

INK CARTRIDGE WITH SELF-CLOSING VALVE

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BACKGROUND

Field Of The Invention

This patent relates to liquid dispensing cartridges for automated dispensing systems. More specifically, this patent relates to an ink cartridge with self-closing valve for use with automatic lithographic presses.

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Description Of The Related Art

Lithography is a printmaking process dating back to the 1700s in which ink is applied to a plate having both image and non-image areas. The image areas are ink-receptive and water-repellent. The non-image areas are water-receptive and ink-repellent. In rotary type lithographic presses the ink plate is mounted on a cylinder that rotates during printing. In one typical configuration, the plate cylinder picks up the ink at the image areas and transfers the image to a blanket cylinder, which then transfers the image to the paper. In multi-color sheet-fed type lithographic presses, multiple inking stations are placed in series. Each station has its own ink feeding system and handles a separate color. As the paper sheet moves from station to station, a new color is put down at each station.

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Because lithographic ink is thixotropic, conventional lithographic ink feeding systems require a complex system of drums, vibrators and fountain rollers to handle and dispense the highly viscous ink. In a typical lithographic ink feeding system, workers remove the ink from a drum (or, in some cases, small tins) with specially made spatulas and spread the ink

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across a tray (the ink fountain). Fountain rollers roll against the ink fountain to pick up the ink and transfer it to the plate cylinder. The process is labor intensive and subject to error.

5 It is also difficult to store and reuse lithographic ink in drums. The ink is prone to oxidation which can result in color variations from one press run to another, and even from sheet to sheet within a single run. In addition, upon exposure of the ink to the atmosphere, volatile organic
10 compounds (VOCs) evaporate, which can cause ink spoilage.

 Some modern lithographic printers use specially designed cartridges to dispense ink, such as that described in Rea et al. U.S. Patent No. 6,192,797. These cartridges are much smaller than drums, being typically nine to thirteen inches
15 long and about three and a half to five inches in diameter. During printing, the ink cartridge moves back and forth across the fountain, dispensing ink into a fountain trough or directly onto an ink form roller. In automated presses, the amount of ink in the trough is continually monitored and
20 replenished as needed.

 Ink cartridges can be easily filled, transported, used and reused. The cartridge minimizes exposure of the ink to the atmosphere and also minimizes the amount of residual ink left in the cartridge after use.

25 Ink cartridges typically comprise a hollow cylindrical body, a plunger at one end and a dispensing fitment at the opposite end. The cylindrical body is filled with ink. The plunger can move axially within the cylindrical body. The ink is extruded from the dispenser when the plunger is forced

toward the dispensing end by, for example, mechanical or pneumatic pressure.

The dispensing fitment is mounted in sealing engagement within the dispensing end of the cylindrical body and typically has a valve for opening and closing the cartridge. In the ink cartridge described in U.S. Patent No. 6,192,797, the valve is recessed below the rim of the cartridge so it does not become damaged during shipment and storage. However, the valve must be manually opened to allow ink to flow, which is time consuming and can lead to error. In addition, valves that stay open until manually closed work poorly with lower viscosity inks because of their tendency to "drool." This is particularly troublesome in the United States, where inks are made with varying degrees of viscosity. A number of automatic valves have been tried that open and close in response to pressure from the ink, but they tend to remain open when the pressure is decreased, thereby allowing ink to continue to be extruded.

Thus there exists a need for an ink cartridge dispensing valve that opens when subjected to pressure from the ink and closes automatically and completely when the pressure is decreased below a certain predetermined level, even when used with lower viscosity inks. The present invention satisfies this need.

SUMMARY OF THE INVENTION

The present invention is an improved ink cartridge of the type used to dispense ink in automatic lithographic presses. The ink cartridge comprises a hollow cylindrical body for

holding a supply of extrudable ink and has a plunger end and a dispensing end. The plunger end is closed by a plunger adapted to act as a piston within the cylindrical body to extrude the contents of the dispenser when the plunger is forced toward the dispensing end by mechanical or pneumatic pressure. The dispensing end is closed by a dispensing fitment affixed to the cylindrical body by glue or other suitable means. The improvement comprises a valve member mounted over a central aperture in the dispensing fitment, the valve member being adapted to open when subjected to pressure from the ink and close automatically and completely when the pressure is decreased below a certain predetermined level.

In the improved ink cartridge, a substantially cylindrical nozzle extends from the periphery of the dispensing fitment aperture and terminates in a rim. The nozzle defines a substantially cylindrical space. A flexible molded plastic spring is mounted within the cylindrical space and urges the valve member against the nozzle rim. The spring is bowed rearward in the direction of the plunger when the valve member is in the closed position. The spring has openings to accommodate the flow of ink through or around the spring.

The valve member is located downstream of and supported by the spring. The valve member is moveable between a closed position in which the valve member is urged against the nozzle rim by the biasing force of the spring, and an open position in which the valve member is raised above the nozzle rim to create an annular opening when pressure applied by the ink to the spring and to the valve member exceeds the biasing force

of the spring.

In one embodiment, the valve member comprises a substantially flat disk-shaped portion and prongs extending upward from the disk-shaped portion and through a hole in the spring to secure the valve member to the spring.

The plunger comprises a substantially circular disk portion and a sidewall extending from the periphery of the disk portion in a direction away from the dispensing fitment.

Preferably, the plunger includes an annular ring protruding from the circular disk portion in the direction of the dispensing fitment. The annular ring has a cylindrical outer wall and a concave inner wall and is adapted to fit around the valve member prongs and within the space defined by the nozzle to minimize ink left in the cartridge when the plunger is fully depressed.

THE DRAWINGS

Figure 1 is a perspective view of an ink cartridge and dispensing fitment according to the present invention, shown with an optional shipping and storage cap mounted over the valve;

Figure 2 is a perspective view of the ink cartridge and dispensing fitment of Fig. 1, shown with an optional nozzle extension mounted over the valve and the valve in the open position;

Figure 3 is a cross-sectional view of the ink cartridge and dispensing fitment of Fig. 1 taken along line 3-3;

Figure 4 is a cross-sectional view of the ink cartridge

and dispensing fitment of Fig. 2 taken along line 4-4;

Figure 5 is top planar view of the dispensing fitment of Fig. 1, shown with the storage and shipping cap removed; and

Figure 6 is a bottom planar view of the dispensing fitment of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

Turning to the drawings, there is shown in Figures 1-4 an ink cartridge 10 of the type used for lithographic printing presses. The ink cartridge 10 comprises a hollow cylindrical body 12, a plunger 14 mounted in sliding engagement within one end of the cylindrical body 12, and a dispensing fitment 16 glued or otherwise affixed to the opposite end of the body 12.

In automated lithographic printing presses, the ink cartridge 10 is mounted within a cartridge carriage (not shown) with the dispensing fitment 16 facing down. During operation, the carriage moves laterally along the length of a fountain roller while an ink level sensor constantly monitors the amount of ink in the fountain roller to determine the exact locations where ink is needed. When a low level of ink is detected by the sensor, the controller activates an air supply which forces air against the pneumatically controlled plunger 14 slidingly engaged within the cartridge, which then forces ink onto the fountain roller.

The cylindrical body 12 has a plunger (filling) end (not shown) and a dispensing end that terminates in a rim 18. Preferably, the cylindrical body 12 is made of convolutely wound paper lined internally with polymeric material, although any suitable materials may be used, including, depending on the application, metal or plastic. In practice, the cylindrical body 12 typically is about nine or thirteen inches long, but any suitable length may be used depending on need.

The plunger 14 comprises a substantially circular disk portion 20 and a peripheral sidewall 22 extending upward therefrom (upward being defined as the direction away the

dispensing end when the plunger 14 is inserted into the
plunger end of the cylindrical body 12). The plunger 14 is
inserted into the filling end of the ink cartridge 10 in
sliding engagement with the inner wall of the cylindrical body
12 after the cartridge 10 is filled with ink.

A centrally disposed annular ring 24 protrudes from the
circular disk 20 toward the dispensing fitment 16. The
annular ring 24 has a substantially cylindrical outer wall 25
and a concave inner wall 26. and is adapted to fit within the
space defined by the dispensing fitment cylindrical nozzle 42
when the plunger is fully depressed. The concave shape of the
inner wall 26 is designed to accommodate the upwardly
extending prongs 54 of the valve member 50 described below,
allowing the plunger 14 to fit flush against the dispensing
fitment 16 when the ink is fully dispensed from the cartridge
10, as shown in Fig. 4, thereby minimizing ink waste.

The dispensing fitment 16 is mounted in sealing
engagement within the bottom end of the cartridge body 12.
The fitment 16 may be glued to the inner wall of the cartridge
body 12 or attached by any other suitable means. The
dispensing fitment 16 is generally cup-shaped, and includes a
flat covering portion 32, a sidewall 34 formed around the
periphery of the covering portion 32, and an orifice 38
disposed in covering portion 32 through which ink can flow. A
closure flange 36 extends radially outwardly from the bottom
end of the sidewall 34. When the dispensing fitment 20 is
fully inserted into the cylindrical body 12, the closure
flange 36 abuts the rim 18 of the cylindrical body 12 to
prevent further insertion of the dispensing fitment 16. The
dispensing fitment 16 also has an optional stiffening wall 40

extending downward from the flat covering portion 32 and a substantially cylindrical nozzle 42 extending downward from the perimeter of the orifice 38 but not beyond a plane defined by the bottom surface of the flange 36. The nozzle 42 defines a substantially cylindrical space and may have a beveled rim 43.

In a key aspect of the invention, a flexible spring means 44 and valve member 50 are mounted within the space defined by the cylindrical nozzle 42. Preferably, the spring means 44 is formed of molded plastic and is held within an annular groove located along the inside of the nozzle 42. Alternatively, the spring means 44 may be formed as an integral part of the nozzle 42 and dispensing fitment 16 as shown in the figures.

In the illustrated embodiment, the spring means 44 comprises a central portion 46 and bridge portions 48 extending between the central portion 46 and the nozzle 42. The central portion 46 has an opening therein, the purpose of which will now be explained.

A valve member 50 comprises a substantially rigid disk-shaped portion 52 and rearward or upward extending prongs 54.

The valve member 50 is attached to the flexible spring means 44 by inserting the prongs 54 into the opening in the central portion 46 of the flexible spring 44. The disk-shaped portion 52 may have a beveled edge 53 that abuts the beveled rim 43 of the cylindrical nozzle 42 when the valve member 50 is in the closed position.

The invention works in the following manner. In its relaxed, non-pressurized state (Figure 3), the flexible spring 44 is concave, that is, bowed rearward (upward) in the direction of the plunger 14 (not shown in Fig. 3). When the

flexible spring 44 is in this relaxed state, the valve member disk-shaped portion 52 is seated against the beveled edge or rim 43 of the nozzle 42 and ink cannot flow.

When pressure is exerted on the plunger 14 (indicated by arrows in Figure 4), the plunger 14 is forced forward (downward) into the cartridge, causing the ink to exert pressure on the spring 44 and on the valve member disk-shaped portion 52. When the ink pressure exceeds the biasing force of the spring 44, the valve member 50 moves forward, pulling the flexible spring 44 downward, and creating an annular opening 60 between the nozzle rim 43 and the valve disk-shaped portion 52 through which ink can flow, as shown in Figure 4.

When the ink pressure force decreases below the biasing force of the spring, the flexible spring 44 returns to its original concave position, reseating the valve disk-shaped portion 52 against the nozzle rim 43 and automatically closing the valve.

An optional nozzle extension 62 (Figures 2 and 4) may be attached to the substantially cylindrical nozzle 42 extending from the dispensing fitment 16 via a snap-fit or other attachment means to help guide the flow of ink. An optional removable cap 64 (Figures 1 and 3) may be used to cover the valve member 50 when the cartridge 10 is not in use.

Without the optional nozzle extension 62 (but preferably with the optional cap 64 installed), the cartridge can be set on a flat surface with the dispensing end facing down. The cartridge can be stacked this way until ready for use.

Thus the present invention provides an ink cartridge having a self-closing valve that opens when subjected to pressure from the ink and closes automatically and completely

when the pressure on the valve is decreased below a predetermined level, even when used with lower viscosity inks.

The cartridge automatically dispenses ink when the plunger end is depressed, forcing ink through the annular opening 60 between the nozzle 42 and the valve member 50. When pressure on the plunger is reduced to a predetermined level, the valve automatically and completely closes. The present invention is particularly suitable as an ink dispenser for use with sheet fed lithographic presses having an automatic ink level sensor.

Other modifications and alternative embodiments of the invention are contemplated which do not depart from the spirit and scope of the invention as defined by the foregoing teachings and appended claims. It is intended that the claims cover all such modifications that fall within their scope.

WE CLAIM AS OUR INVENTION:

1. An improved ink cartridge (10) of the type used in lithographic printing presses, the ink cartridge (10) comprising a hollow cylindrical body (12) for holding a supply of extrudable ink, the cylindrical body (12) having a dispensing end and a plunger end, the plunger end being closed by a plunger (14) adapted to serve as a piston within the cylindrical body (12) to extrude the contents of the ink cartridge (10) when the plunger (14) is forced toward the dispensing end, the dispensing end being closed by a dispensing fitment (16) affixed thereto, the dispensing fitment (16) comprising a flat covering portion (32), a sidewall (34) formed around the periphery of the covering portion (32), and an orifice (38) disposed in the covering portion (32), the improvement comprising:

a nozzle (42) extending from the periphery of the orifice and having a rim (43), said nozzle (42) defining a space;

a flexible spring means (44) mounted within the space defined by the nozzle (42) and having openings to accommodate the flow of ink therethrough; and

a substantially rigid valve member (50) located downstream of and supported by the flexible spring means (44), said valve member (50) being moveable between a closed position in which the valve member (50) is urged against the nozzle rim (43) by the biasing force of the flexible spring

means (44) and an open position in which the valve member (50) is raised above the nozzle rim (43) to create an annular opening (60) when pressure applied by the ink to the spring means (44) and to the valve member (50) exceeds the
5 biasing force of the spring means (44).

2. The improved ink cartridge (10) of claim 1 in which the flexible spring means (44) is formed of molded plastic and is bowed rearward in the direction of the plunger (14) when
10 the valve member (50) is in the closed position.

3. The improved ink cartridge (10) of claim 2 wherein the flexible spring means (44) is held within an annular groove formed in the nozzle (42).
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4. The improved ink cartridge (10) of claim 1 wherein the valve member (50) comprises a substantially flat disk-shaped portion (52) and prongs (54) extending from the disk-shaped portion (52) in the direction of the plunger (14) through a
20 hole in the flexible spring means (44) to secure the valve member (50) to the spring means (44).

5. The improved ink cartridge (10) of claim 4 wherein the nozzle rim (43) is beveled and the flat disk-shaped portion (52) has a beveled edge that engages the beveled nozzle rim (43) when the valve member (50) is in the closed position.
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6. The improved ink cartridge (10) of claim 1 wherein the plunger (14) comprises a substantially circular disk portion (20), a sidewall (22) extending from the periphery of the disk portion (20) in a direction away from the dispensing fitment (16), and means for minimizing ink waste, said minimizing means comprising an annular ring (24) protruding from the circular disk portion (20) in the direction of the dispensing fitment (16), said annular ring (24) having an outer wall (25) and a concave inner wall (26), said annular ring (24) adapted to fit around the valve member prongs (54) and within the space defined by the nozzle (42) when the plunger (14) is seated against the dispensing fitment (16).

7. The improved ink cartridge (10) of claim 1 further comprising a nozzle extension (62) removably attached to the nozzle (42).

8. The improved ink cartridge (10) of claim 1 further comprising a cap (64) removably attached to the nozzle (42).

9. The improved ink cartridge (10) of claim 1 wherein the cylindrical body dispensing end terminates in a rim (18), the dispensing fitment (16) further comprises a flange (36) extending radially outward from the dispensing fitment sidewall (34) and abutting the rim (18) of the cylindrical

body (12), the flange (36) having a bottom surface defining a plane, and both the nozzle rim (43) and the valve member (50) in its closed position do not extend beyond the plane defined by the bottom surface of the flange (36).