

Optimizing Efficiency Automated Feeding in Double-Disc Grinding

¹Mr. Rohit Jadhao, ²Mr. Swaroop Patil, ³Mr. Aditya Sonar, ⁴Mr. Jasraj Singh Suri, ⁵Mr. Sushant Khedekar

¹Assistant Prof. Department of Mechanical Engineering, “Nutan Maharashtra Institute of Engineering & Technology”, Talegaon, Pune, Maharashtra 410507

^{2,3,4,5} UG Scholar Mechanical Engineering, “Nutan Maharashtra Institute of Engineering & Technology”, Talegaon, Pune, Maharashtra 410507

Abstract— In today’s manufacturing industry product with high quality is an important measure. To achieve it is necessary to have special skills and advanced technologies, which can improve the quality of the product and reduce the time of manufacturing with minimum human interference. In the Double Disc Grinding machine when the number of jobs is grinded it requires a significant amount of time to feed it manually. Implementing an automated job feeder mechanism in this machining can reduce fatigue and increase productivity

Keywords: Mechanism Design, Automation, CAD Designing, Future Development, Industrial Automation, Assembly Techniques.

I. INTRODUCTION

In today's competitive landscape, small and medium-scale industries within the automobile sector face significant challenges in maintaining efficiency and competitiveness while contending with limited financial resources. Outdated machinery and manual operation processes present obstacles to achieving high-quality production at low costs. Specifically, in the realm of grinding operations, such as those performed by Double disc grinder machines, the manual feeding of jobs not only leads to inefficiencies but also poses risks to worker safety due to fatigue and potential injuries from sharp edges. To address these pressing concerns, this project endeavors to develop a low-cost feeder mechanism that can be seamlessly integrated with existing Double-disc grinder machines. By automating the job-feeding process, this solution aims to enhance productivity, reduce worker fatigue, mitigate safety risks, and ultimately bolster the profitability and sustainability of small and medium-scale automobile industries.

Within this context, the Double disc grinder machine stands out as a critical component in the production process, particularly for tasks like grinding surfaces or faces of components with high precision. However, the manual feeding of jobs into these machines presents a significant bottleneck, as it is labor-intensive, time-consuming, and prone to human error. Moreover, the repetitive nature of this task increases worker fatigue and the risk of injuries, further impeding operational efficiency and worker well-being. The introduction of such a feeder mechanism holds the potential to enhance the competitiveness of SMEs in the automobile sector by enabling them to optimize their existing infrastructure without incurring prohibitively high costs. Furthermore, by alleviating manual labor requirements and enhancing workplace safety, the project contributes to fostering a

more sustainable and productive manufacturing environment.

II. OBJECTIVES

1. Improve the overall efficiency of grinding operations by reducing cycle times, optimizing resource utilization, and maximizing machine uptime through the implementation of the feeder mechanism.
2. Minimize worker fatigue associated with manual job feeding tasks, thereby enhancing employee well-being and reducing the risk of injuries caused by repetitive motions and exposure to sharp edges.
3. Ensure that the feeder mechanism maintains high levels of precision and accuracy in the positioning and alignment of jobs within the grinder machine, thereby preserving the quality and consistency of the finished components.
4. Develop the feeder mechanism with a focus on cost-effectiveness and affordability, allowing small and medium-scale enterprises to benefit from automation without incurring prohibitive expenses.

III. PROBLEM STATEMENT

Small and medium-scale enterprises (SMEs) within the automobile industry face significant challenges in maintaining competitiveness and efficiency due to reliance on outdated machinery and manual operation processes. Specifically, in the context of grinding operations performed by duplex grinder machines, the manual feeding of jobs presents a bottleneck, leading to inefficiencies, worker fatigue, and safety risks. The existing solutions, such as expensive CNC machines, are often financially inaccessible to SMEs with limited budgets. Therefore, there is a pressing need to develop a cost-effective feeder mechanism that can automate the job feeding process in duplex grinder machines, thereby improving productivity, reducing cycle times, mitigating worker fatigue, and enhancing safety. This project aims to address this critical gap by designing and implementing a low-cost feeder mechanism tailored for SMEs in the automobile sector, enabling them to modernize their manufacturing processes and remain competitive in the market.

IV. LITERATURE REVIEW

There are several research papers have been published regarding various topics related to double disc grinding machines and Slider crank mechanism manufacturing. They have been reviewed as follows:

Gurudas Gopalkrishna et al. (2019) In the present study, the main emphasis has been on processing the materials to obtain the balanced mechanical properties for the given application. One of the processing routes is to alter the properties of heat treatment. Nearly 80% of the structural applications are related to medium carbon unalloyed steel. The major requirement in conventional steel is to improve workability or ductility and refine the grain structure with sustained improvement in the tensile properties. Due to this, it is important to study the mechanical properties of EN8 unalloyed steel with and without heat treatment. So bought (hot rolled or cold rolled) materials are subjected to conventional hardening, normalizing, and tempering treatments. These untreated and heat-treated components are subjected to hardness, tensile & metallography. A comparative study of the result is performed to authenticate the properties. Microstructure was studied by using Optical Microscope and Scanning Electron Microscopy. The main intention of this study is to find out the effect of different heat treatment processes on EN8 STEEL in different conditions and the various changes that occur in its mechanical properties, Hardness, and Microstructure. This gives a wide knowledge of the effect of the various heat treatment processes and the enhancement of various properties that can be achieved using these advanced technologies. From this study, it will be possible to understand the various aspects related to microstructure, mechanical properties of the steel, and the changes that occur in the steel after subjecting to the heat-treatment process.

Mehmet Iteris Sarigecili & Ibrahim Deniz Akcali et al. (2018) "Development of constant output–input force ratio in the slider–crank mechanisms" This paper examines the slider–crank mechanism whereby output piston force is produced against an input force at the crank pin center, the output force varies rapidly when the crank changes its position. For the applications that need the same piston pushing force as in feeder mechanisms, a method is needed for identifying the parameters to keep output force at a constant value for any crank angle position. Hence in this study, two methods are shown for a slider–crank mechanism operating in the horizontal plane. Initially, a manual control process generates a constant piston force, and the resulting errors are indicated. Subsequently, identifying the parameters of a mechanical controller for a readily available slider-crank mechanism in an open force control process and the associated error state is shown. Then, an approach to improve the results of open force control is explained. Finally, the developed methods are mapped for any orientation of the slider–crank mechanism. A user-friendly interface is developed to transform all the processes into a computer program.

Soham Milind Mudalgikar et al, (2018) "Case Study of Automation for Double Disc Grinding Machine" This article takes a look at the concept of a robotic arm for automation, the technologies which are used for robotic arm automation have the application of low-cost automation. The Mechanical arm with the ability to contemplate the need for work will make generally speaking work and consequently industry a lot more intelligent and productive. Utilization of AI is helpful in the automated arm for certifiable experience.

M. Bala Chennaiah et al. (2016). "Influence of Heat Input and Post weld Heat Treatment on the Microstructure and Mechanical Properties in Dissimilar (IS2062-EN8) Welded Joints" This study evaluates the impact of heat input and post-weld heat treatment on mechanical properties and microstructure in dissimilar metal joints made of mild steel and EN8. MIG welding is used to melt the metals together, and tensile strength, impact resistance, and hardness are measured to evaluate joint performance. Heat input is a critical factor affecting the entire weldment zone, with hardness values identifying different zones across the traverse length. Input parameters such as voltage, current, and wire speed are adjusted to heat input between low and high levels. The study analyses the microstructure and mechanical properties of different zones in each plate with and without PWHT, aiming to optimize welding processes and enhance dissimilar metal joint performance.

Hong-Tzer Yan et al. (2013) This paper describes a method used to make the design of a slider-crank mechanism. The innovative design of a slider-crank four-link mechanism uses PLC to control the combined motions of the pneumatic cylinders so that the slider can carry out the following functional actions: straight reciprocating motions. Unidirectional straight intermittent reciprocating motions, bidirectional straight intermittent reciprocating motions, and step displacements at the left and right dead points. Variable-motion strokes. The study results can act not only as teaching material for mechanism creative design and mechatronics courses but also as a reference for developing similar mechanisms for industry. In further research, the variable crankshaft length and the combined application of motions could be used to design more functions and create more value for the variable intermittent slider-crank four-link mechanism.

KANZUO SAITO. (1999) His study describes worker fatigue in modern industries as a complex phenomenon influenced by multiple factors. It leads to exhaustion, decreased physiological functions, autonomic nervous system imbalances, and reduced work efficiency. Industrial fatigue arises from excessive workloads, significant changes in posture, and disruptions to daily rhythms. The shift from whole-body work to specific body parts and from physical to mental labor characterizes modern industries. Visual Display Terminal (VDT) work is prevalent in various workplaces. While numerous fatigue tests exist, selecting the most appropriate test battery remains challenging. To address fatigue in VDT work, the Visual Reaction Test (VRT) and Portable Fatigue Meter have been developed. Additionally, immune parameters in peripheral blood and splenic T cells have been explored as indicators of physical fatigue.

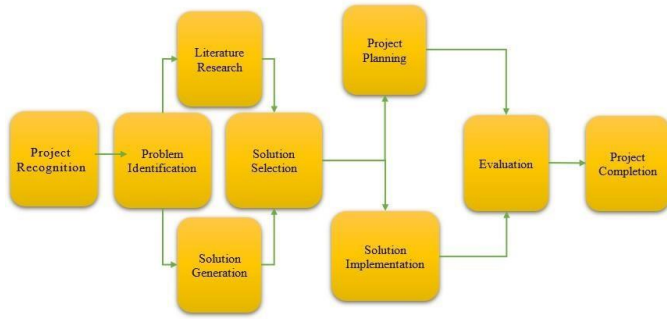
P. Kah & R. Suoranta et al, (2012)

This paper explores arc welding innovations for heat-sensitive materials, focusing on digitalization's impact in gas metal arc welding. It emphasizes the need for optimizing welding parameters for efficient deposition and proposes integrating gas flow and wire motion control algorithms for improved waveform precision.

Devarakonda Harish Kumar (2015) This research investigates the cost-effective use of cylindrical grinding on a lathe machine for achieving high dimensional accuracy and fine surface finish in modern manufacturing. By retrofitting a heavy-duty lathe with a grinding attachment, the study aims to provide regression equations for surface roughness, aiding in optimizing input parameters.

V. METHODOLOGY

Fatigue and Health related issues in operators.	Problem's Arising
Manual Feeding in Double Disc Grinding Machine.	
Excess Grinding of pins present in workpiece.	



Design of linear push method.	Solution Available
Developing bowl feeding mechanism.	
Developing robotic arm for feeding mechanism.	

Flow-Chart of Methodology

VI. MATERIAL USED

Sr. No.	Parts	Material used
1.	Base	EN8
2.	Block	EN8
3.	Connecting Rod	EN31
4.	Part Guider	EN8
5.	Bush	BRASS
6.	Pushing Element	EN31
7.	Disc	EN8
8.	Piston	EN31
9.	Motor Shaft	EN31

VII. DESIGN CALCULATIONS

1. Grinding Wheel:

Diameter of wheel=300 mm Speed =6500 RPM

Power =5 HP=3.770 KW

Torque= Power × 60×2π × Speed

=5.53 Nm

Radius =5.400×0.15 = 36N

2. Pushing Force:

Weight of one piece

=0.05 kg Coefficient of friction =0.15

Total load

= [(No. of pieces ×Weight of one piece) + (Friction

Force)]× g

=49N

3. Motor Specifications

Power =0.25 HP = 186.5 Watts

RPM =960

By power equation

$P = (2\pi NT) \div 60$

T=1855 Nm

Available torque at the end of the gearbox by power

relation $P = T \times N$

$T_{\text{motor}} \times N_{\text{motor}}$

= $T_{\text{gb}} \times N_{\text{gb}}$

= $T_{\text{gb}} = 118.784\text{Nm}$

Required torque for a mechanism

$T_{\text{mech}} = F \times r$

= 1.225 Nm

$T_{\text{mech}} < T_{\text{gb}}$

Hence the Powerpack is sufficient for the mechanism

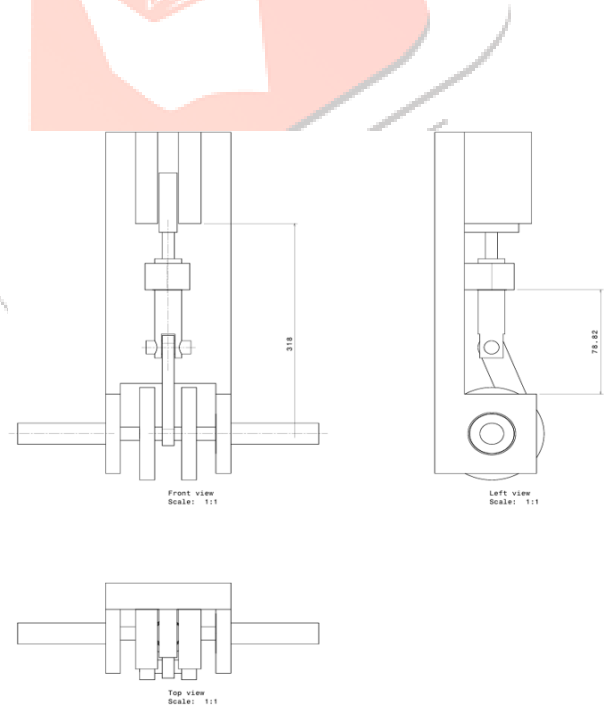
Total force delivered by the gearbox

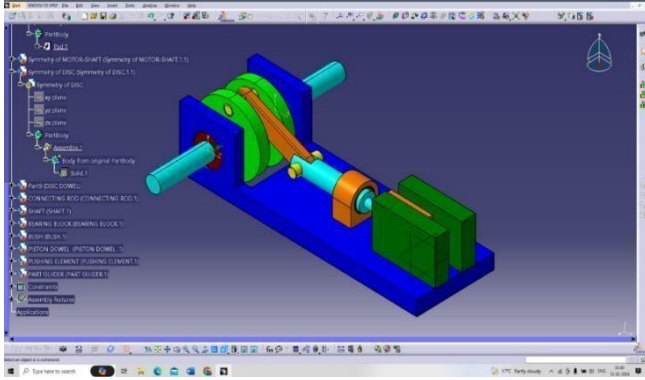
$F = (T_{\text{gb}}) \div r$

= 4751.36 N

VII. MODEL DESIGNING

A. 2D Design





C. Physical representation



D. Before Automation



E. After Automation.



VIII. RESULTS

The following table shows the results of productivity before and after the implementation of the mechanism.

	8 hour/day (Jobs)	1 hour/day (Jobs)
Before Automation	4000	500
After Automation	5760	720

Before implementation of automated job feeder worker was suppose to push the part manually by thumb which was quite time consuming and exhausting which resulted into feeding 4000 jobs in 8 hours/day, However after implementing the automated job feeder mechanism the productivity has been increased by 60% from 4000 jobs/day to 5760 jobs/day

Quality Result Graph



To maintain the quality of job the length of the pin after grinding should be maintain in between 12.3mm to 12.4mm Before the implementation of job feeder mechanism (Manual feeding) there was a large variation in pin length due to uneven feed rate which resulted into excess grinding or under grinding of pins. After implementing the Automated job feeder, it helped to achieve constant feed rate. Therefore maintain optimum pin length. Hence the issues related to quality of the product were significantly minimized

IX. Conclusion

In conclusion, the development of a low-cost feeder mechanism for double disc grinder machines represents a significant advancement in the field of modernizing manufacturing processes within the automobile industry, particularly for small and medium-scale enterprises (SMEs). By addressing the challenges associated with outdated machinery and manual operation processes, this project has successfully introduced a solution that enhances operational efficiency, productivity, and worker safety while remaining cost-effective and accessible to SMEs with limited financial resources.

1. The implementation of an automated job feeder significantly increased productivity by 60%, enabling the processing of 5760 jobs per day compared to the previous manual method which manufactured only 4000 jobs per day. This improvement not only reduced manual effort and exhaustion but also optimized efficiency in job feeding processes.
2. Implementing an automated job feeder mechanism stabilized pin length during grinding, maintaining optimal dimensions between 12.3mm to 12.4mm. This minimizes quality issues, ensuring consistent product quality.
3. Automating job feeding mechanism reduces worker fatigue, enhancing well-being and minimizing injury risks from repetitive motions and sharp edges.
4. As the mechanism was based on slider crank mechanism, it was simple to design and manufacture, enabling small scale industries to afford it in cheaper price.

X. REFERENCES

- [1] Gurudas Gopalkrishna, Ravindra Babu Gurumurthy, and Mahesh Davanageri (2019) "Heat treatment and mechanical characterization of EN8 steel" AIP Conference Proceedings 2080 (March). 37
- [2] Mehmet Ilteris Sarigecili & Ibrahim Deniz Akcali (2018) "Development of constant output-input force ratio in slider-crank mechanisms" Inverse Problems in Science and Engineering Volume 27(5): 565-
- [3] Soham Milind Mudalgikar, M.H. Kulkarni (2018) "Case Study of Automation for Duplex Grinding Machine" International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS) Volume 7(4), April: 2278-2540
- [4] Ján Šteinger, Slavomír Hřeček, Branislav Krchňavý (2017) "The Design of Universal Loading Device for a Grinding Machines" Procedia Engineering, Volume 192, 869-874
- [5] M. Bala Chennaiah, Dr. P. Nanda Kumar, Dr. K. Pahlada Rao. (2016) "Influence of Heat Input and Post weld Heat Treatment on the Microstructure and Mechanical Properties in Dissimilar (IS2062-EN8) Welded Joints" Materials Today: Proceedings, Volume 4(2), 1193-1198
- [6] Hong-Tzer Yan (2006) "Innovative Design of a Variable Intermittent Slider-Crank Mechanism" International Journal of Mechanical Engineering Education, Volume 34(4)
- [7] KANZUO SAITO (1999) "Measurement of fatigue in industries" Industrial Health, Volume 37(2), 134-142
- [8] P. Kah & R. Suoranta & J. Martikainen (2012) "Advanced gas metal arc welding processes"
- [9] Devarakonda Harish Kumar (2015) "Fabrication of cylindrical grinding attachment on lathe machine and optimization of grinding parameters by regression analysis"
- [10] S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
- [11] Textbook of Machine Design by R.S. Khurmi and GK Gupta, S chand & Company.
- [12] Textbook of "Strength of Materials" By Dr.R.K.Bansal, Laxmi Production.

