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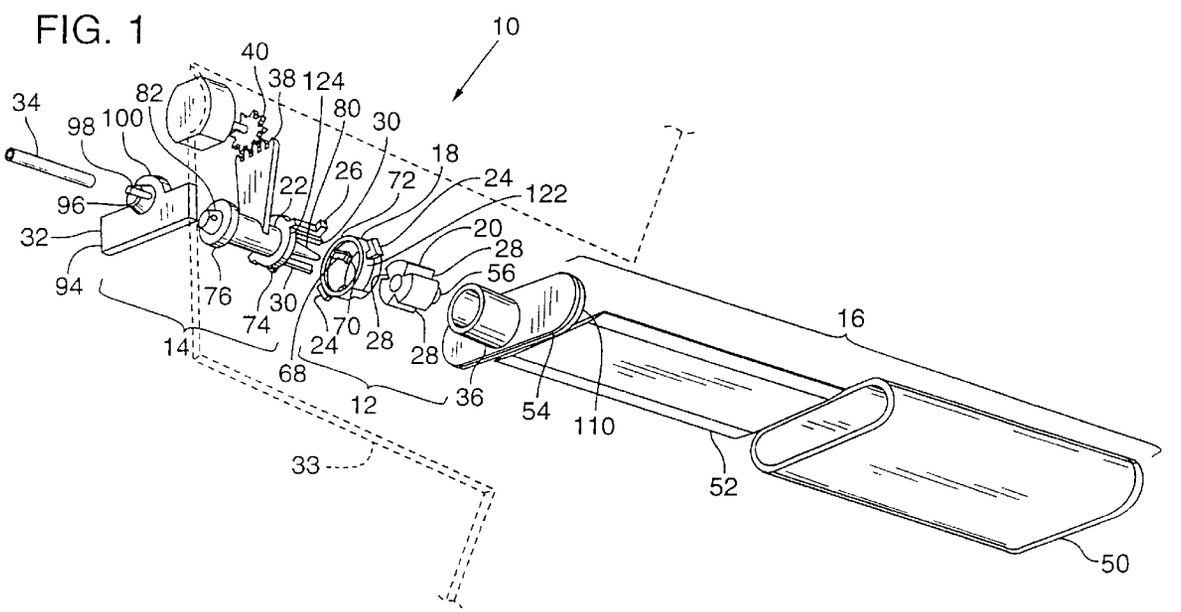
(54) Interlocking connector assembly

(57) The connector assembly includes an outlet assembly on an ink supply container and an inlet assembly mounted to a printer station. The outlet and inlet assemblies have an outlet and inlet valve respectively. The outlet and inlet valves are simultaneously rotatable into open positions to allow ink flow from the supply container to an ink delivery tube on the station. The outlet and inlet assemblies also have a hook and a latch, respectively, that engage when the outlet and inlet valves are coupled and are in the open position, thereby preventing the outlet assembly from being uncoupled from the inlet assembly when either the outlet or inlet valve is in the open position.

FIG. 1



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Description

FIELD OF THE INVENTION

This invention relates to an interlocking connector that can be used to connect an ink supply container to an ink-jet printer.

BACKGROUND AND SUMMARY OF THE INVENTION

Ink-jet printers typically have pens that traverse a sheet of paper or other material. The pen has a print head that selectively ejects tiny droplets of ink to form desired characters or images. In some ink-jet printers, a supply of ink is contained in a reservoir at the pen. This type of ink supply allows for the simple delivery of ink from the reservoir to the print head. The size and weight of the reservoir, however, may adversely affect printer speed because the entire ink supply is moved with the print head. In other ink-jet printers, the ink supply is contained and located elsewhere on the printer, allowing the pen to traverse the paper at a greater speed. A flexible ink delivery tube connects the pen and a supply container.

In this latter type of printer, the supply container is occasionally replaced. To facilitate the replacement, ink-jet printers are generally provided with docking stations. The docking station houses the supply container. The supply container can be easily plugged into and uncoupled from the docking station. The docking station includes a fluid interconnect to connect the supply container to the delivery tube.

A well-sealed fluid interconnect between the docking station and the supply container is necessary. Otherwise, ink may leak from the supply container and damage the printer. In addition, the fluid interconnect should prevent ink from escaping when the supply container is uncoupled from the docking station so no ink comes in contact with the user.

It is also preferred that the components of an ink supply system be as easy to recycle as possible.

A preferred embodiment of the invention provides an interlocking connector assembly for a well-sealed fluid interconnect between an ink supply container and an ink delivery tube. The connector assembly includes an outlet valve carried on the ink supply container and an inlet valve carried on the docking station. The outlet and inlet valves resist being opened while they are uncoupled. The outlet and inlet valves are simultaneously movable into an open position once coupled. The outlet and inlet valves cannot be uncoupled until the outlet and inlet valves are simultaneously closed, so that ink cannot escape from the ink supply container or the station.

As another aspect of this invention, the connector assembly ink supply container has few parts, and the parts are made from similar materials, thus making the ink supply easy to recycle.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view of a connector assembly of the present invention.

Fig. 2 is a perspective view of the connector assembly of Fig. 1 in an open, coupled position.

Fig. 3 is a section view of the connector assembly of Fig. 1 in an closed, uncoupled position.

Fig. 4 is a section view of the connector assembly of Fig. 1 in a open, coupled position.

DETAILED DESCRIPTION OF THE INVENTION

An interlocking connector assembly 10 in accordance with the present invention is illustrated in Fig. 1. The connector assembly 10 connects an ink supply container 16 to a docking station 33 on an ink-jet printer (not shown). The illustrated connector assembly 10 has an outlet assembly 12 on the ink container 16 and an inlet assembly 14 connected to the docking station 33.

In the illustrated embodiment, the supply container 16 has a container base 54, a flexible ink bag 52, and a hard shell 50. The container base 54 is rectangular with rounded corners and has a thickened mid-section 112, as seen in Fig. 3. The thickened mid-section 112 has a frustum-shaped indentation 62. A bore 42 extends between the wall of the frustum-shaped indentation 62 and the inner edge 120 of the thickened mid-section 112 to open into the bag 52 that is attached at one end to the mid-section 112. In the preferred embodiment, the container base 54 is made from polyethylene.

The edge 114 of the container base 54 has an inwardly protruding skirt 110 over which snap-fits the open end 118 of the shell 50.

The hard shell 50 is made from a low-cost material such as polyethylene and has an inwardly facing annular groove 116. The shell 50 is snapped onto the container base 54 such that a ridge on the skirt 110 fits snugly into the groove 116 on the shell 50. The shell 50 protects the ink bag 52.

The ink bag 52 is attached to the thickened mid-section 112 of the container base 54 by, for example, heat-staking. Fluid can flow from the interior of the ink bag 52 through the bore 42 in the mid-section 112. The ink bag 52 is otherwise enclosed.

The outlet assembly 12 includes a valve holder 36, an outlet valve 20, and a keeper member 18. The valve holder 36 is a projecting tube that is either integrally formed with or attached to the container base 54 by, for example, heat-staking or ultrasonic welding. The valve holder 36 is preferably made from polyethylene.

The outlet valve 20 is cylindrical with a frustum-shaped protrusion 56 at the center of the inward end 64. The outlet valve 20 has an "L" shaped passageway 44 extending from the outward end 66 of the outlet valve 20, along the axis of the outlet valve 20, and radially to the side of the frustum-shaped protrusion 56. The outward end of the passageway 44 is countersunk, and the

passageway 44 tapers slightly before extending radially. Preferably, the outlet valve 20 is injection molded from polyethylene and formed with a void 126 therein to facilitate even cooling of the polyethylene and to reduce material.

The outlet valve 20 fits tightly within the valve holder 36 and is recessed therein so as to resist rotation by hand. The frustum-shaped protrusion 56 of the outlet valve 20 fits tightly within the frustum-shaped indentation 62 in the container base 54.

When the outlet assembly 12 is not coupled to the inlet assembly 14, the outlet valve 20 is in a closed position, in which the passageway 44 is not aligned with or intersecting the bore 42. Thus, the walls of the frustum-shaped protrusion 56 block fluid flow from the bore 42 of the supply container 16, as shown in Fig. 3.

The outlet valve 20 is rotatable into an open position, in which the passageway 44 is aligned with the bore 42 to allow fluid flow from the supply container 16, as shown in Fig. 4 and as will be described in greater detail below.

The outlet valve 20 also has keyways 28, of which there are three in the preferred embodiment (Fig. 1). Each keyway 28 is a "V"-shaped notch that extends axially along the edge of the outlet valve 20. The keyways 28 are equally spaced around the perimeter of the outlet valve 20.

The outlet valve 20 is held in the valve holder 36 by the stationary keeper member 18. The keeper member 18 is ring-shaped and its inner diameter fits snugly around the outer diameter of the valve holder 36. The keeper member 18 has legs 68, as best seen in Fig. 1, extending from the outward edge 72 of the keeper member 18 inwardly to the interior of the ring. The legs 68 have feet 70 extending radially inward and perpendicular to the legs 68. The undersides of the feet 70 abut the outward end 66 of the outlet valve 20, thereby to hold the outlet valve 20 tightly against the frustum-shaped indentation 62 in the container base 54.

The keeper member 18 also has two hooks 24. The hooks 24 extend radially outward from diametrically opposed parts of the outer walls 122 and form a right angle before extending tangential to the keeper member 18. When the outlet and inlet assemblies 12 and 14 are coupled and the outlet and inlet valves 20 and 22 are rotated into the open position, the hooks 24 latch onto the inlet assembly 14 to prevent the outlet assembly 12 from being uncoupled from the inlet assembly 14, as will become clear below.

The inlet assembly 14 has an inlet valve 22 and a valve retainer 94. The inlet valve 22 is cylindrical with an outward flange 74 and an inward flange 76. The inward flange 76 has a frustum-shaped projection 82 centered about the axis of the inlet valve 22. The outward flange 74 has three keys 30 extending outward therefrom and evenly spaced about the center of the inlet valve 22. In the preferred embodiment the keys 30 are hexagonal-shaped, although any shape that fits within the keyways 28 could be used.

When the outlet and inlet assemblies 12 and 14 are coupled, the keys 30 fit into the keyways 28 on the outlet valve 20. Rotating the inlet valve 22 causes the keys 30 to press on the walls of the keyways 28, thereby to rotate the outlet valve 20. Thus, the outlet and inlet valves 20 and 22 can be simultaneously rotated into their open positions, as will be discussed in greater detail below.

The inlet valve 22 also has a tapered nozzle 80 extending outwardly from the outward flange 74 along the axis of the inlet valve 22. The tip 84 of the nozzle 80 is rounded.

The inlet valve 22 also has a channel 48 extending from the tip 84 of the nozzle 80 along the axis of the inlet valve 22 to the inward flange 76 as best seen in Fig. 4. The channel 48 widens at the outward edge 86 of the outward flange 76 and tapers until near the end 88 of the frustum-shaped projection 82. At which point, the channel 48 forms a right angle and extends perpendicular to the axis of the inlet valve 22 and opens through the side of the frustum-shaped projection 82.

As shown in Fig. 1, two elongated latches 26 extend from diametrically opposed sides 124 of the outward flange 74, parallel to the axis of the inlet valve 22. The outermost ends of the latches 26 form a right angle to extend radially from the inlet valve 22. The latches 26 engage the hooks 24 when the inlet valve 22 and outlet valve 20 are rotated into the open position and prevent the outlet and inlet assemblies 12 and 14 from being uncoupled while the outlet and inlet valves 20 and 22 are open.

The inlet valve 22 also has an arm 78 extending radially from the exterior wall 90 of the inlet valve 22 as shown in Fig. 2. The perimeter 92 of the arm 78 has teeth 38 formed therein. The teeth 38 mesh with a gear 40 that is mounted to the docking station 33. The gear 40 is driven to rotate the teeth 38, which rotate the inlet valve 22. When the inlet valve 22 is coupled with the outlet valve 20 (Fig. 4), as the inlet valve 22 rotates, the keys 30 push against the walls of the keyways 28 to rotate the outlet valve 20 simultaneously.

In ink-jet printers having multiple ink containers, a rack of teeth could be used instead of the gear 40 to rotate the inlet and outlet valves on all the ink containers at the same time. Alternatively, a bar linkage could do the same.

The inlet valve 22 is mounted to the docking station 33, as shown in Figs. 1 and 2. The docking station 33 includes the valve retainer 94 and an ink delivery tube 34. The valve retainer 94 is rectangular with a semi-circular protuberance 100. A frustum-shaped valve seat 96 protrudes from near the center of the semi-circular protuberance 100. The valve seat 96 has a protruding duct 98 attached thereto that extends outwardly, parallel to the axis of the valve seat 96. As shown in Fig. 3, the duct 98 is hollow and extends from an opening 46 on the interior surface 102 of the valve seat 96 to a distal end 104. The distal end 104 of the duct 98 is connected

to the ink delivery tube 34.

The inlet valve 22 is rotatable relative to the valve seat 96 from a closed position, in which the channel 48 is not aligned with the opening 46 of the duct 98, as shown in Fig. 3, to an open position, in which the channel 48 is aligned with the opening 46 to allow fluid flow through the inlet assembly 14, as shown in Fig. 4.

In the preferred embodiment, the inlet assembly 14 is recessed within the docking station 33 so that a user cannot reach the inlet valve 22 and thus cannot manually turn the inlet valve 22 from the closed to the open position. Preferably, the ink container 16 protrudes only approximately one inch beyond the docking station when coupled into the inlet assembly 14.

Additionally, it is contemplated that the connector assembly 10 could include an electrical or mechanical switch at the docking station 33 that is triggered upon full insertion of the supply container 16 to actuate a motor (not shown) to drive the gear 40 to rotate the inlet and outlet valves 22 and 20 into the open position.

The interlocking connector assembly 10 could be made suitable for use in ink-jet printers using various colors or types of ink by keying the latches 26 and hooks 24 to allow insertion only of an ink container with the appropriate color or ink.

When the outlet and inlet assemblies 12 and 14 are uncoupled, both the outlet and inlet valves 20 and 22 are in the closed position to occlude fluid flow through the outlet and inlet valves 20 and 22 as shown in Fig. 3. As noted, the tight fit and recession of the outlet valve 20 in the valve body 36 prevent the outlet valve 20 from being rotated by hand into the open position. Similarly, the recession of the inlet valve 22 in the docking station 33 prevents the inlet valve 22 from being rotated by hand into the open position. Therefore, neither the outlet valve 20 nor the inlet valve 22 can be rotated inadvertently into the open position when the outlet and inlet assemblies 12 and 14 are uncoupled.

As the outlet assembly 12 is coupled with the inlet assembly 14, the nozzle 80 extends into the passageway 44 in the outlet valve 20, creating a path through the channel 48 for fluid flow between the outlet and inlet valves 20 and 22, but not between the supply container 16 and the tube 34 because the outlet and inlet valves 20 and 22 are still in the closed position. Also, as the outlet assembly 12 is inserted into the inlet assembly 14, the keys 30 on the inlet valve 22 engage the keyways 28 on the outlet valve 20. The tapered outer walls of the nozzle 80 form a seal with the passageway 44 to prevent fluid leakage.

Once the seal is made, the outlet and inlet valves 20 and 22 are rotated into the open positions, as shown in Fig. 4. This is accomplished by rotating the gear 40, which engages the teeth 38 on the arm 78 to thereby rotate the inlet valve 22 into the open position. The rotation of the inlet valve 22, and thereby the keys 30, causes the simultaneous rotation of the outlet valve 20 into the open position.

Also, as the inlet valve 22 rotates, the latch 26 rotates through the same angle. The keeper member 18 on the outlet assembly 12, and thereby the hooks 24, remains stationary. Thus, when the inlet valve 22 is rotated into the open position, the latches 26 engage the hooks 24 so that the inside edges 106 of the latches 26 abut the side edges 108 of the hooks 24, as illustrated in Figs. 2 and 4. With the hooks 24 and the latches 26 engaged, the outlet assembly 12 cannot be uncoupled from the inlet assembly 14. Rather, the outlet and inlet valves 20 and 22 must be rotated to disengage the hooks 24 and latches 26. Rotating the outlet and inlet valves 20 and 22 through an angle sufficient to disengage them will close the outlet and inlet valves 20 and 22.

Thus, the hooks 24 and latches 26 prevent the outlet and inlet assemblies 12 and 14 from being uncoupled whenever the outlet and inlet valves 20 and 22 are in the open position. This ensures that ink is not released from the ink container 16 or from the tube 34 during uncoupling and thus prevents ink from contacting the user. This also prevents a user from carelessly extracting the ink container 16 when either the ink container 16 or the tube 34 has a path open for fluid flow.

Also, this invention provides an ink container that is easy to recycle. This invention also prevents the ink from drying out because the inlet and outlet valves are always closed when the inlet and outlet valves are uncoupled, and thus the ink is never exposed to ambient air. This invention allows multiple couplings and uncouplings.

This description illustrates various embodiments of the present invention and should not be construed to limit the scope thereof in any way. Other modifications and variations may be made to the assembly described without departing from the invention as defined by the appended claims and their equivalents.

Claims

1. A connector assembly for connecting an ink supply container to a station on an ink-jet printer, the connector assembly comprising:

an outlet assembly (12) connectable to the ink container (16), the outlet assembly including:

a keeper member (18);

an outlet valve (20) mounted for rotation relative to the keeper member into an open position to allow ink to flow from the ink container, and into a closed position to occlude ink flow from the container; and

an outlet latch member (24) mounted to protrude from the keeper member; and

an inlet assembly (14) mounted to the station (33) and couplable with the outlet assembly, the inlet assembly including:

an inlet valve (22) rotatably mounted to the sta-

tion and movable into an open position to allow ink flow through the inlet valve and into a closed position to occlude ink flow through the inlet valve; and

an inlet latch member (26) connected to the inlet valve and rotatable with the inlet valve; and wherein the inlet and outlet latch members engage when both the outlet assembly is coupled with the inlet assembly and the inlet valve and the outlet valve are rotated into their open positions, so that the inlet and outlet assemblies cannot be uncoupled when either one of the inlet valve and outlet valve is in the open position.

2. The connector assembly of claim 1 in which moving the inlet and outlet valves (22, 18) into the closed position disengages the inlet and outlet latch members (26, 24), thereby allowing the inlet and outlet assemblies (14, 12) to be uncoupled.

3. The connector assembly of claim 1 in which the inlet assembly (14) further includes a key (30) and the outlet assembly (12) further includes a keyway (28), the key being insertable into the keyway to couple the motion of the inlet assembly with the motion of the outlet assembly.

4. The connector assembly of claim 1 in which the inlet valve (22) includes teeth (38) mounted thereon, the teeth being drivable by a gear (40) on the printer, thereby to move the inlet valve between the open and closed positions.

5. The connector assembly of claim 1 in which the ink container (16) includes a bore (42) and the outlet valve (20) includes a passageway (44), the bore and the passageway being configured such that the passageway is aligned with the bore in the open position to permit the flow of ink from the container and through the outlet valve and such that the passageway is away from the bore in the closed position thereby to occlude ink flow from the container.

6. The connector assembly of claim 1 in which the station (33) on the printer includes an opening (46) and the inlet valve (22) includes a channel (48), the opening and the channel being configured such that the channel is aligned with the opening in the open position to permit the flow of ink through the inlet valve into the printer station and such that the channel is away from the opening in the closed position, thereby preventing ink flow between the inlet valve and the printer station.

7. An interlocking connector assembly for connecting an ink container to an ink-jet printer, the connector assembly comprising:

an outlet valve (20) mounted to the ink container (16) rotatable into an open position to allow flow from the container and into a closed position to occlude the flow from the container, the outlet valve having a keyway (28);

an inlet valve (22) mounted to the printer and rotatable into an open position to allow ink flow through the inlet valve into the printer and into a closed position to occlude ink flow from the printer, the inlet valve being matable with the outlet valve and having a key (30) insertable into the keyway on the outlet valve such that rotation of the inlet valve into the open and closed positions causes rotation of the outlet valve into the open and closed positions, respectively.

8. The connector assembly of claim 7 in which the inlet valve (22) includes teeth (38) mounted thereon that can be driven by a gear (40) on the printer, whereby the inlet valve and thereby the outlet valve (20) are rotated between the open and closed positions.

9. The connector assembly of claim 7 in which the ink container (16) has a bore (42) through which ink may flow out of the container and in which the outlet valve (20) has a passageway (44), the bore and passageway being configured such that the passageway is aligned with the bore in the open position to permit the flow of ink from the container and through the outlet valve and such that the passageway is away from the bore in the closed position to occlude ink flow from the container.

10. The connector assembly of claim 7 in which the station (33) on the printer has an opening (46) through which ink may flow into the printer and in which the inlet valve (22) has a channel (48), the opening and the channel being configured such that the channel is aligned with the opening in the open position to permit the flow of ink through the inlet valve into the printer and such that the channel is away from the opening in the closed position, thereby to prevent ink flow through the inlet valve.

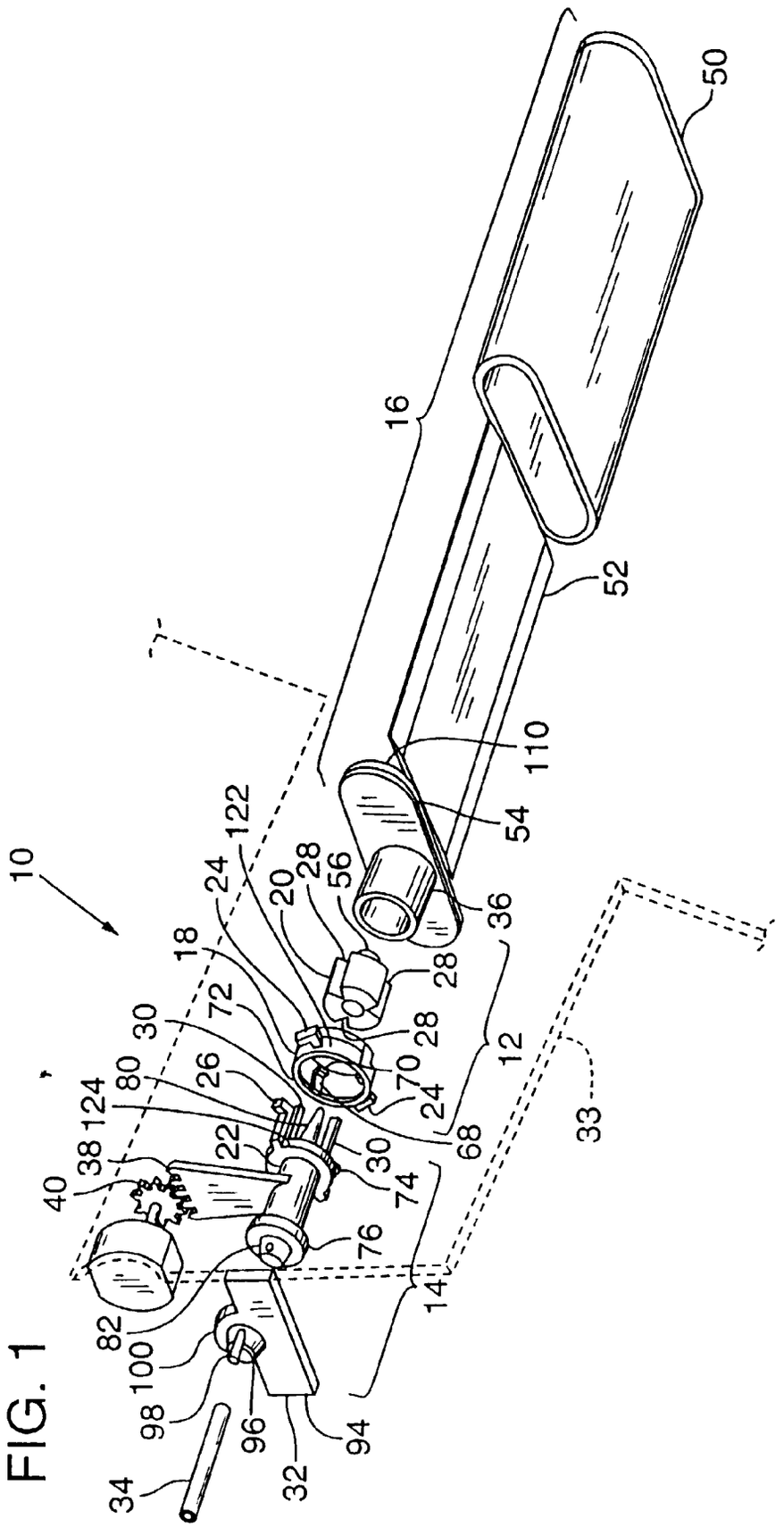
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FIG. 1

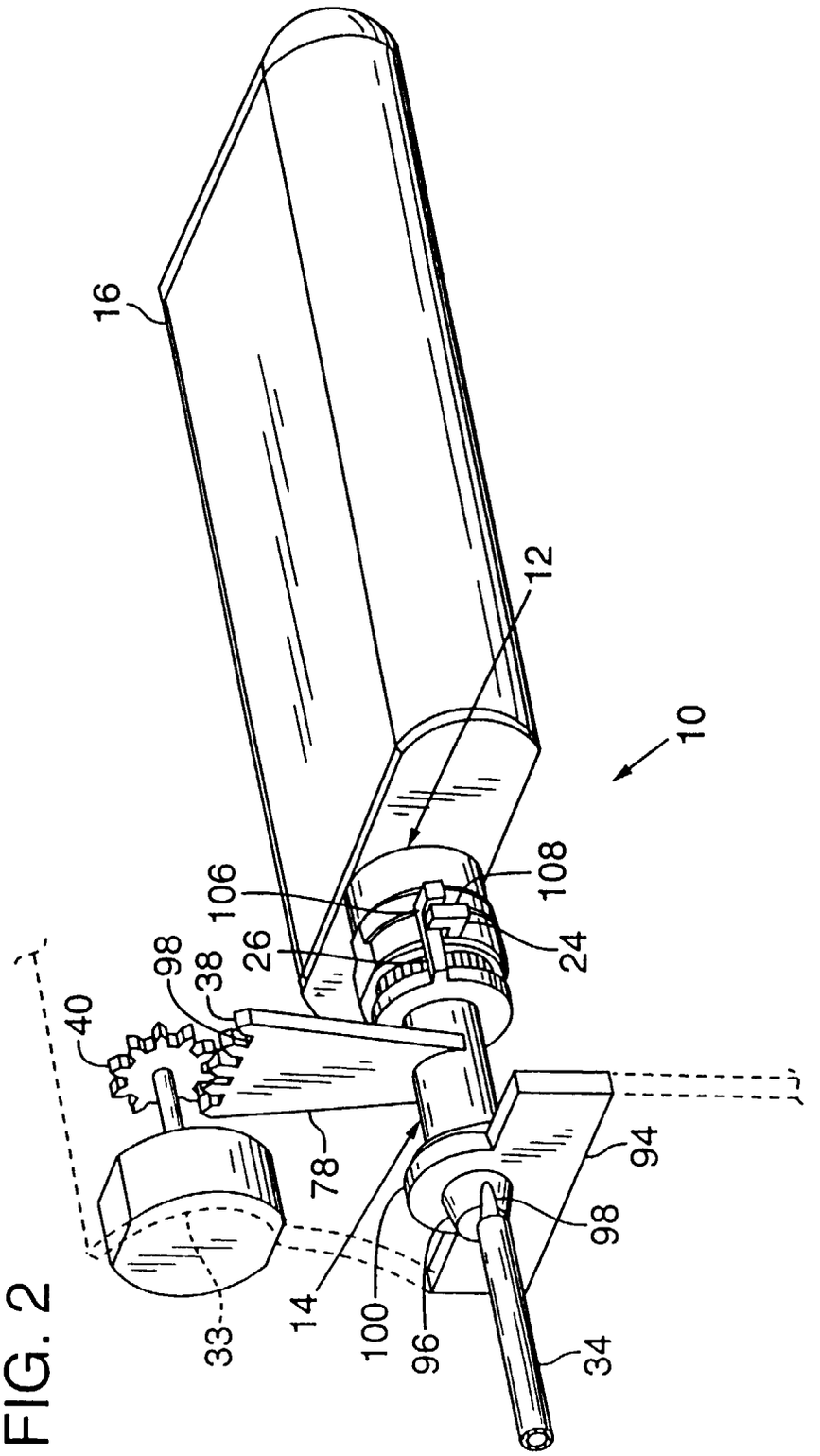

FIG. 2

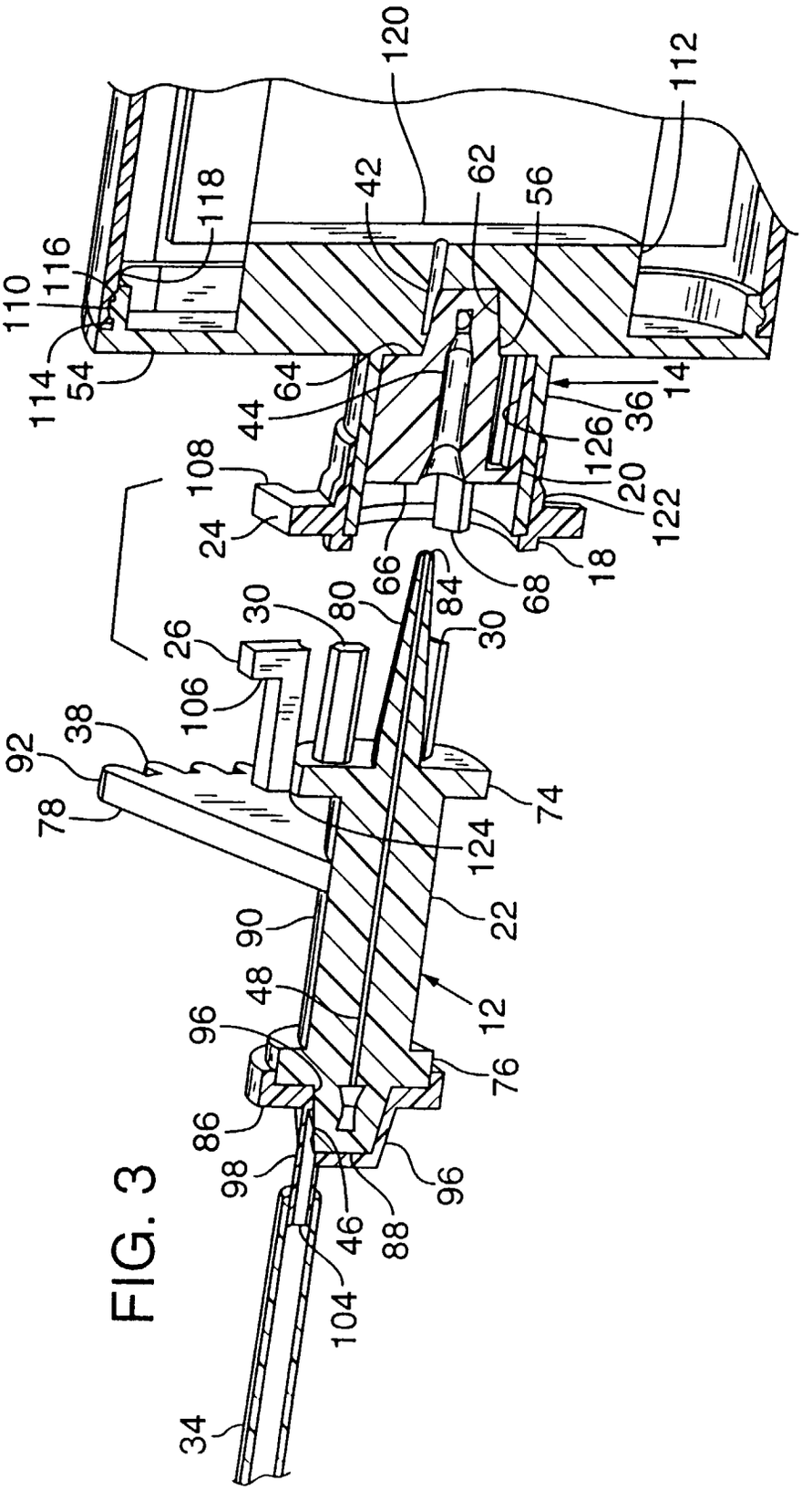
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FIG. 3

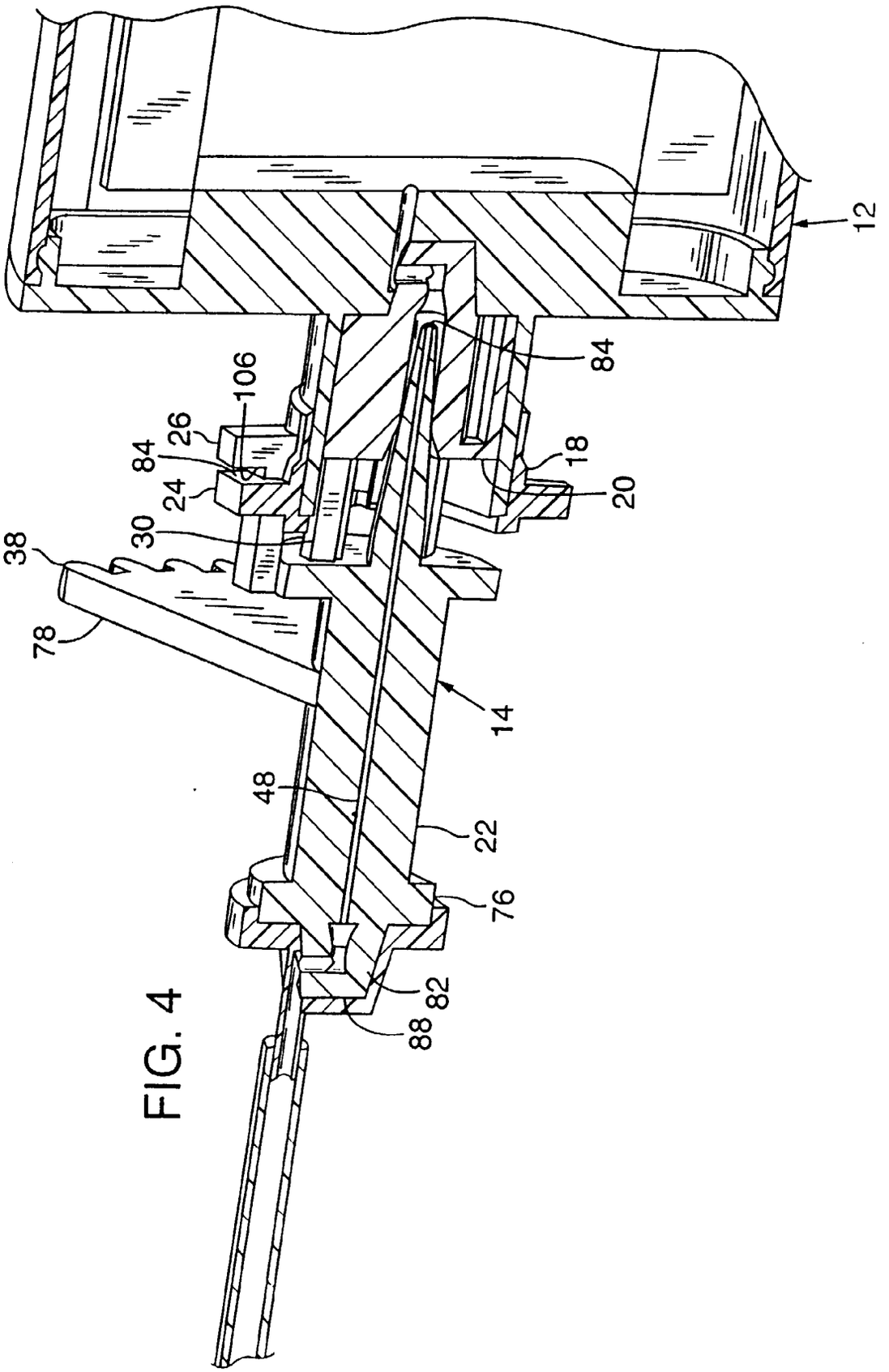

FIG. 4