethane foam with a swelling factor of more than 60% by volume would take up a too large amount of aqueous liquid, so that the amount of aqueous liquid that can be taken out of the container is reduced, which means that the container becomes an ineffective liquid supplier.

If a polyurethane foam before insertion has a sufficient cell diameter to retain an aqueous liquid without a need for compression, its swelling factor may be relatively low. If a polyurethane foam has a relatively large cell diameter, the foam is preferably inserted into the container in a compressed state insofar as it is possible to take advantage of the swelling property.

The number of cells in the polyurethane foam may be property selected although it is generally 30 to 200 cells/25 mm. For ink retention purposes, foams having 50 to 200 cells/25 mm, especially 70 to 200 cells/25 mm are preferably because such foams can be used as an ink retainer without compression.

Most preferred form of polyurethane foam is an open-cell reticulated urethane foam having no cell

membranes.

Of course, a polyurethane foam which must be compressed before it can be inserted into the container is acceptable in the present invention. Even when the foam is in incomplete form, for example, deformed or wrinkled at the time of insertion, the foam itself cures such defects as it is swollen with an aqueous ink, becoming a fully effective ink retainer.

EXAMPLE

Examples of the present invention are given below by way of illustration and not by way of limitation.

Example 1 & Comparative Example 1

A flexible polyurethane foam (A) was prepared using a polyether polyol formed from propylene oxide alone and having a molecular weight of 3,000 and another polyether polyol having an ethylene oxide/propylene oxide (EO/PO) weight ratio of 75/25 and a molecular weight of 3,000 and tolylene diisocyanate (TDI). In the resulting polyurethane foam, the weight ratio of total EO/PO was 40/60. The polyurethane foam (A) had 60 cells/25 mm and a swelling factor of 15% by volume with water.

Into a transparent plastic container casing defining an interior of 30 mm × 40 mm × 50 mm was inserted a block of polyurethane foam (A) cut to slightly smaller dimensions of 28 mm × 38 mm × 48 mm. The container was then charged with aqueous ink.

The container was visually observed from the outside to find no empty space at the container inner wall. Ink was slowly discharged from an exit port at the bottom of the container under a constant negative pressure. A constant flow rate could be maintained. There was created no air shortcut path connecting a vent at the top and the exit port at the bottom.

Comparative Example 1 used a flexible polyurethane foam (B) which had 60 cells/25 mm and was little swellable with water. This polyurethane foam (B) was inserted into the same container as in Example 1. The polyurethane foam (B) was also shaped to conform to the container interior as in Example 1.

An ink discharge test was carried out to find that an air shortcut path connecting the vent and the exit port was created along the container inner wall, disturbing smooth ink delivery.

Examples 2-3 & Comparative Examples 2-3

Tested in these examples were polyurethane foams having a swelling factor with water of less than 3% by volume (Comparative Example 2), 15% by volume (Example 2), 30% by volume (Example 3), and 70% by volume (Comparative Example 3). Before insertion into the container, all the polyurethane foams had 40 cells/25 mm.

Containers had an interior of 30 mm × 40 mm × 50 mm as in Example 1. A polyurethane foam block having a volume 4 times the container interior volume was compressed and inserted into each container.

The containers were then charged with aqueous ink. The behavior of the polyurethane foam was visually observed. In Comparative Example 2, a deformation of the foam induced upon insertion was left after ink admission. This is probably because the foam in Comparative Example 2 was little swellable with the ink. In the remaining Examples, the swollen foams appeared satisfactory.

Next, the ink was discharged by suction from the exit port at the bottom at a constant flow rate of 10 ml/min. The suction test was terminated at the point of time when ink delivery from the exit port ceased, that is, when air came out first. The amount of ink sucked till then was measured.

The suction amount was 49 g and 45 g in Examples 2 and 3, respectively. In Comparative Example 2, the suction amount was as small as 22 g despite a sufficient amount of ink left in the container because an air path was created to provide communication between the vent and the exit port. Comparative Example 3 performed better than Comparative Example 2, but a large amount of ink was taken up by the polyurethane foam and the suction amount was 32 g.

These results show that when used as an aqueous ink retainer, the polyurethane foam should have a volumetric swelling factor with water between 5% and 60%.

There has been described a container for storing an aqueous liquid, typically aqueous ink in which a flexible polyurethane foam which is swellable with the aqueous liquid is received. Upon insertion of the foam into the container, the foam need not closely conform to the container inner wall. Once the aqueous liquid is admitted into the container, the polyurethane foam swells therewith to come in close contact with the container inner wall. The swollen foam completely occupies the container interior. In an embodiment wherein a polyurethane foam block having a slightly smaller volume than the container interior volume is inserted into the container, charging of the container with an aqueous liquid causes the polyurethane foam to be swollen therewith so that the foam may come in close contact with the container inner wall without leaving a gap.

In swollen state, the foam is not only effective for retaining the aqueous liquid against wavy mo-

tion, but also allows the aqueous liquid to be released therefrom if a suction force is applied. Even when the container is moved or swung, the liquid in the container is prevented from sloshing and can be discharged from the exit port at a constant flow rate.

The container of the invention is thus a useful ink reservoir for storing and supplying an aqueous ink to a printing head. It also finds application as tanks to be attached to vehicles.

Although some preferred embodiments have been described, many modifications and variations may be made thereto in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

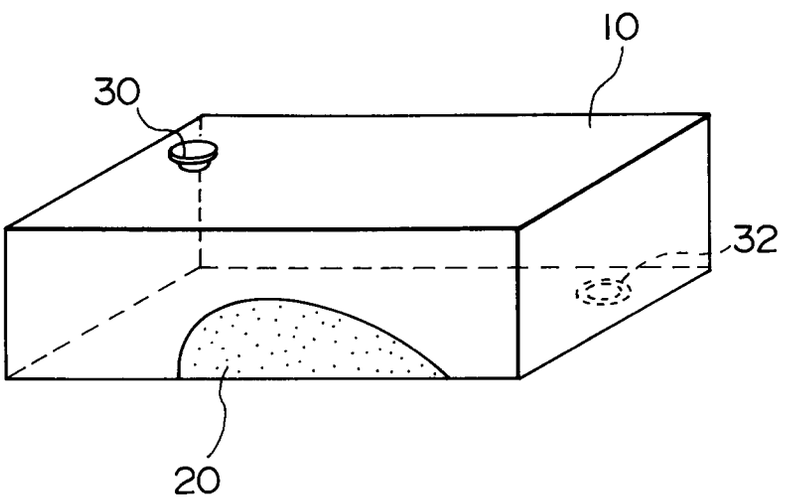
Claims

1. A container having a flexible polyurethane foam received therein for storing an aqueous liquid, wherein said polyurethane foam is swellable with the liquid so that the polyurethane foam may come in close contact with the inner wall of the container.

2. A container according to claim 1 wherein said polyurethane foam has a hydrophilic group introduced therein.

3. A container according to claim 1 or 2 wherein said polyurethane foam has a swelling factor of 5 to 60% by volume with the aqueous liquid.

FIG. 1



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 31 0609

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.6)
Y	EP-A-0 520 695 (BRIDGESTONE CORP.) 30 December 1992 * column 1, line 38 - column 2, line 55 * ---	1-3	B41J2/175 B65D81/26
Y	US-A-4 088 132 (WOOD ET AL.) * abstract * -----	1-3	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B41J
B65D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 April 1994	De Groot, R

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

EPO FORM 1503 03.82 (P04C01)