DESIGN AND CONSTRUCT AN OPEN DIE FORGING MACHINE WITH A 1.5 HP ELECTRIC MOTOR AND 5 KG HAMMER

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Abstract: *This project outlines the design and construction of an open forging machine equipped with a 1.5 HP electric motor and a 5 kg hammer for use in the Material Technology Laboratory. The primary objective was to create a versatile and controlled environment for forging and shaping materials. The project began with the conceptualization and design phase, where the layout and components of the machine were planned. Materials were carefully selected for durability and performance. Construction was meticulously carried out with an emphasis on safety.The machine underwent rigorous testing to ensure it met the laboratory's specific requirements, and adjustments were made for optimal performance. Fine-tuning was performed to calibrate the machine, addressing temperature control, speed, and pressure settings. The completed open forging machine promises to enhance research capabilities in material technology, facilitating experiments in material science and research. This project represents a significant step in advancing the laboratory's capabilities and marks the beginning of a new phase in material technology research and experimentation.*
Keywords: *Forging Machine, Electric Motor, Hammer, Material,Laboratory Equipment*

A. Introduction

Forging is a metal processing technique that uses plastic deformation to change the shape of a workpiece. The forging process is one of several types of metal forming, and it is characterized by low costs, high productivity, and high product quality.

A power hammer machine is a machine used for the formation of a product in the manufacturing process, namely with a system of continuous forging/pressure on the specimen so that the deformed specimen becomes denser and stronger according to the desired shape.

Based on the search results, there are several machines that can be designed and built for forging, including power hammer machines and automated hammering machines. However, there are no specific instructions or plans for designing and constructing an open forging machine with a 1.5 HP electric motor and a 5 kg hammer.

The main components of an open forging machine may vary depending on the specific design and purpose of the machine. However, based on the search results, some common components of forging machines include:

Hammer: The hammer is the main component of the forging machine that applies force to the workpiece to shape it. The hammer or press can be powered by an electric motor or hydraulic system.

Die: The die is a tool that is used to shape the workpiece. This die made of AISI 410 steel.

Anvil: The anvil is a stationary component of the forging machine that supports the workpiece during the forging process. The anvil made of AISI 410 steel

Control system: The control system still manual regulate the speed and force of the hammer.

Cooling system: The cooling system is used water and oil to cool the workpiece and prevent it from overheating during the forging process.

The materials used in the construction of an open forging machine can have a significant impact on its performance. Here are some ways in which the materials can affect the performance of the machine:

Strength and durability: The materials used in the machine should be strong and durable enough to withstand the high forces and temperatures involved in the forging process. If the materials are not strong enough, they may deform or break during the forging process, leading to poor performance and safety hazards.

Wear resistance: The materials used in the machine should be wear-resistant to prevent damage to the machine and ensure its longevity. For example, carbide is a hard and wear-resistant material that is often used for dies in forging machines.

Thermal conductivity: The materials used in the machine should have good thermal conductivity to ensure that the heat generated during the forging process is dissipated efficiently. This can help prevent overheating and ensure consistent performance.

Corrosion resistance: The materials used in the machine should be corrosion-resistant to prevent damage from exposure to moisture or chemicals.

Weight: The weight of the materials used in the machine can affect its portability and ease of use.

The materials used in the construction of an open forging machine can have a significant impact on its performance. The materials AISI 410 was carefully selected to ensure that they are strong, durable, wear-resistant, thermally conductive, corrosion-resistant, and appropriate for the specific design and purpose of the machine.

B. Research Methode

The research methods for designing and constructing a forging machine with a 5 kg hammer and an electrical motor of 1.5 HP would involve a combination of theoretical and practical approaches. Here are some steps that could be taken:

Research and Planning: The first step would be to research and plan the design of the forging machine. This would involve studying the principles of forging and the requirements of a forging machine with an electrical motor. Once the research is done, a plan can be developed for the design of the machine.

Design: The next step would be to design the forging machine with a 1.5 HP electrical motor. This would involve creating a detailed design that includes all the necessary components and specifications. The design was based on the research and planning done in the previous step. The design also took into account the electrical motor's power requirements and how it will be integrated into the machine.

Construction: Once the design is complete, the forging machine can be constructed. This would involve assembling all the components according to the design. It would also involve testing the machine to ensure that it is working properly. The electrical motor 1.5 HP install and wired according to the manufacturer's instructions.

Testing and Evaluation: After the machine is constructed, then tested and evaluated to see how its performance. The involve testing the machine under different conditions to ensure that it is working properly. The electrical motor's performance was also be evaluated to ensure that it is providing the necessary power to the machine.

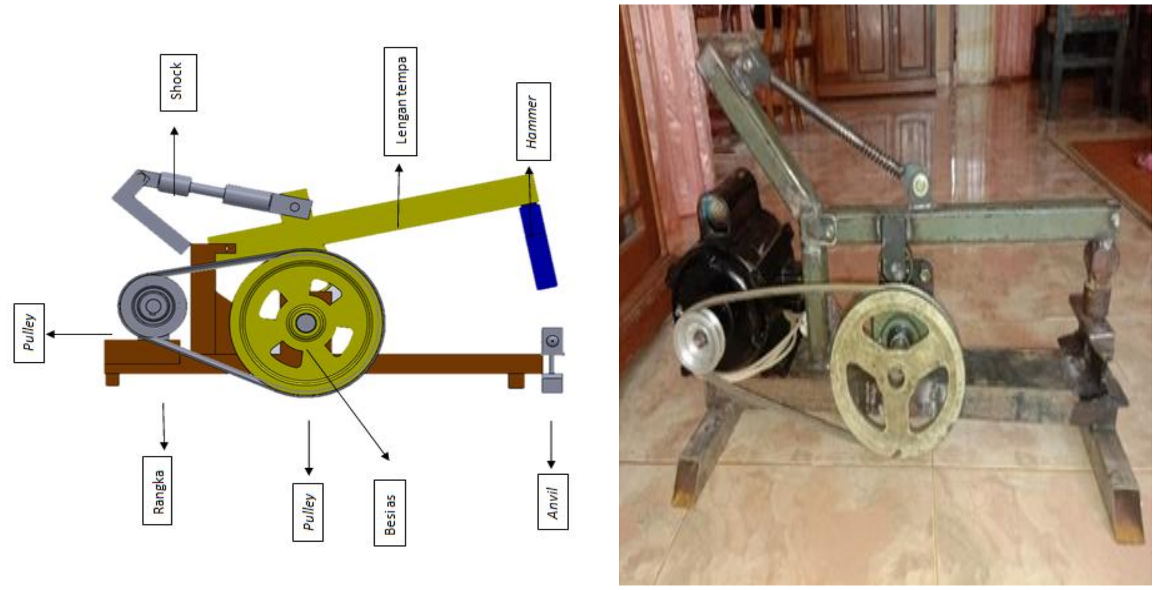

Fig. 1 a) Design b) Forging Machine

C. Discussion

This forging machine will be tested for its performance using several types of leaf springs from different cars, including Toyota Kijang, Colt T, and trucks. The test results will vary the hammer mass, the number of forging strikes, and the temperature, thereby producing a reduction in cross-section that can be used to discuss the relationship between each testing variable.

Table 1 Data forging process at Toyota Kijang spring leaf

Speed/rpm	Hammer mass	Strikes/min	T/^{0}C	Reduction
1500 rpm	4 kg	60	700-800	9 mm
1500 rpm	5kg	54	700-800	7 mm
1500 rpm	6kg	48	700-800	5 mm

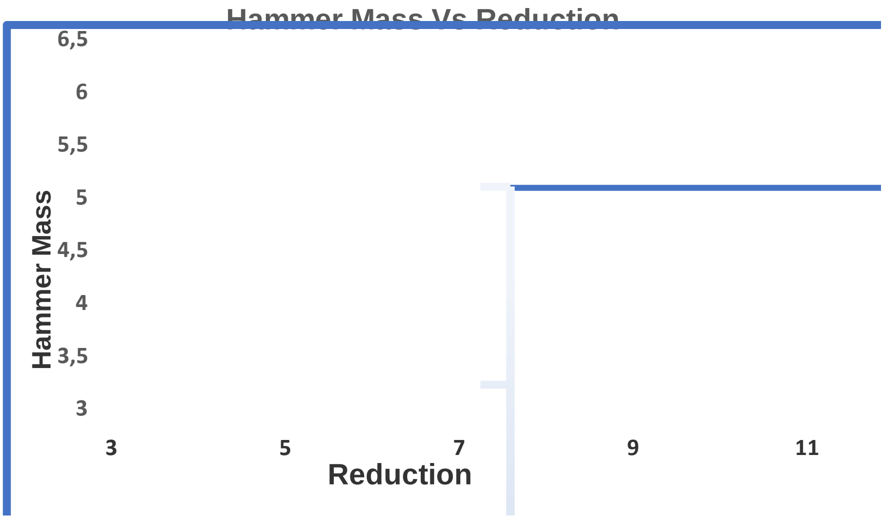

Figure 2 shows the graph of the relationship between hammer masst and cross-sectional reduction in the forging process at Toyota Kijang spring leaf

Table 3 Data forging process at Colt-T spring leaf

Speed/rpm	Hammer mass	Strikes/min	T/^{0}C	Reduction
1500 rpm	4 kg	60	700-800	7.35 mm
1500 rpm	5kg	54	700-800	8.85 mm
1500 rpm	6kg	48	700-800	9.25 mm

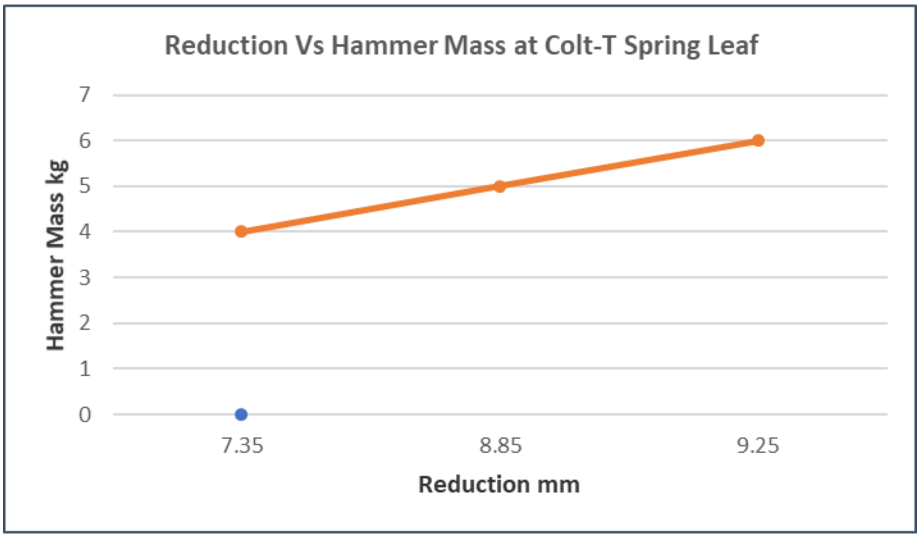

Figure 3 shows the graph of the relationship between hammer mass and cross-sectional reduction in the forging process at Colt -T spring leaf

In the initial experiment, it is evident that the mass of the hammer exerts a notable influence on both the dimensional characteristics and the temporal efficiency of specimen processing, as well as the overall durability of the forging machinery. The deployment of a 4kg hammer in the first test led to a reduction of 1mm in cross-sectional dimensions and a processing time of approximately 1 minute.

The primary limitation associated with this configuration is the extended processing time, but it is counterbalanced by the prolonged operational lifespan and durability of the machine.

Subsequently, the second test featuring a 5kg hammer demonstrated comparable results to the 4kg hammer, with the distinguishing feature being a reduction in dimensional parameters and a decreased number of hammer strikes. This second testing iteration proved to be more effective than its predecessor, chiefly due to the substantially reduced processing time and the significant dimensional alterations.

Conversely, the third test employing a 6kg hammer proved to be less efficient for knife production. The inherent coarseness in the processing method, coupled with the necessity for the dynamo machine to align with the weight of the hammer, posed challenges. Forcing the dynamo machine's operation would result in rapid overheating, prompting the viable solution of upgrading to a more robust dynamo machine.

Furthermore, it is worth noting that manual forging methods failed to meet productivity requirements while maintaining high-quality standards. Consequently, the development and implementation of a dedicated forging machine present a scientifically sound solution to enhance productivity in the context of the forging process.

D. Conclusion

In summary, the empirical examination of open-die forging machine trials has yielded substantive findings regarding the influence of hammer weight on critical facets of the forging procedure. The selection of hammer weight, specifically 4kg, 5kg, or 6kg, has manifest implications for dimensional alterations, processing duration, and the overall mechanical integrity of the equipment.

The deployment of a 4kg hammer, although associated with protracted processing periods, is concomitant with a pronounced extension in the machine's operational lifespan. Conversely, the 5kg hammer, producing results akin to its 4kg counterpart, exhibits a reduced processing time and significant dimensional transformations, rendering it a more operationally efficient alternative. In contrast, the 6kg hammer, owing to its coarser processing characteristics and the imperative of a commensurate dynamo machine, demonstrates limited efficacy in the context of knife production.

The overarching recommendation arising from this study is the transition from manual forging techniques to the adoption of specialized forging machinery. This not only serves to bolster productivity but also ensures the sustained attainment of exacting quality standards. The research underscores the pivotal significance of judiciously selecting the appropriate hammer weight and machinery to optimize the forging process in an academic and industrially relevant context.

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