

# **Design of Automatic Sleeve for Transfer Nut Clutch using Programmable Logic Controller**

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## **ABSTRACT**

The equipment transfer press products after processing that controlled by Mitsubishi Programmable Logic Controller (PLC) FX0-20MT is one manifestation of the application of the theory has been obtained regarding the automation control system using Programmable Logic Controller to control the pneumatic system. This switching device made on a machine press operator aims to replace the dangerous task and less effective if it is done manually by humans, which move products from the dies after the press as well as the presence of these tools can help to increase production capacity expected by firms. The operation of this simulator to do after being given power and ready to operate, so the system has a high work rate as in the working process does not require a relatively long time as in a matter of minutes or hours. The transfer nut clutch system is automated using Programmable Logic Controller have been able to make effective use of energy by increasing the amount of production to 470,000 pieces per month initially only 180,000 pieces per month. To ensure operator safety, the safety sensor mounted on press machines and machining operations using two start buttons.

**Keywords:** automatic control, machine press, Programmable Logic Controller, transfer nut clutch system

## **INTRODUCTION**

One of the components contained in a motorcycle clutch is the clutch nut. Coupling nut type 261-04E06-00S serves as a binder or a unifying component in the clutch. To produce these components must go through several stages, where the main stage is the formation of the coupling nut material or printing the form of sheet plate coil in the press with a mold (dies) that have been established (design) with a size so that the material can be shaped nut plate type clutch 261-04E06-00S. The process uses a machine press 160 Ton AIDA type. In order to increase production capacity, product removal process after the press is still done manually should be converted into an automated process. Problems experienced in producing clutch nut manually, operators quickly exhausted because the production process is still manual and done repeatedly.

Based on the data obtained from the production department in May to June of 2010, produced a special nut production has yet to reach its target of a standard, 450,000 pieces per month. Based on the above background, the authors conducted a study related to the development of control systems on the stamping press machine. How to make the tools of production that can replace the role of the operator in the process of moving the nut products after the press. How to improve the coupling nut production in the press and ensure operator safety during conditions that are not in accordance with the standards of the work tool. How to create a

system of controls on the transfer tool nut products if there is an error in the process of working tools. How does coupling nut removal product after the press can be run automatically without having to be done by the operator. Previously, we have researched about control system by using PLC (Syahril, A & Meylati, N, 2012; Syahril, A& Cokro, S, 2012). In addition, we have also research about communication control using GSM (Global System for Mobile Communication) SIM300C and Microcontroller PIC 16F877 (Syahril, A, Muhammad, H, & Arum Y, 2010).

## 2. METHODOLOGY

Research methodologies in this study were:

- Observation Field. That process of collecting data with direct observations in the field, studying and analyzing the situation on the ground, and find problems and data processing problems to find solutions to these problems.
- Bibliographical Studies. Research methods for obtaining data from books, papers, and other literature sources to get the basics of the theory behind the product transfer equipment manufacturing special nuts.
- Interview. The process of obtaining data by direct questioning by the competent authorities to provide information about the data that is needed. This activity is carried directly to the operator, group leaders, and supervisors about the condition and existing problems.
- Design, manufacture, and testing of the system. The process of determining the design development and testing tools transfer nut products specifically tailored to the tasks of stamping machines that get the best design to be implemented in the machine.

### Clutch Nut Products

Nut on automotive components precisely motorcycle clutch components used in motor vehicles serves as a unifying bond or other component parts found in a motor vehicle clutch. Figure 1 shows coupling nut 261-04E06-00S on a motorcycle clutch.



**Figure 1.** Coupling nut 261-04E06-00S on a motorcycle clutch

### Press material Process

press material process is the running such as sheet material roll width 40 mm plate that begins from uncoiled machine that serves as stretching rolls of material, when touching the sensor plate material feeder machine will pull the nut plate material 261-04E06-00S to measure the distance that has been adapted with size (setting) coupling nut products on the machine feeder. After that, the sheet material will be pressed so that the coupling nut products 261-04E06-00S.

### Operating mode Aida 160 Ton Press Machine

- Inch mode. How to operate the machine manually press.
- One cycle mode (single mode). How to operate a machine press is by one full rotation (360<sup>0</sup>) and press the 2 key once operation of the machine, if the second operation button is not pressed the machine will stop.

- Auto Mode. How to operate continuously press machine, provided the machine has spun a full one-time (360<sup>0</sup>). If the 2 button is not pressed, the operation of the machine press machine continues to run.

### Basic Concept Design Tool Product Shifters (Automatic Sleeve)

Design tools transfer coupling nut products 261-04E06-00S (arm automatic) based on the increase of the demand for these types of nut products and there are problems in the production process i.e. making process of the product is still press machine dies manual (taken by the operator) that throw production time with the result that production is not maximized. To avoid the risk of accidents by implementing manual processes in decision and move nut products after the press then be made a tool that can replace the assignment operator in the decision and move nut products.

### The processes of production before a product removal tool coupling nut 261-04E06-00S

- Manual: the product after the press was taken from the dies and transferred to the product container operator, using the "inching mode" in the operation of the machine press each round process stop.
- Given the output of the relay to the solenoid as wind settings for the product launch of dies using a "one-cycle mode" that his process must hold 2 running the engine, if the button is released or not pressed then the process stops.

### Press Machine

Press machine used to produce the coupling nut is a type of machine presses 160 Ton AIDA. That the machine can work automatically, then use other automated machines to assist the production process such as: uncoiler machine that serves as stretching material, and machine feeder that serves to pull the material through a process of press material. This machine has been the unity of the working process press machine. Figure 2 shows the schematic of press machine.

But the processes of making the clutch nut products rely on the operator to be done manually which takes product already pressed and then move it to container production. While the process has been automated using tools and product transfer loop sensor that delivers the signal from the sensor that goes into the product and then the signal is received by Digital Cam PS-701 (control signal) if the signal has been entered in accordance with the setting of the output cam product on PS- 701 then the process continues, but if no signal is received products to PS-701 the engine will automatically emergency stop (stop), and the production process stops. The process is highly automated safety for machine operator's safety, rather than the operator shall take the product and process with the workings of the machine manually presses for the production of low or minimal levels of safety.

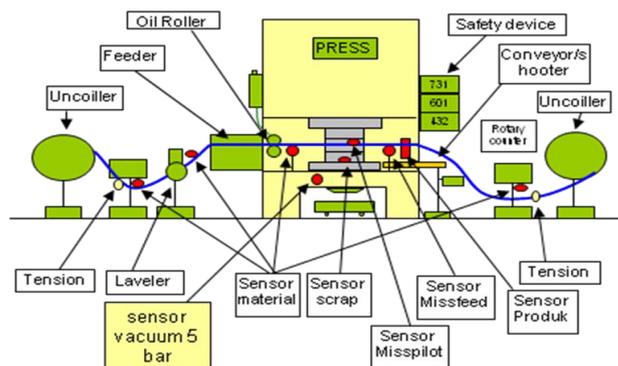
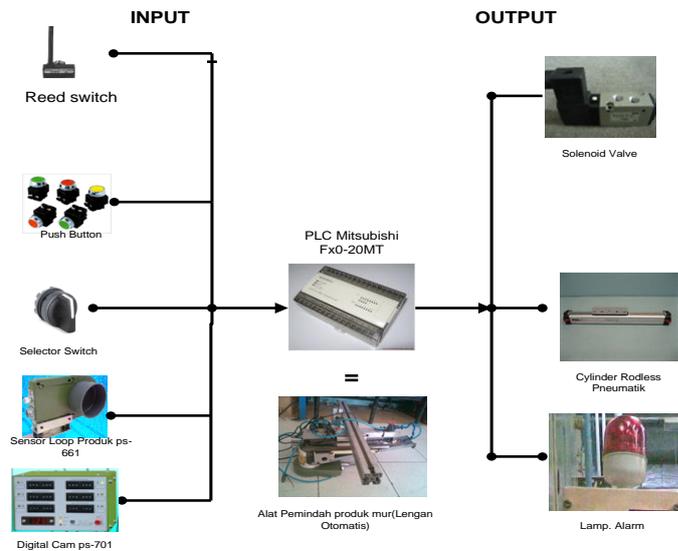


Figure 2. The Schematic of Press Machine

## Control System Design

Designing the control system transfer tool nut products tailored to the concepts that have been made, with the aim of replacing the operator's role in the removal of the product. Figure 3 shows the design of the control system transfer tool products.



**Figure 3.** The design of the control system transfer tool products

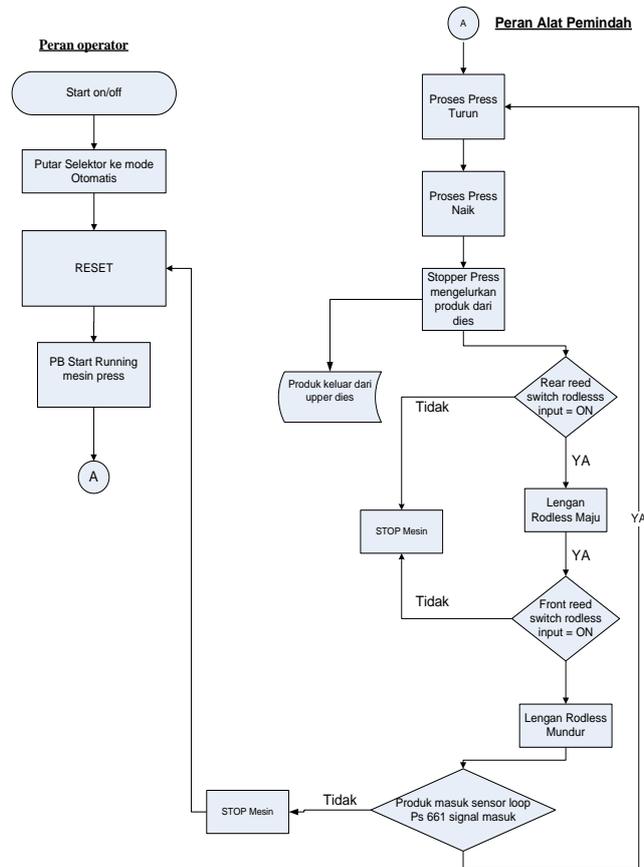
## Mover Tool Nut Products (Automatic Sleeve)

Shifters tool coupling nut products are tools that operate automatically, it is because the process is controlled by using PLC Mitsubishi type Fx0-20MT. As the name implies, this tool was made to move the product from the product material dies after experiencing the press. Figure 4 shows the tool coupling nut products Mover 261-04E06-00S.



**Figure 4.** The tool coupling nut products Mover 261-04E06-00S

The work process equipment is governed by sequences in synergy with machine press. These devices are controlled using a PLC while not using a press machine PLC control. Plate material products into the press dies according to the distance set by the machine feeder. Then, the material having the press, after the signal from the encoder rotary engine in accordance with the value set on the ps-701 (digital cam). As input PLC, automatically switching devices is going forward to take a product that is still present in upper dies. Products will fall on the transfer tool dies after upper stopper mounted on the machine press. We make the transfer tool to assist in the production of the clutch nut with Mitsubishi PLC control using FX0-20MT type, then there are significant changes to the process of production press the clutch nut with the engine type AIDA 160-ton press. Figure 5 shows the process flow coupling nut production 261-04E06-00S.



**Figure 5.** Flow coupling nut production process 261-04E06-00S

Before starting mass production using the auto mode, the operator should have tried doing the clutch nut production to produce a good product quality standard. In this process, the operator uses inching mode press machine. After getting the product, then the operator can run the automated process by: operators enable auto selector press machine, then turn on auto mode for product transfer equipment (automatic arms transfer products). Rod-less cylinder will move back and forth when the digital cam ps-701 that serves to read the signals from the rotary encoder engine speed by reading the previous machine has been set up. Digital cam ps-701 rev encoder reading press machine will provide input signals to the PLC program so cylinder rod-less will move forward and move backwards. If the magnet is detected by the sensor rod-less cylinder reed switch located on the front and back of the product and the transfer apparatus rod-less error occurs when the forward and backward, then press machine will stop. The production process will automatically continue to run if the sensor detects the product loop signal sensor products that enter the loop. If not, then the process stops production in the absence of the input signal from the sensor loop (sensor products) to 661 ps (safety device). If an error occurs, then the operator what to do is to press the reset button to restore to its original state, and then press the button to restart the machine running the production process.

### 3. RESULTS AND TESTING

Programs that have been made to go through the testing phase, both hardware and software. The purpose of this test was to find a variety of potential failures in the production process or in the system control. The percentage of error is usually found on a wired connection, sensor, or actuator. Testing the PLC program to transfer tools work processes nut products (auto arm switching products) include: test input, test output, auto testing program, testing program and

manual.

### Input Testing

How to test the input device can be done in two ways: by connecting the PLC to the personal computer and with a direct view through the existing status LED on the PLC. On the PC or the status LED, we can monitor the input is entered into the PLC. Tests conducted by pressing the push button, turn selector switch, and activate the reed switch sensor products and the product transfer equipment. Here is a table that can be used in testing the product input switcher tool to check the functionality of each device connected to the PLC. Table 1 shows hail input device testing program transfer tool products.

### Output Testing

Just as the testing input, output testing can also be monitored via a PC or status LED that exist in the PLC. Tests conducted by giving input to the solenoid which serves to move the rod-less cylinder. By way of giving input, it can be output to the PLC. Table 2 shows the results of testing the output of the program transfer tool nut products.

**Table 1**

The results of the testing program input switcher tool products

<b>Input Address</b>	<b>Explanation</b>	<b>Function</b>	<b>Good</b>	<b>NG</b>
X000	Proximity cylinder rod-less front	Indicator cylinder rod-less back	✓	-
X001	Prox. Cylinder rod-less rear	Indicator cylinder rod-less forward	✓	-
X002	Manual Button	Manual operation	✓	-
X003	Reset	Reset internal error	✓	-
X004	Digital Cam	Indicator signal encoder rotary press machine	✓	-
X005	On-Off	On -off tool	✓	-
X006	Selector switch Auto	Mode auto	✓	-
X007	Inching	Inching process	✓	-
X011	DH.Up Signal	Signal continue prod. Auto	✓	-
X012	Selector switch Single	Mode single	✓	-
X013	Sensor product signal	Indicator signal sensor loop	✓	-

**Table 2**

Output device testing program transfer tool products

<b>output Address</b>	<b>Explanation</b>	<b>Function</b>	<b>Good</b>	<b>NG</b>
Y000	Alarm Indicator	Lamp Emergency	✓	-
Y001	Solenoid rod-less	Cylinder rod-less forward	✓	-
Y003	alarm	Machine indicator off	✓	-

### Cycle Time Testing

Once the tool automatically switching products designed to help improve the production process that uses nut clutch press machine in the early stages of the production process, the cycle time to produce the nut must be tested. This test is to see how long it takes transfer

press machines and tools to produce nut products per pieces by using the formula velocity = SPM struck per minute. Standard high speed press machine for producing clutch nut is 35 Spm, 1 minute to produce = 30 pieces = 2 seconds to 1 product. In the manual process, requiring a relatively longer time is 6-10 seconds to produce 1 product. With the tools of production to move the coupling nut products, the production targets to maximize the achievable nut products, 450,000 pieces per month. By calculation: workmanship 16jam per day = 2 Shift produces approximately 20,000 pieces per day clutch nut products. If done during the 24 days, the number of products (product quantity) is = 20,000 x 24 days = 480,000 pieces per month. Based on the calculation of production when production has reached the target month but has not been able to achieve a job that should have been a month to reach 480,000 pieces per month with this tool can only reach a maximum production of 460,000 pieces per month has reached the target month, but has not yet reached production should is 480,000 pieces production yield reached 85%, due to production time 8 hours should only be done 6-7 hours because there is a process engine maintenance, component installation, maintenance dies, and the trial before mass production process.

Calculation of production:

30 x 60 minutes = 1800 pieces | 1800 x 14 hours = 25 200 pieces | 25,200 x 24 = 604,800 pieces per month.

### **Mover Tool Testing Products**

In this assay test in the movement of transfer tool nut products (arm automatic), whether it is in accordance with the design and process flow as shown in Figure 5, which had been planned before construction. Testing is done by operating press machines and tools transfer products (arm automatic) in manual mode and automatic mode and press the buttons that you want to test and see the results, according to Input Output devices that have been in the wiring and programmed the PLC Mitsubishi Fx0-20MT. Table 3 shows result of the mover tool product testing.

**Table 3**  
Result of the mover tool product testing (arm automatic)

<b>Testing</b>	<b>Action</b>	<b>Standard</b>	<b>Result</b>	<b>Test Point</b>
Mover Tool to move forward manually	Pressing the forward button	Move forward	Move forward	X002 = ON
Shifters tool can work continuously (automatic)	Rotate the selector switch in Auto mode	Work continuously, without operator pressing the running	Work automatically	X006 = ON M3 = ON

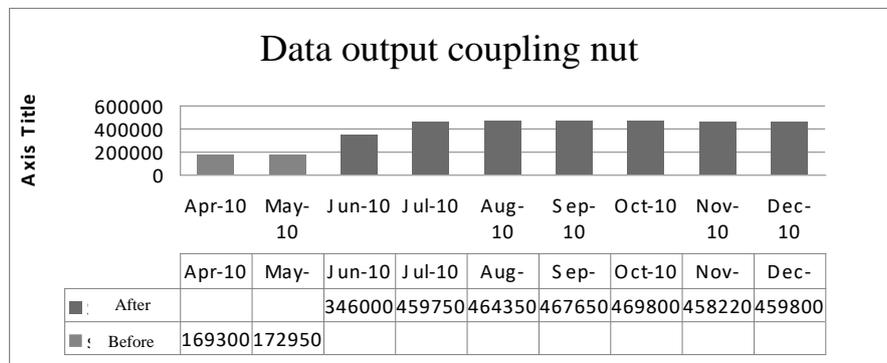
### **Testing the Program**

In this test, the test is whether or not the program that created the tools to operate the transfer product, and if it is in accordance with the work function of the tool. Testing is done by running the necessary functions to operate the tools (automatic arm) as well as the feedback given to the operator if there is an error in the process.

### **The Output Data of Coupling Nut 261-04E06-00S with Automatic Mover Tool**

Figure 6 shows the data produced by automatic transfer tool. In Figure 6, with the establishment of production tools for the removal of the nut products after the press showed positive results consistent with the objectives before the instrument is made. An increase in product output coupling nut 261-04E06-00S in June until December 2010 production results

even exceed the target per-month, 450,000 pieces per month. Dies very supportive condition factor of production because if dies in good yield may exceed its production target of coupling nut 261-04E06-00S per month. The production process is done 16 hours a day 2 in 8-hour working shift its (1 shift) produces about 10,000 pieces coupling nut products press machine spin speed is 30 SPM. Working time-shift operator per 8 hour clean time yet to do the production, because the operator 8 hours working time is reduced with the installation of coil plate material products, checking production machinery and tools, checking the condition dies, then the trial product to product in accordance with the standards or OK and mass production feasible.



**Figure 6.** The data produced by automatic transfer tool

#### IV. CONCLUSION

The design of tool in the production process in the form of automatic arms transfer products after the press run using a mechanical arm with pneumatic and PLC control system. By using the PLC as a control tool that can work automatically and continuously in the removal of the product after the press can help to increase production capacity to 470,000 pieces per month initially only 180,000 pieces per month using a manual process done by the operator, to ensure security operator safety sensors mounted on the machine press and also to operate the machine installed 2 button start (running) engine. System control is created by using the PLC type FX0-20MT Mitsubishi type, which is used as many as 11 input consists of a sensor reed switches, push buttons, selector switches and rotary cam (digital cam) and PLC outputs consisting of as many as 3 alarm indicator in the form of emergency lighting (biken), rod-less cylinder to drive the solenoid and relay to contact emergency stop engine. A product can be run automatically by the movement of arms transfer system is controlled and programmed using a PLC with a program such as ladder diagrams that have been made in accordance with the work on the machine tool and the movement on the press.

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