Flow Drill for Joining Stronger Materials (2016-020)

Electrically assisted flow drill to efficiently join strong materials from one side

Market Overview

This technology allows for the coupling of high strength and dissimilar materials, particular for lightweighting designs. An effort to reduce fuel consumption has led automakers to use new high strength materials and fastening methods, making these into $110 Billion dollar markets by 2021. Driven by regulatory standards, this push has led to increased use of flow drill screws (FDS) in one-sided joining processes. However, current methods are limited in use by material stackup stiffness, strength, and fasteners. Clemson University researchers have developed a technique that allows for the joining of stackups that cannot currently be joined by FDS, and can do so in a faster manner than current methods for common stackups.

Technical Summary

FDS is a slow process compared to many other joining processes, and is limited by the 8Nm torque limit of the commonly used and lightweight M5 fastener. By applying electricity from the left to right ends of both sheets when two aluminum sheets are being joined, or from the bottom in an aluminum on steel stack, process time is reduced. Current is initially applied during the finding process, and ultimately leads to an 18% decrease in installation torque and a 32% reduction in process time due to a pre-process starting temperature of 128 °C. Not only does this process retain one-sided accessibility, but this addition of electricity allows the M5 fastener to penetrate a commonly used, stronger material such as Boron Steel, which it would otherwise fail to be able to.

Application
Manufacturing; Automotive

Development Stage
Validated Prototype

Advantages
- Applied electric current creates ability to join thicker and stronger material stackups
- Reduced process time and installation torque results in increased manufacturing efficiency
- Existing machines in production lines can be modified for this technology now and when new materials emerge

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	62/460,462	NA	2016-020	Laine Mears, Brandt Ruszkiewicz, Jamie Skovron

About the Inventors

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Dr. Laine Mears is the BWM SmartState Chair and Professor of Automotive Engineering at the CU-ICAR Campus. Prior to founding the Clemson University Automotive Engineering graduate program, Dr. Mears worked seven years for a global bearing manufacturer and four years for a Japanese engine and steering parts manufacturer. His research interests include precision positioning control, control of processing difficult-to-machine materials, metal injection molding, and electrically-assisted manufacturing. He is a SME Certified Manufacturing Engineer, ASQ Certified Quality Engineer, and licensed Professional Engineer.

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