

Design and Fabrication of a Multi-Spindle Tapping Machine for Embedded Automotive Cable Brackets

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ABSTRACT – The manufacturing industry in carrying out the production process has the target of achieving high productivity, good quality products and efficiency. Many factors have direct and indirect influence in realizing optimal production processes. Currently, every employee is responsible to ensure fulfilment of high efficiency in every task assigned without exception. For this reason, a multi spindle tapping (MST) was designed, developed and successfully fabricated from a single spindle tapping for embedded automotive cable brackets application. For this success, the production department of an automotive based manufacturing company has improved its production efficiency with monetary benefits of about one hundred and fifty million rupiahs each month.

1. INTRODUCTION

Today's manufacturing companies are being challenged for efficiency on a large scale due to the increase in the standards requirements of raw material and other parts. For this reason, every department within the company is required to innovate and develop steps and strategies to improve efficiency. Otherwise the company will have to cease operations or relocate to another place that is more likely to allow the company to manufacture products at better efficiency.

In an automotive manufacturing sector, there exist demand for multiplying production of cable brackets in particular of motorcycles. As for this reason, a task has been assigned by *PT. Katsuyama Finetech Indonesia* to conduct a design and development process of a multi spindle tapping (MST) machine ([1], [2]) capable of fabricating four products in one machine operation in a single mass production line. Productivity increases up to four times which can lead to both positive and negative impacts to the production process. Of course, manufacturing companies can increase efficiency, but on the other hand, it will also lead to a reduction in power. This will be returned to the company's policy in manufacturing production.

Main challenges that are expected in production of four products once the machine is realised are: to consistently maintain the standard quality of the desired product; availability and ease of interchangeability of

the two jigs for two distinct products named *kojo* and *koro* availability of spare parts especially for gears and shafts; and supply chain to the company's sub-count convenient when demand for the products increases. These challenges can be overcome with good anticipation and collaboration among all parties involved

2. METHODOLOGY

Figure 1 shows overview and activities of the process sequence design flow for the multi spindle tapping machine including the assembly drawings, fabrication of component parts machined until trial session by the prospective user.

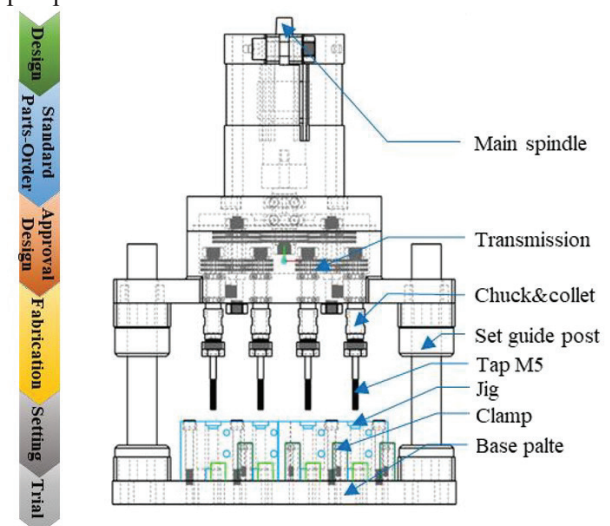


Figure 1 Overview of Multi Spindle Tapping

The machine design was based on the company requirements for a multi spindle tapping machine from existing single tapping configuration. Survey was conducted whereby the outcomes served as initial design requirements for the multi spindle tapping machine. With approval of *PT Katsuyama Finetech Indonesia*, the tapping process applied the gear transmission (gearbox) concept was later fabricated at *CV Surya Utama Sejahtera* with parts standard being bought in parallel. Settings, adjustments, and testings

were then performed at PT Cipta Unggul Karya Abadi. Trials were conducted involving products of *kojo* and *koro* respectively until the product quality meet the quality of automotive parts standard.

3. DESIGN AND FABRICATION OF MULTI SPINDLE TAPPING MACHINE

Figure 2 shows the basic design concept that employed a simple gear transmission system ([3], [4]) with 2:1 ratio comparison. Table 1 lists the main parts and the origins of the Multi Spindle Tapping.

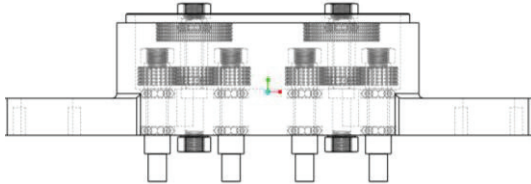


Figure 2 Gear Ratio of MST

Table 1 Parts provider

Parts	Provided by
Main arbor	User
Guide post 2 sets	Misumi, import
Koyo bearings	Supplier
Tapping Chuck 4 sets	Supplier
Main gear set	Own fabricated
Transfer gear, 2 sets	Own fabricated
Driver gear, 4 sets	Own fabricated
<i>Kojo</i> jig set	Own fabricated
<i>Koro</i> jig set	Own fabricated
Housing set of device	Own fabricated

Figure 3 shows the product trails of the MST machine. The production capacity was determined based on the variable number of products that are tapped divided by the variable time of the machine operation as shown in equation 1 ([4]).

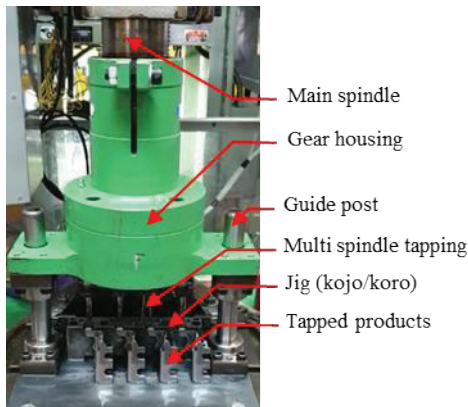


Figure 3 Product trials on MST Machine

$$WC \text{ of MST} = \frac{Nlt}{Tt} \quad (1)$$

where: WC of MST = working capacity of MST
 Nl = number of leaves threaded (pieces)
 Tt = testing time (minute)

Equation (1) theoretically calculates the production capacity of the MST machine at 1440 pieces per hour.

4. RESULT AND DISCUSSION

Figure 4 shows a GONOGO thread plug used for the measurement of the trial products. Table 2 lists the results of two product trials for *kojo* and *koro* products



Figure 4 GONOGO Thread Plug

Table 2 Experimental results

Trials	1	2	4	4	5	6	7	8	9
<i>Kojo</i> (pcs.)	1	2	3	4	4	4	4	4	4
Results	No	No	No	Go	Go	Go	Go	Go	Go
<i>Koro</i> (pcs.)	1	2	3	4	4	4	4	4	4
Results	No	No	No	Go	Go	Go	Go	Go	Go

The “No” results indicated failure test results while “Go” indicated the success of the GONOGO thread plug application. Results obtained conclude that the MST machine is capable to perform multi-piece operation with good success.

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