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DEVELOPMENT OF PNEUMATIC TESTER FOR LIFE TESTING OF INDUSTRIAL ELECTRONIC ROTARY LATCHES

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Abstract

Since electronic rotary latches operate under difficult conditions, there is always the possibility of errors. In this study, a pneumatic test system was designed to detect these errors and reduce them to the minimum number. Electronic rotary latches may fail under conditions such as; it may not be triggered electronically, it may not be physically opened in case of load on its latch, etc. These situations should be simulated and controlled, and necessary actions should be taken. In this study, a pneumatic life test device for electronic rotary latch was studied. This device performs the mechanical locking and unlocking operations of the lock, thanks to a specially designed mechanism with a pneumatic system. Electrical locking is achieved with a signal given repeatedly within the set time. On the LCD screen, the number of repetitions can be monitored and in case of a possible error, the system stops itself and gives a warning. As a result of this study, the life test of the latch locks is carried out and the errors are observed. Based on this study, similar studies can be carried out for other locks in the future, and the study can be developed and expanded.

Keywords: Life Testing; Automation; Electronic; Rotary Latches; Pneumatic.

1. Introduction

Today, industrial locks are used for locking panels and cabinets [1] in different sectors such as automotive, white goods, data center, railway, HVAC (air conditioning plant) [2], cargo delivery points [3]. Due to sectoral needs, electronic locks, the use of which has increased in the industrial field with the development of technology, can vary in different application areas according to the needs. Along with the electronic tiling systems used in the industry; due to the necessity of application areas and environmental conditions, the life span of the locks used in the field and their resistance to external effects have gained importance [4].

In this study, it is aimed to discover possible problems beforehand by simulating the working environment of electronic locks that need to work continuously. After this study, the damaged parts of electronic rotary latches, which are formed as a result of long-term continuous work, will be determined and improvements will be made on these parts.

2. Pneumatic Tester Design and Commissioning

There was a need for a test device against the repeated use of locks. The design here has been made according to the working mechanics of the electronic rotary latches we currently use. The design with the same criteria will not be suitable for different locks. For other locks, a design with a new working mechanic suitable for that lock is required. In this study, this test device was used with a pneumatic system [5]. Pneumatic system will make continuous linear motion to lock the electronic rotary latch. One of the disadvantages of the pneumatic system can be noise, which is mostly caused by the release of used compressed air. This noise problem can be solved with noise silencers attached to the pneumatic system nozzles [6]. In this way, the noise from the pneumatic system is prevented and can continue for a long time.

2.1 Mechanical Design

In our research, the concept model was designed with the 2021 version of SolidWorks, one of the 3D design programs. (Fig.1)

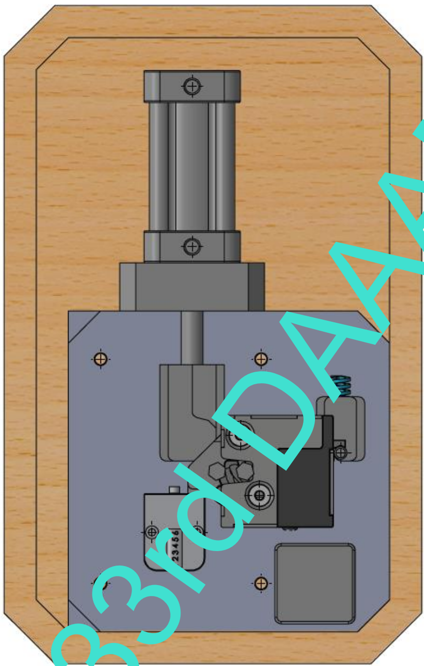

Fig. 1. Project Design Prepared in Solidworks

The concept design of the life test device consists of the following parts;
• Test platform
• Steel Bodies and Fasteners
• Piston and drive elements
• Life Test Counter
• Industrial electronic lock to be tested for life

The designed steel blocks are fixed to the test platform, and they are bearing the industrial electronic lock, piston, counter and drive elements which will be tested for life.

The industrial electronic latch lock to be tested is mounted inside the steel block in the open position. Pneumatic piston mounted on the test platform provides a pushing force with 0.3 bar air pressure and locks the electronic latch lock [7]. The process of opening the electronic lock; carried out with the electronic control card designed within the scope of the research study. The opening signal sent from the control card triggers the electronic lock and the electronic valve to open it. This on-off process is repeated continuously, and a life test is carried out. A counter has been added to the concept design to determine the number of on-off operations while the test process is in progress.

2.2 Electronical Design

The electronic board and schematic diagram of the test device are designed. Arduino Nano[8] model was used as the main processor. 1 LCD screen is used to show the necessary information and 1 buzzer is used to give the necessary warnings. The working voltage of the electronic rotary latch to be tested is 12 Volts, the operating voltage of the valve and sensor used in the system is 24 volts and the I/O's of Arduino Nano are 5 volts. 3 relays are used to control the electronic latch and valve and to control the necessary information from the sensor in a way that the processor can understand. The pins that control the electronic lock signal, the buzzer and the valve are conditioned as output, the pins used for the sensor and the switch showing the open or closed position of the latch in the electronic lock are conditioned as Input. For the electronic lock to be easily connected to the test device, a 6-pin PCB type female socket suitable for the socket of the electronic lock was selected. Screw sockets are used for easy assembly for power input and other connections. The printed circuit board (PCB) of the described electronic system is shown in Fig.2, and its schematic diagram is shown in Fig.3.

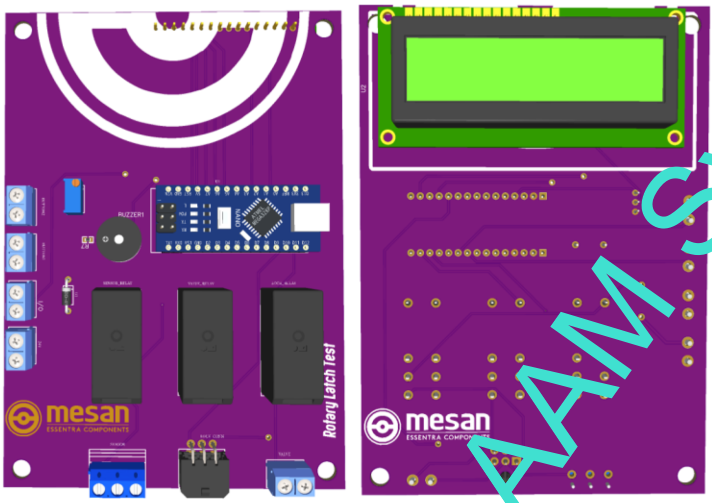

Fig. 2. PCB of tester

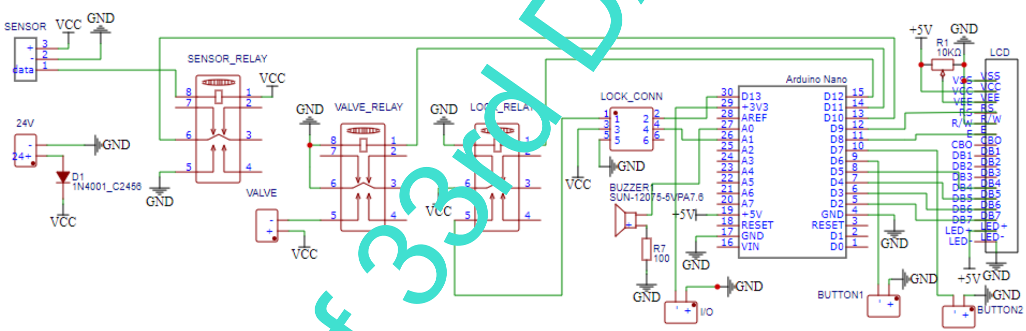

Fig.3 Schematic of tester

2.3 Software

Arduino IDE[8] was used as the programmer for the software of the system, since the microcontroller Arduino Nano was used. Electronically triggering the lock, Valve control, processing the sensor status, writing to the LCD screen, etc. Arduino Nano, which is used to perform operations, can control this process thanks to the software written for all these situations. A part of the code that prints the number of tests on the LCD screen as a result of a repetition of the system is given below.

```
#define sensor 10
#define buzzer 14

unsigned int count = 0;
#include <LiquidCrystal.h>
const int rs = 9, en = 8, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup() {
 Serial.begin (9600);
 lcd.begin(16, 2);
```

```
  pinMode(sensor, INPUT_PULLUP);

  }
void loop() {
   if (digitalRead(sensor) == HIGH) {
     lcd.clear();
     count = count + 1;
     lcd.setCursor(0, 0);
     lcd.print("Test Qty = ");
     lcd.print(count);
   }
}
```

2.4 General Structure and Operation of the System

For the system to work, the lock must be fixed to the system in the open position. When it is wanted to be operated in the closed position, the LCD screen is told to turn it on, and it cannot be operated until it is turned on. The pneumatic piston moves the part made to move the latch and locks the latch.

After locking, the pneumatic piston retracts itself. The lock is triggered electronically, and the latch opens. Latch returns the piece to its original position. Thanks to the metal sensor, it seems that this part is in the right position. When all this scenario is completed, one test is considered completed and the number of tests becomes 1. Each time this scenario completes without errors, the number of tests is incremented by 1. The locking scenario of the system is shown in Fig.4.

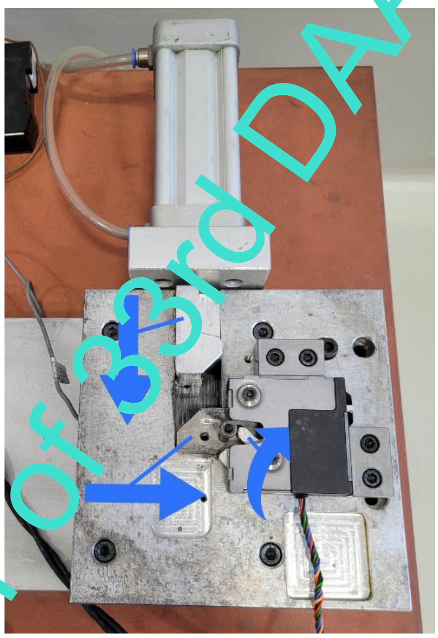

Fig. 4. Locking scenario of tester

In case of a possible error such as the spring in the lock is broken, the latch is worn out and cannot be locked anymore, it cannot be triggered electronically, "ERROR" is written on the LCD screen and the test number at the time of the error is written under the "ERROR" text on the screen. The test stops progressing so that the detection at the time of error can be made correctly. Meanwhile, the buzzer on the electronic card gives an audible warning and warns the person concerned. Error moment is shown in Fig.5. In this way, when the operator removes the electronic rotary latch from the assembly, it can be seen in which number of tests it failed.

Fig.5. Error moment

3. Conclusion

Prior to the study, there was no system for testing electronic rotary latches. As a result of a few manual tests, the locks could encounter problems in the field of use. This tester system was made in order to detect and reduce these problems in advance.

As a result of our work, we can test our electronic rotary latches and take the necessary actions according to the results. We become able to see which problems we encounter in which number of repetitions. This enables us to detect and solve problems that may arise in customers' use of electronic rotary latch.

When the results are compared with the old manual test mechanics without the tester, it is observed that the problems can be detected beforehand. In the manual testing system, it was very difficult to detect possible errors as very few repetitions were possible. With this tester, the rate of finding errors increased as a result of more repetitions. The problem addressed by the article is solved by the results represented.

For this tester, it is aimed to remotely monitor the system and the status of electronic rotary latch by adding a wi-fi module or sim card module to the electronic card in the future. This work can be used for different locks using a similar mechanism system. For other existing locks or new locks, similar developments can be made in future.

4. Acknowledgements

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5. References

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