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Testing device for electrical car networks*

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Abstract: One of the production steps in DSE Draexlmaier company [1], which is - besides other activities - a global player in producing electrical car networks is to make a final test of their products after manufacture process. The problem was connected with designing a mechatronic fixing and checking device for plugs of electrical car networks. The available testing device, on hand by DSE Draexlmaier, was completely analysed and simulated. The device should test the air tightness in order to make sure that the electrical isolation is waterproof. Additionally, two electrical connections should be checked during the test. The main aim of this project was to make an improvement of the whole device in order to decrease the production costs and to make it smaller than the existing one. The resulting concepts were modelled in CATIA®V5 and animated with CoCreate OneSpace Designer®2002 programs. Both assumptions were taken into consideration in the designing process and as the final result solution which serves required expectations and constitutes the basis for the possible future manufacture implementation has been achieved.

Keywords: Virtual simulation; Electrical car network; Mechatronic device

1. INTRODUCTION

One of the many activities of DSE Draexlmaier Company is production of electrical car networks with production sites all over the world. Reputable German car producing companies were supplied through a long period of time and in the future, the GM group as well. To maintain the high level of their products, the company as everyone else, has to prove the quality at the end of the production line in order that everything works fine. Therefore a testing device was introduced, along with others.

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1.1.Development

Changing technical demands and the progress in the field of car networks enforce continuing development of the existing testing sites. One step of the production line is shown in Figure 1a. The plugs and the wires were attached to the mounting platform while sensors observe the process. After connecting all plugs and wires to the network it is attached to the final testing site.

a)

b)

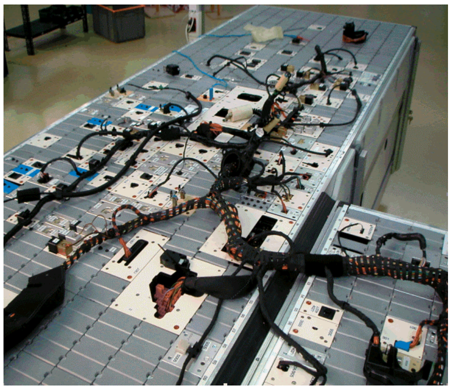

Figure 1. a) Production step of electrical car networks, b) Horizontal testing site

1.2. Testing site

During the production in company DSE Draexlmaier, two different kinds of testing sites were used. The older system, with vertical construction and a newer one with horizontal arrangement (Figure 1b). The testing devices are built in modules, which allow small manipulations without reaching the inside. The new generation of testing devices does not disturb elements above the surface while the horizontal arrangement avoids damages as well. During the production, the network remains in the horizontal position. This configuration allows a simpler attachment to the testing site.

2. DESCRIPTION OF THE TESTING DEVICE AND MECHANICAL SOLUTION

One of many available testing devices was the basis for this project. The system used to fix the plug and the other functions were analysed (FluidSIM3) [2,4,5] and documented. The following Figure 2a gives an overview of the used parts of the testing device.

In a complex car network exists many different kinds of plugs, Figure 2b shows only a few examples.

First of all the new solution should be suitable for all different kinds and shapes of plugs. It should be able to fix the plug with or without the air tightness test. The required space for the testing element should be also standardised. A cheap solution is to produce the force for moving the part in at least one direction by a spring. This principle is implemented by using a single-acting cylinder. The existing solution needs energy during the whole test to fix the plug, despite the fact that compressed air is cheap. From the energy point of view, it would be better to fix the plug with a spring and insert energy to the system only for releasing the plugs.

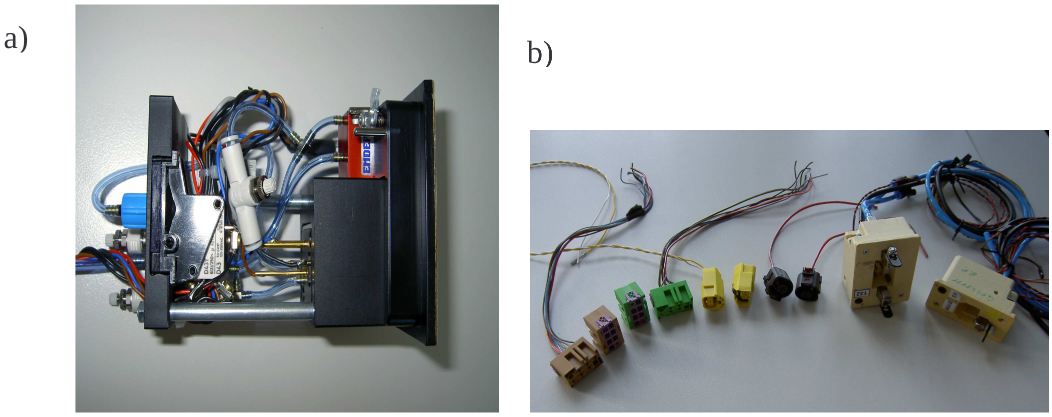

Figure 2. a) Used testing device, b) Different plugs and two old testing devices

The first realisation of the swivel bar is shown in Figure 3a. The rotating axis is placed in the centre of the plug. The dotted lines show the centre plane. The mentioned triangular shape allows the usage of the same element for all different kinds of plugs, only the position of the rotation axis has to be modified to the certain plug in order to make sure that the right part of the swivel bar is entering the inlet. The second realisation to achieve the normally closed setup is shown in Figure 3b.

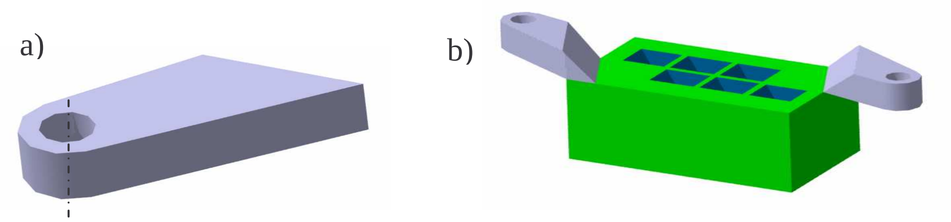

Figure 3. a) Swivel bar, b) Solution proposal

Similar to the old system, the plug has to remove the bar before it is able to enter the inlet. If the plug touches the bar, it starts a rotational movement and it will leave the empty space of the inlet. The centre plane is again symbolised by dotted lines. As soon as the plug reaches its final position, the spring presses the bar into of the inlet, the plug returns to the initial position and the plug is fixed by the swivel bar.

2.1. Construction suggestion of swivel bar

The reference plug and two swivel bars to fix it are shown in Figure 3b. If the plug reaches the slanted surface, the swivel bars would move around their rotation axis that is symbolised by the drilling.

As mentioned earlier, the plug has to be underneath the surface and this could cause a problem for removing the plug. The simplest solution would be to produce two openings, which allows the operator to grab it. Another way to deal with this problem is to attach a replacement part as shown in Figure 4. By operating the opening and a little further movement, the slanted surface causes the plug to be lifted leading to better accessibility.

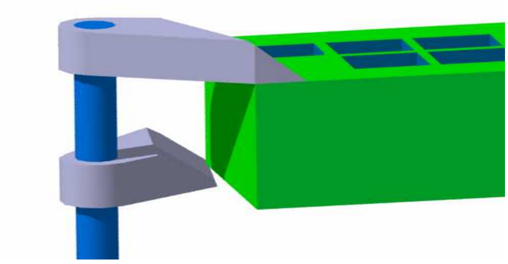

Figure 4. Swivel bar concept with replacing element

In order to generate needed force to move swivel bar and release a plug would be the use of an actuator made of a nickel-titanium alloy. Under the brand name FLEXINOL [3], the company Dynalloy sells these wires in 5 different diameters. At room temperature, FLEXINOL wires are easily stretched by a small force, which could be done by the spring that is already used to operate the fixing element. However, when heated to above their transition temperature either by a source of heat or by a small electric current, they change to a much harder form and the wire returns to its un-stretched length: The wire shortens with a useable amount of force which can be applied to unlock the plug.

3. CONCLUSIONS

The combination of a swivel bar and the FLEXINOL wire is the simplest and cheapest solution. The requirement of universal usage and the functional requirements are solved by introducing the solution with the swivel bar. The space problem is generally solved by introducing the principle of force transferring by rotational axle.

The implementation of the replacement mechanism would result in lower replacement time, provide easier work for the operator, thereby increasing the productivity.

The main aim was probably the reduction of the costs. The replacing of the pneumatic system to fix the plug with FLEXINOL-wire leads to a seriously costs decrease.

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