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Friction Welding Machine Design

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Keywords:
Friction Welding
Hydraulics
Friction
Rotation
Pressure

ABSTRACT

The development of welding science is increasingly rapid in the fields of construction, vehicle component manufacturing, electrical component manufacturing. Welding that is currently developing is friction welding and also friction stir welding. The use of Friction Welding is to combine two shafts using a Friction Welding machine as an example of a vehicle axle component (Shaft), repairing a broken axle, and currently there have been many studies from lecturers and students about Friction Welding with publications in national and international journals. The design of the Friction Welding machine is made by modifying the tail stock on a lathe which functions as a pressing tool. The design process first studies the work of the lathe then designs the actuator (hydraulic pressing tool) using a hydraulic system to obtain axial pressure using a piston as a forge when the friction welding process is carried out. From the design results, the diameter of the hydraulic cylinder is 85 mm, the diameter of the piston rod is 30 mm and the piston stroke is 200 mm using the piston diagram, force and pressure which means that the hydraulic cylinder is safe to use.

INTRODUCTION

Background

The development of welding science is related to technology that is also increasingly developing. Both in the fields of construction, vehicle component manufacturing, electrical manufacturing. Welding that is currently developing is friction welding and also friction stir welding. The use of Friction Welding is to combine two shafts using a Friction Welding machine as an example on vehicle axle components (Shaft), repairing broken axles, and currently there has been a lot of research from lecturers and students about Friction Welding with publications in national and international journals.

The results of the researcher's observations are that the Friction Welding Machine currently used for research by lecturers and students is a lathe that has been modified with the addition of a hydraulic system (as a press/forge when connecting two shafts).

Based on the identification of the problems above, the researcher took the initiative to conduct research, namely Designing a Friction Welding Machine Without Modifying a Lathe Machine.

Objectives

1. Design and build a Friction Welding machine that is useful for research by lecturers and students in the Department of Mechanical Engineering, Surabaya State University.
2. Can be used as a practical for mechanical engineering students to learn about various welding methods.

RESEARCH METHOD

Type of Research

The approach method used in this research is experimental analysis research which aims to design and make a friction welding machine using a lathe.

The use of this method is based on the research problem to be used, the research objectives and the research process according to the desired research results and objects.

Location

The research locations are:

a. Manufacture of Friction Welding Machine, namely a pressing tool and hydraulic system in the machining laboratory of the mechanical engineering department of Surabaya State University.

b. Assembly of Friction Welding Machine in the Machining Laboratory of the Department of Mechanical Engineering, Surabaya State University.

c. Friction Welding Machine Testing in the machining laboratory of the mechanical engineering department of Surabaya State University.

Research Design

Research design is the steps and stages carried out by researchers in an effort to create tools and analyze the tools created.

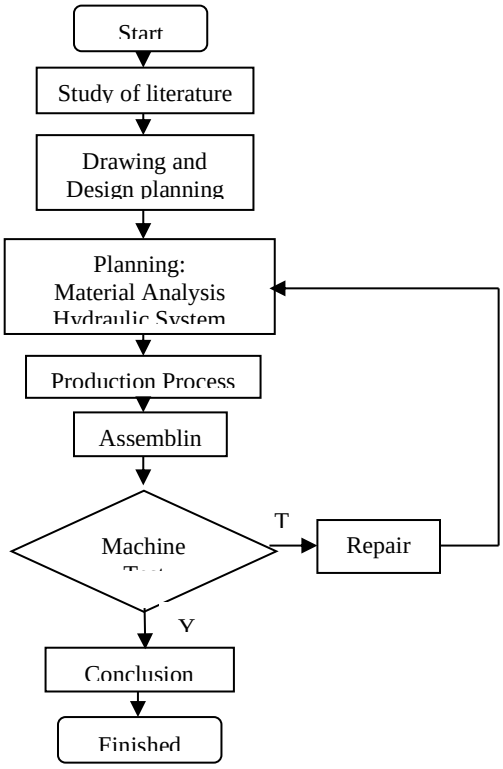


Figure 1. Flowchart Research

RESULTS AND DISCUSSION

Result

Hydraulic Press Tool Design

Therefore, a press tool with a hydraulic mechanism was designed to replace the tail stock. This tool is placed in the position where the Tail Stock is placed on the lathe. As in the Figure 2.

Figure 2. Tail Stock

Based on the shape and size of the Tail Stock, a replacement design for the Tail Stock can be designed using a hydraulic system as shown in Figure 3.

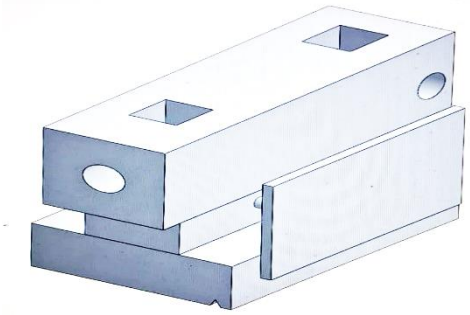
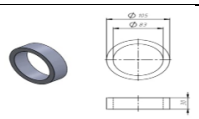
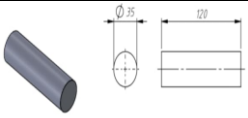
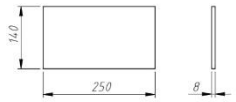
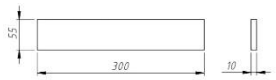
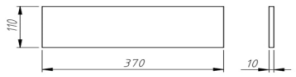
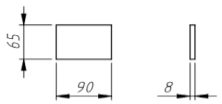
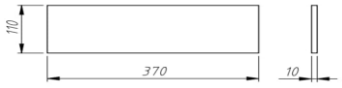
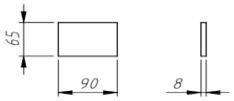


Figure 3. 3D Drawing

Drawing and Work Process

In the process of making a hydraulic press tool (actuator) there are several things that need to be considered, namely: preparing materials, preparing the tools/machines to be used, understanding the work diagram and following the sequence of work steps.

NO	Draw	Work
1		Saw Machine Lathe Welding machine
2		Saw Machine Lathe
3		Saw Machine Milling machine Welding machine
4		Saw Machine Milling machine Welding machine

5		Saw Machine Milling machine Welding machine
6		Saw Machine Milling machine Welding machine
7		Saw Machine Milling machine Welding machine
8		Saw Machine Milling machine Welding machine
9		Saw Machine Milling machine Welding machine
10		Saw Machine Milling machine Welding machine
11		Saw Machine Milling machine Welding machine
12		Saw Machine Milling machine Welding machine

The production process carried out is the sawing process (raw materials), the turning process, the grinding process and finally the welding process. Once completed, the next step is to assemble the hydraulic press machine, namely installing the piston and lathe chuck.

Figure 4. Hydraulic Press Machine

Hydraulic System

The circuit used in the hydraulic system functions as a press.

NO	Component Name	Size	Information
1	Hydraulic cylinder	Dp: 85mm, Dst: 30, Stroke: 200 mm	*Double Acting Cylinder*
2	steering valve	*Hand Path* Type	4/3

3	Hydraulic pump	10 MPa (1000 Mpa)	*Gear Pump*
4	Flexible Hose	3/8 inch	SAE 100 R2 DI
5	Hydraulic tank	40 liters	
6	Electric motor	3 *phase AC*	1HP, 1400RPM
7	Appropriate	*MPT Double Nipple*	3/8 inch

The designed hydraulic system looks like Figure 5.

Figure 5. Hydraulic System

This study uses the CHIA-GA lathe on the Unesa lathe because it has a mechanical brake system that becomes an electric brake where when braking the spindle stops and cuts off the electric current to the electric motor to prevent overloading as shown in Figure 6.

Component	Specification
Brand	CHIA, GA
Spindle speed	1800 Rpm
Tailstock travel	100mm
Tail taper	MT 3
Electric motor	1 HP

Figure 6. The System

a. Stages of friction welding process:

1) Adjustment of hydraulic press tool with lathe chuck. In this adjustment, two pieces of tapered iron are used which are clamped in the hydraulic press chuck and clamped in the lathe chuck which is set in the middle, namely parallel to the two sharp angles with the distance between the specimens to be tested for welding.
2) Tighten the bolts and nuts so that the hydraulic press machine does not move or shift as in Figure 7.

Figure 7. Setting Center

3) Friction welding process.
4) The lathe rotation setting is 1800 Rpm.
5) Adjust the hydraulic pump pressure on the hydraulic press by adjusting the valve lever and pressure gauge.
6) Mount both specimens in the chuck of the press tool and the chuck of the lathe.
7) The welding process is by turning on the lathe with the desired rotation of 1800 Rpm and the position of the chuck on the press tool does not rotate, attach it to the surface of both ends of the shaft then move the valve lever slowly forward to create friction pressure which will result in heating the surface of both specimens by providing pressure called tempering pressure so that a connection occurs between the two specimens. After the connection occurs, wait a few seconds then the lathe is run. brake and turn off the lathe and remove the welding specimen as shown in Figure 8.

Figure 8. Friction Welding Process

The stages of testing specimen material are as shown in the table.

Table 1. Specimen Material

NO	Material	Example	Diameter	Long	Rpm	Time
1	St 41	1	20	100	1800	30
2	St 41	2	20	100	1800	30
3	St 41	3	20	100	1800	30
4	St 41	4	20	100	1800	30

Discussion

Based on friction welding testing, the results obtained are:

NO	Example	Picture
1	1	

2	2	
3	3	
4	4	

From the friction welding results using the hydraulic press tool design (actuator), it can be concluded that there must be improvements in the binding of the hydraulic press tool holder to the lathe bed because the design for the bed holder is made the same as the Tail Stock holder and the influence of hydraulic pressure (Forging) prevents burning of both shafts in the friction welding results.

CONCLUSION

The overall result of the friction welding machine design process can be concluded that the design of this friction welding machine is designed as follows:

1. Hydraulic press tool (actuator).
   There is a design improvement because the fastener connecting the actuator to the lathe bed is not tight, the design is adjusted to the tail stock of the lathe machine
2. Hydraulic System

NO	Component Name	Size	Information
1	Hydraulic cylinder	Dp: 85mm, Dst: 30, Stroke: 200 mm	*Double Acting Cylinder*
2	steering valve	*Hand Path* Type	4/3
3	Hydraulic pump	10 MPa (1000 Mpa)	*Gear Pump*
4	Flexible Hose	3/8 inch	SAE 100 R2 DI
5	Hydraulic tank	40 liters	
6	Electric motor	3 *phase AC*	1HP, 1400RPM
7	Appropriate	*MPT Double Nipple*	3/8 inch

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welding (friction welding, FW) the joining process occurs due to the heat generated by heating between two metal surfaces. In *Seminar Proceedings*.

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