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MODELING AND PROTOTYPING OF COMPLAINT CENTRIFUGAL CLUTCH USING FDM PROCESS

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Abstract - *This research pioneers using FDM technology to create a complaint centrifugal clutch for automobiles. It tackles the limitations of traditional designs by integrating advanced modeling and leveraging FDM's unique capabilities. The study employs sophisticated CAD tools to optimize the clutch's design for peak performance and durability, then strategically utilizes FDM's layer-by-layer method to materialize the prototype. Careful material selection ensures the clutch meets its mechanical and thermal demands. The resulting prototype undergoes rigorous testing to validate its performance under various conditions. This research aims to not only optimize clutch efficiency but also introduce the advantages of FDM to the automotive industry, opening doors for further exploration and adoption of this transformative technology in the design and production of critical automotive components.*

***Key Words*: Fused Deposition Modeling (FDM), Computer-aided design (CAD), Complaint centrifugal clutch, Prototyping, Optimize, etc.**

1. INTRODUCTION

This research tackles the limitations of traditional centrifugal clutches by employing FDM, a layer-by-layer additive manufacturing process. It utilizes advanced CAD to optimize clutch design for efficiency and durability, showcasing FDM's potential to reshape automotive component production. By exploring various thermoplastics and rigorously testing the prototype, the study aims to bridge the gap between theory and practice, paving the way for FDM adoption in developing efficient and lightweight clutches for improved vehicle performance. This timely contribution offers a cutting-edge perspective on integrating advanced design with FDM, redefining the manufacturing landscape for critical automotive components.

1.1 Additive Manufacturing

Additive manufacturing, the 3D printing marvel, upends traditional production. Building layer by layer, it grants unmatched design freedom, rapid prototyping, and cost-effectiveness. Gone are the shackles of subtractive methods; intricate shapes and customization flourish, slashing waste and time-to-market. From aerospace to healthcare, across industries, this versatile technology redefines how we create, from concept to production. Additive manufacturing stands as a beacon of innovation, ushering in a new era of limitless possibilities.

1.2 Centrifugal Clutch

Centrifugal clutches, the silent heroes of many machines, seamlessly adjust power transmission based on speed. As the engine revs up, centrifugal force engages the clutch, connecting the engine to the workload. This automatic dance makes them perfect for applications like chainsaws and go-karts, where smooth power delivery is key.

There are different types of centrifugal clutches, each with its strengths. The classic shoe type uses pivoting arms to engage the power, while the cone type employs a gradual, progressive engagement ideal for heavier machinery like lawn tractors.

From compact tools to mighty machines, centrifugal clutches keep the power flowing, adapting to ever-changing demands. Their versatility and reliability make them indispensable players in the world of mechanical engineering.

1.3 complaint mechanism

Compliant centrifugal clutches ditch clunky multi-part designs for a single, flexible plate. This simpler build not only slashes costs but also stores energy and transmits higher torque. Fewer moving parts mean less wear and tear, while a clever graphical design ensures smooth operation. A game-changer for efficient, durable power transmission

2. EXPERIMENTATION

Digital design transforms into physical reality through a sequence of steps. First, ideas take shape in CAD software, where 2D sketches evolve into 3D models. Next, slicing software prepares the model for printing, generating precise instructions. Finally, specialized 3D printers like the 3D Metaform PRO-500 or Adroitec machines meticulously construct the components layer by layer, translating digital blueprints into tangible objects.

Modeling of the product has involved the steps in general are Create a new file, select plane orientation, create a 2D sketch using line, circle, Sline, and arc entities, set dimension, finish sketch, extrude, and click OK.

The next process converting digital 3D models into layers for the printer to follow. It determines the print parameters, such as layer height and infill, ensuring precise and accurate fabrication. Common examples include Cura, Simplify3D, and Prusa Slicer.

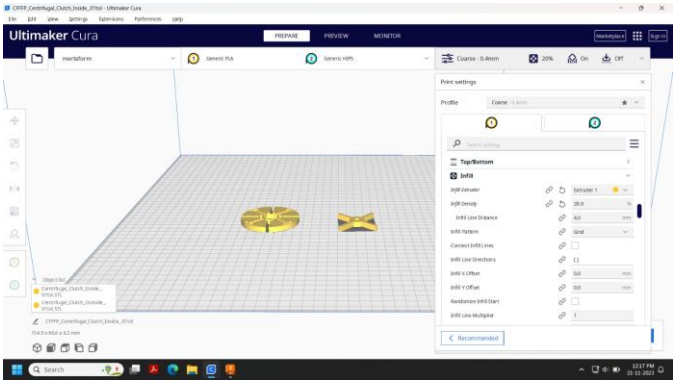

Figure 1 Slicing the product in Cura.

Manufacturing using an FDM 3D printing machine namely Metaform PRO-500. It 500 is a high-speed, large format 3D printer ideal for building low-cost objects and industrial samples. It offers industrial quality and reliability, with a wide range of thermoplastic materials. It features Wi-Fi, USB data transfer, power off resume, a 5-inch touch display, and a filament runout sensor.

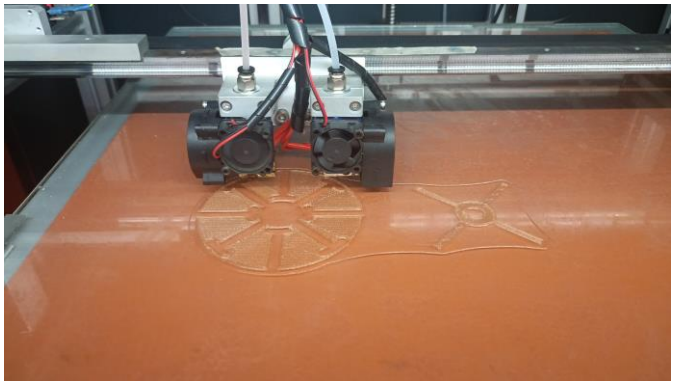

Figure 2 Printing product using Metaform PRO-500

2.1 Result

Our research marries cutting-edge design with FDM's 3D magic, churning out a centrifugal clutch stronger and smoother than ever. FDM's layer-by-layer build banished traditional limitations, yielding a prototype that aces both strength tests and real-world simulations. This isn't just about clutches; it's about FDM reshaping car parts, one precise layer at a time. Buckle up, the future of efficient, resilient vehicles is in sight.

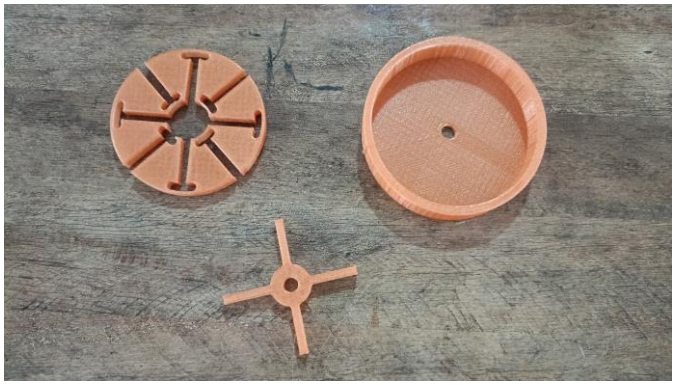

Figure 3 Final parts of the complaint centrifugal clutch

3. CONCLUSION

Clutching onto innovation, this research marries advanced design with FDM 3D printing to forge a next-gen centrifugal clutch. FDM's layer-by-layer magic transcends traditional limitations, crafting intricate, durable components. Beyond clutches, this study paves the way for broader FDM adoption in autos, driving toward a future of efficient, resilient vehicles. Our tangible results rewrite the narrative of automotive engineering, shaping a road paved with performance and sustainability.

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