

ISSUES DURING ASSEMBLY NEW TYPE OF ELECTRIC BRAKE PROTOTYPE AND INITIAL TESTS OF INDIVIDUAL COMPONENTS

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Abstract

In this article, the author focused on the two main issues. Firstly, the assembly phase of the new type of electric brake prototype was described and secondly author introduced the initial tests of individual components. The assembly phase of the new prototype of the electric brake was very significant. In this stage, the parts were fitted and mounted. The new functionality of new type prototype was checked and the designing was verified. If there were some mounting problems this was proper time to correct the dimensions and exchange parts. Sometimes the materials or even or heat treatment of some part were exchanged. In that kind of prototype, it was really important to check electric parts like motors during the load. The most important issue was to find the best solution. The motors weight should have been as small as possible and the nominal torque should have been enough for normal working of prototype. In the initial tests of individual components, the real parameters were tested and possibility of using the parts was checked too. During designing phase, the parameters were defined and the tests results gave the answers for the possibility of real working on the object. The most important parameters there were the motors parameters and the possibility of mechanism force transmission.

Keywords: assembly, electric brake, prototype, mounting, new designing

1. Introduction

The purpose of this article was to show preliminary phase of preparing new electric brake prototype to the main tests, where real braking conditions were imitated. The main target of the project was to create the prototype of new electric brake and prepare methodology of that kind of prototype, which could be useful in next project.

In this article author focused on the two main issues. Firstly, the assembly phase of the new type of electric brake prototype was described and secondly author introduced the initial tests of individual components. Both phases were initial steps of checking the functionality and possibility of working as a brake in real conditions.

2. Assembly of the brake

The electric brake assembly phase was very important. Firstly, the produced parts were verified and checked. Secondly, the brake was assembled. The parts were connected and movement of mechanism was checked. Later the gears were installed and the motors were fitted to them. Every mechanism had to work correctly without jams. The controlling system and emergency were prepared. All controlling cables were connected. The simple test of functionality was performed on this phase. In the Fig. 3, the electric brake was installed on the wheel with brake disc.

3. Initial tests

Initial tests of individual components were the second test phase. Firstly, the motors were connected with control system and lately the motors parameters were changed. The controller has



Fig. 1. Assembly of brake parts

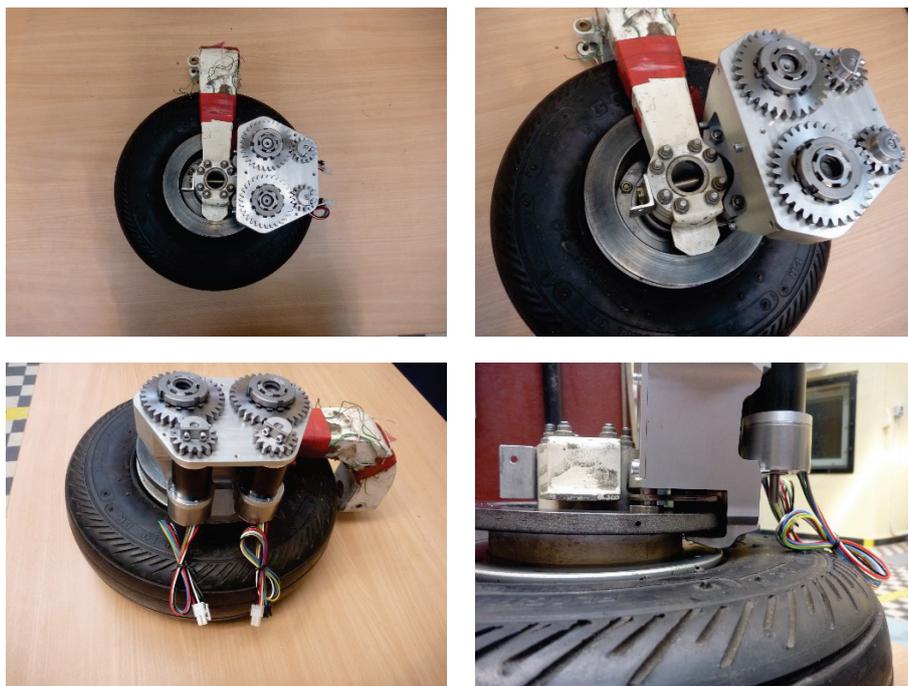


Fig. 2. The brake mounted on the lever with wheel and tire

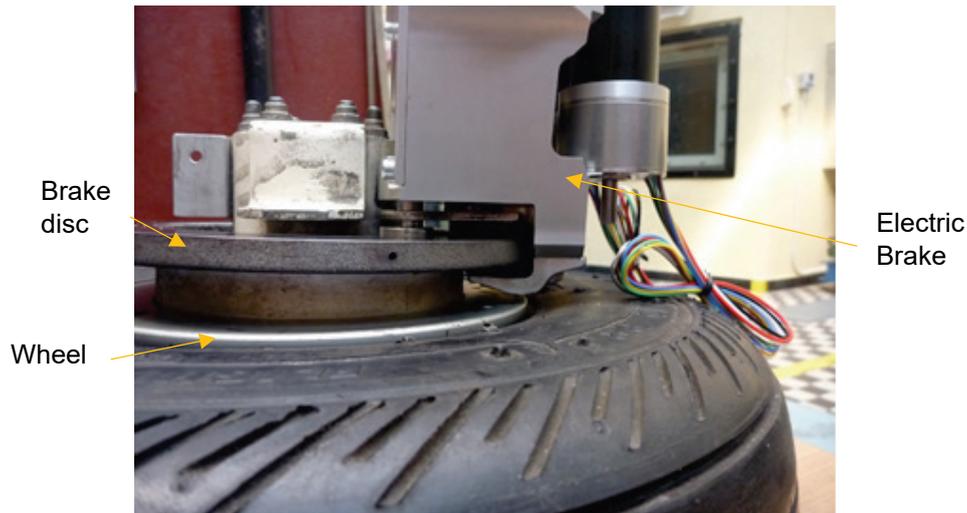


Fig. 3. Checking the force of the brake



Fig. 4. Connection the engines with control systems

protective circuits against overcurrent, excess temperature, under- and overvoltage, against voltage transients, and against short-circuits in the motor cable. Furthermore, it is equipped with protected digital inputs and outputs and an adjustable current limitation for protecting the motor and the load. The motor current and the actual speed of the motor shaft can be monitored by means of the analogue output voltage.

The motor parameters were set on special dedicated program Escon Studio. The system was launched and worked on those parameters.

Escon Studio program allow starting up and setting the parameters of the motor. The following options are available: start-up, regulation tuning, firmware update, controller monitor, parameters, data recording, and diagnostics.

Below in Tab. 1 there were measured parameters. For different rotation speed, the current was changed. As a result of the rotation speed, increase the current increased and the voltage was stable.

The current consumption was insignificant.

The second important issue was measurement of force, which the mechanism of brake could generate during braking process. The special stand was built to measure this force. For measuring the force was used force sensor range to 10 [kN] which was installed on special device. The tests were performed when the rotation speed was increased by controlling potentiometer. This resulted increased load on the piston rod. The measured force was displayed on the screen. The testing scheme is shown on the Fig. 5 and Fig. 6.

Tab. 1. Current parameters

| | Rotation speed [rpm] | Voltage [V] | Current [A] |
|---------|----------------------|-------------|-------------|
| Motor 1 | 0 | 23.3 | 0.03 |
| Motor 2 | 0 | 22.8 | 0.03 |
| Motor 1 | 2640 | 23.2 | 0.09 |
| Motor 2 | 2620 | 22.8 | 0.1 |
| Motor 1 | 7080 | 23.3 | 0.23 |
| Motor 2 | 7080 | 22.8 | 0.25 |
| Motor 1 | 10060 | 23.3 | 0.36 |
| Motor 2 | 10050 | 22.8 | 0.35 |

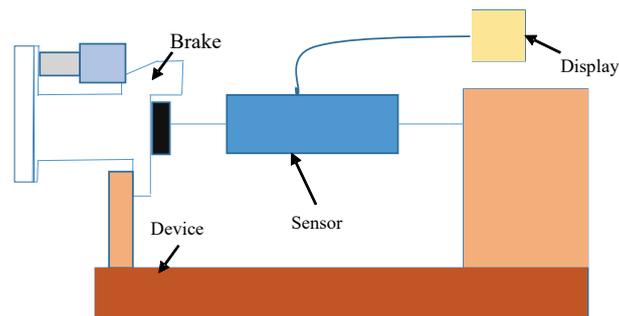


Fig. 5. Scheme of testing force of the brake

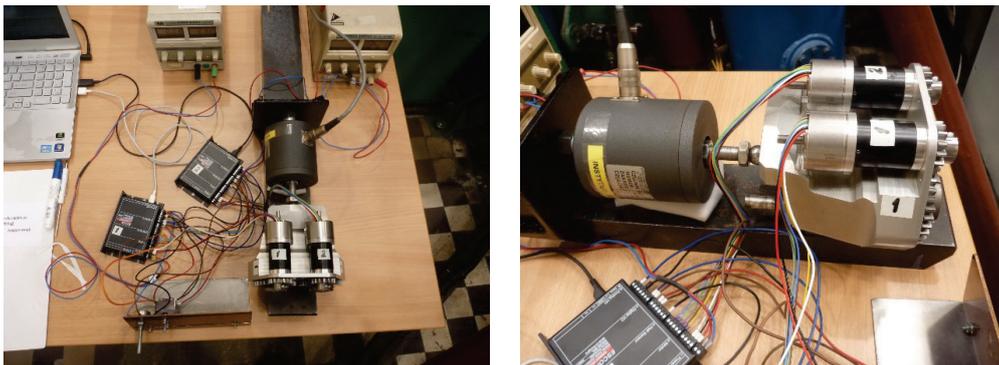


Fig. 6. Measurement system of brake force

The test stand consisted of:

- sensor with CL-14 display with measuring range 0-10 [kN],
- brake,
- device.

The engine control system was shown in the picture above (Fig. 6), while the measure force was attempted. The components of the position (device) for measuring the force were made on their own. A solution for an electric brake has been constructed.

During the tests the speed setting were increased while the force of braking were measured. The limitation of the process was the short time of the full braking. Other aspect was design of the brake where the piston stroke, extension of the traverse screw allows only for short acceleration. This aspect was rather intentional function made by designer, which allowed work on fast during the brake.

The results from test were shown in Tab. 2. The forces of the piston in brake were between about 2.8 to 3.2 [kN]. Conclusion from this the increase of motor speed affected only little on piston force. These tests were made to verify the designing assumptions, which were the result of full design and choosing the proper components.

Tab. 2. Result of brake force

| Measure 1 | Motor 1 | Motor 2 | Motor 1 | Motor 2 | Motor 1 | Motor 2 | Force [kN] |
|-----------|-------------------|---------|-------------|---------|-------------|---------|------------|
| | Motor speed [rpm] | | Voltage [V] | | Current [A] | | |
| 1 | 0 | 0 | 23.2 | 22.8 | 0.4 | 0.4 | 2.819 |
| 2 | 1500 | 1500 | 23.2 | 22.8 | 0.39 | 0.4 | 2.950 |
| 3 | 3400 | 3400 | 23.2 | 22.8 | 0.39 | 0.4 | 3.120 |
| 4 | 3400 | 3400 | 23.2 | 22.8 | 0.39 | 0.4 | 3.2 |
| 5 | 3600 | 3600 | 23.2 | 22.8 | 0.4 | 0.4 | 3.24 |
| 6 | 3070 | 3070 | 23.2 | 22.8 | 0.4 | 0.4 | 3.17 |
| 7 | 2900 | 2900 | 23.2 | 22.8 | 0.4 | 0.4 | 3.23 |

Later in the last step of tests the full-scale electric brake were tested on Młot-3T test stand in laboratory, which imitates the real braking conditions. This test allowed checking the new prototype designing in full scale in real conditions. Młot 3T tests were required to evaluate brake design and to prove the efficiency and reliability. Test stand allowed the researcher to change the parameters in order to evaluate behaviour of the brake.

In order to test the electric drive, the control system was adapted to the position, changing the length of the wires. This is also due to the safety procedures. Brakes verification is a difficult and time-consuming process due to many circumstances, which must be taken into account during tests. Brake tests should be done on many levels including laboratory tests made on samples, laboratory tests made on fully assembled brakes (Fig. 7) and finally tests made with use of fully prepared vehicle both in laboratory and in real life conditions [4]. The full-scale brake test will be described in next articles.



Fig. 7. Brake mounted on Młot 3T test stand

5. Summary

The methods of checking and verifying proper work of new prototype of electric brake was described in this article. The results only could be compared with the nearly solution but in some way the reader could see how it looks like. The tips subscribed the tests could be useful for the specialist because the practical knowledge is included in it. The initial tests of individual

components were shown and results presented. These methods seem to be simple but there is very significant to have possibility in future to compare with different solutions. These methods in new kind of prototype are innovative and based on designer experience and knowledge.

The laboratory simple tests allowed of making assumptions for optimization of the brake in efficient and cost-effective way. The suitable parameters of electric motors were chosen and set to the main tests. Test results and new design will be useful in the future prototype of that kind of design.

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