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AUTOMATIC INTERMEDIATE TANK REMOVAL DETECTION BASED ON THE FEEDBACK FROM THE INTERNAL AIR PRESSURE SYSTEM (APS) FOR MFJ 3D PRINTERS

HP INC

Automatic Intermediate Tank removal detection based on the feedback from the internal Air Pressure System (APS) for MJF 3D printers

Abstract

3D printers are powerful tools for companies involved in prototyping since they can iterate designs much faster than other technologies. The main difference between HP MultiJet Fusion 3D and their competitors is the usage of agents to, accurately, generate and form the desired part's exact shape.
Agents used on MJF are water-based ink agents known as Fusing Agent (a.k.a. FA) and Detailing Agent (a.k.a. DA). FA agent is used to melt the part while, DA allows to obtain better details of printed parts by cooling the contour of the parts.

Currently, all MJF system are using the same ink-type for their prints which are not facing any problem of pigment settling. However, for future MJF programs, which will allow it to print on new materials and with new properties, new ink types will be used that have started to show some problem if no recirculation is done on them.

Due to the chemical properties of some agents, it is necessary to recirculate the agents to avoid issues related to agent settling in the ADS (Agent Delivery System), such as the cartridge, Internal reservoirs, tubes, etc.
Providing the printhead with enriched or depleted agent could impact on the Part Quality, but also leading to printhead failure if the printhead's filter is clogged due to the enriched agent.

This problem could be solved by an ADS that allows the agent recirculation, which may include multiple cartridges to recirculate the agent between these cartridges, helping to redisperse the pigments.
In some cases, however, it is not possible to have an ADS that allows the agent recirculation. For instance, when reusing the existing hardware of a non-Recirculable ADS to print with an agent that needs to recirculate to ensure that the pigment is redispersed to provide the best Part Quality.

This limitation may require the customer to regularly agitate some reservoirs, such as the cartridge or the Intermediate Tank in order to redisperse the agent. As this is an operator dependent maintenance routine, we need to ensure to mitigate the risk of misuse or human error (customer might skip the maintenance or perform it incorrectly). In this case printer should be able to detect the error-prone condition, via having some checks during the maintenance routine to validate that the customer has performed the maintenance.
Typically, the cartridge includes an acumen to store information related to the cartridge (agent remaining, expiration date,…) and it can detected if the cartridge has been removed based on the acumen detection. However, the Intermediate Tank may not include an acumen since it is not required to store or read any data from this reservoir. Thus, not being possible to verify if the Intermediate Tank is removed based on the acumen detection.

This invention describes a new methodology to the detect that the Dugong (without acumen) has been removed during the maintenance routine reusing the air pressure signal from the Air Pressure System.

Invention

The solution is based on monitoring the air pressure signal of the APS (Air Pressure System), which includes an air pressure sensor and an air pump to pressurize the Intermediate Tanks.

When pressurizing the APS using the air pump, if the Intermediate Tank is not installed, there would be an air leakage through the needle of the fluid interconnect (printer – Intermediate Tank) and it would not be possible to reach a certain air pressure threshold, detecting that the Intermediate Tank has been removed to perform the maintenance routine.

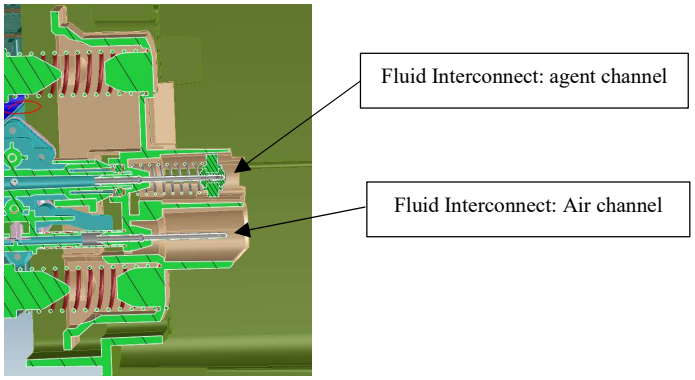

Figure 1. Fluid Interconnect without Intermediate Tank installed.
If the APS is pressurized, there is an air leakage through the air channel

Case Intermediate Tank *is **installed***: when turning on the agent pump, the air pressure reaches a defined threshold. Thus, it can be detected that the customer has not removed the Intermediate Tank and an alert is sent to the customer.

1. Active depressurization of the APS. When APS is depressurized, the customer is requested to remove the Intermediate Tank
2. Customer validates that the Intermediate Tank has been removed and the APS is pressurized. Since the Intermediate Tank is installed, the air pressure reached the threshold.
3. APS is depressurized to continue with the workflow. Indicating to the customer that the Intermediate Tank has not been removed.

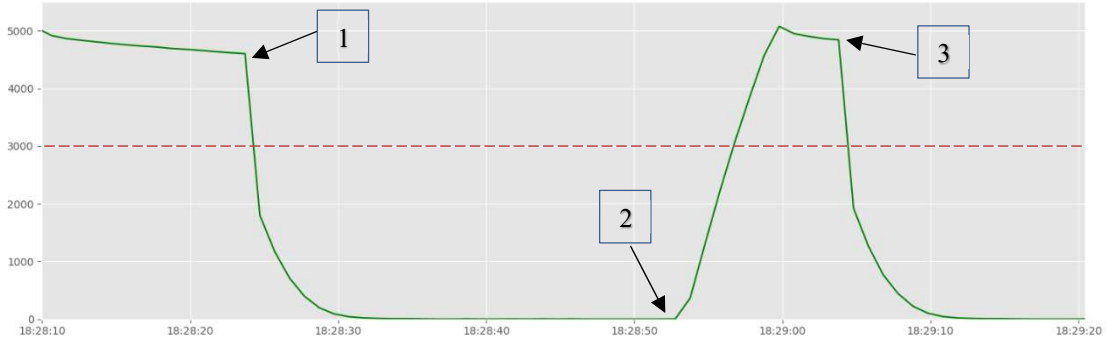

Figure 2: Maintenance routine - Intermediate Tank installed

Case Intermediate Tank *is **uninstalled***: when the air pump is turned on, since there is an air leakage through the fluid interconnect, the pressure does not reach a certain threshold, indicating that the customer has properly removed the Intermediate Tank and performing properly the maintenance routine.

1. Active depressurization of the APS. When APS is depressurized, the customer is requested to remove the Intermediate Tank
2. Customer validates that the Intermediate Tank has been removed and the APS is pressurized. Since the Intermediate Tank is uninstalled, there is air leakage through the fluid interconnect and the air pressure does not reach the threshold.
3. APS is depressurized to continue with the workflow.

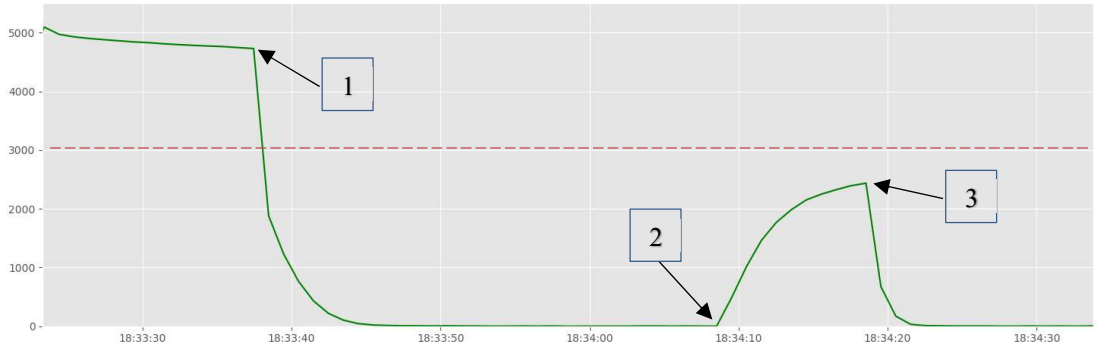

Figure 3. Maintenance routine - Intermediate Tank removed

The advantages that the solution provides are:

• Automatic detection: allows to detect if the Intermediate Tank has been removed during the maintenance process based on the air pressure signal.

• Robustness: not relying on the customer to verify that the Intermediate Tank has been removed increases the robustness of the workflow.

• Warranty cost: providing feedback regardless the maintenance routine has been performed or not allows HP to properly manage the warranties related to Part Quality defects or printheads failures due to agent settling.

• Service Cost: being able to monitor if the customer is performing properly the maintenance routine avoids issues related to agent settling and Service Engineers visits. If the customer is not performing the routine, an alert is raised.

• Printhead life: it is increased since the invention allows to detect if the maintenance routine is skipped, which could end up having a printhead malfunction.

• Cost: It reuses the current hardware of the printer and no additional electronic element (EE board, cables, …) or mechanical parts (adding an acumen on the Intermediate Tank) are required.

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