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SELF-GUIDING JAWS FOR GRIPPING COMPOSITE SPECIMENS AT THE TENSILE-TORSION TEST

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Abstract: *In the past decades the usage of composites materials in industries met an important growth. If initially composites materials were directly associated with aerospace industry, nowadays more and more products and applications are tailored to various composites (e.g. automotive, pharmaceutical, food industry). The validation of composites in the specific application is mostly based on tests; which subject materials to various mechanical loads.*

Often, these tests are requested and controlled by standards which are checking the material performance in a certain direction (e.g. static tensile strength test). The purpose of this paper work is to present an idea of a set of jaws which combines the tensile with torsion load, the movements being given strictly by the device geometry.

Keywords: *composites, tensile, torsion, jaws, device*

1. INTRODUCTION

Composite materials have a large area of applicability, therefore the testing in various mechanical load conditions are often encountered, from static loads to cyclic loads, hereby the literature mentioning studies, for example, correlated to SMC (Sheet Molding Compound's), short chopped fibbers embedded in the material matrix, subjected to the mechanical stresses [1-3]. For a good predictability of testing results the mechanical properties of materials could be determined using the analysis with finite elements [4-5]. It has been observed among all made researches [6-10] a certain preference of using carbon and glass fiber as fillers in the tested materials [11-12]. Composites structures containing thermoplastic resins and natural material has been researched in various load condition [13-17].

2. DEVICE WORKING PRINCIPLE – COMPONENTS DESCRIBTION

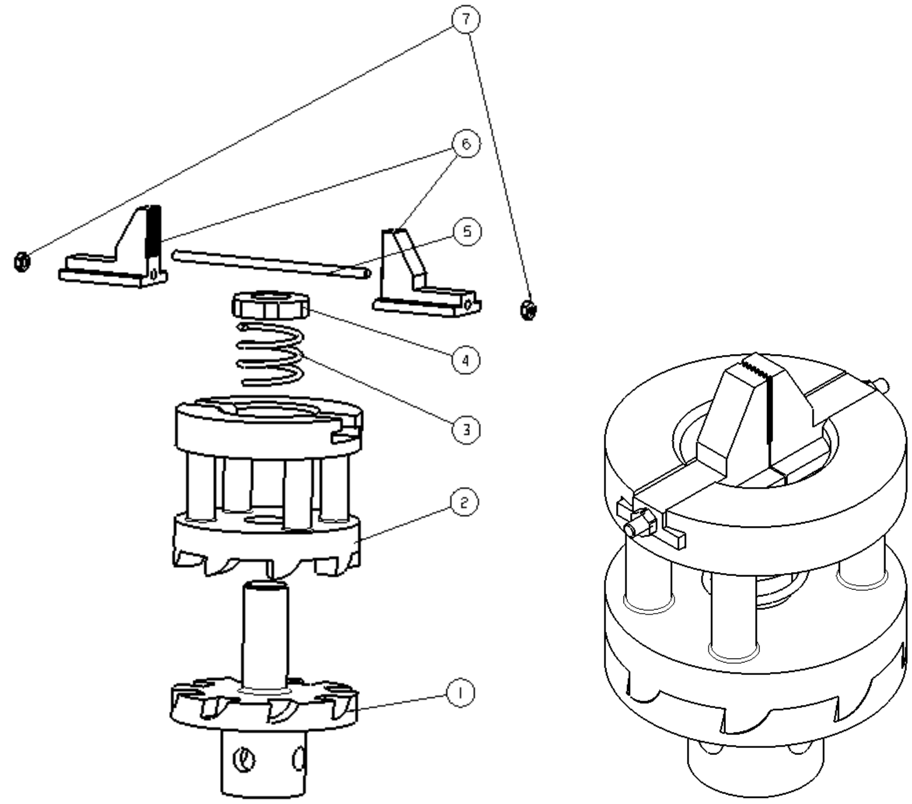
The purpose of the self-guiding jaws device is to use the displacement given by the tensile machine when testing, converting part of linear motion in rotation, through a cam type mechanism. As shown in Table 1 and Figure 1 a), the assembly contains a fixed support 1, on which is a threaded rod, a guide 2 and helical return spring 3. The spring is hold in position by the M48 nut 4. On the guide, gripping jaws 6 are sliding through the rail cut-outs. The position of jaws on the sliding axis is given by threaded rod 5 and the two M8 nuts placed at the end of each sides.

The working principle has been shown in Figure 2, a) and b); the pulling force lift the guide to a defined height "a" in the same moment linear motion being converted into rotation, the guide teeth sliding through the guides defined in the fixed support. The rotation induces a torque in the device hence the tested specimen is endeavor to withstand traction and twisting in the same time, as shown in Figure 3.

Table 1: List of components

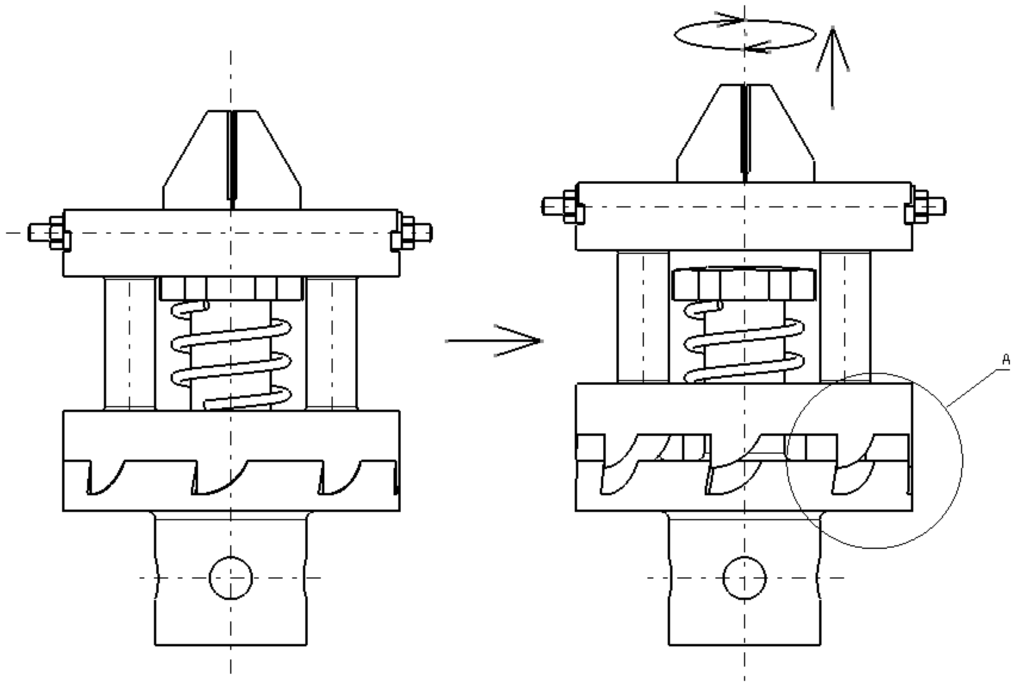
Position	Item
1	Fixed support
2	Guide plate
3	Helical spring
4	M48x1.5 Nut
5	M8x1.5 rod
6	Sliding jaws
7	M8x1.5 nuts

The return spring has to allow guide plate displacement with distance “a”, has to assure the returning in the initial position of the guide plate and has to assure, by maximum of compression, that guide plate never exceed distance “a” and comes out of contact with the fixed support. Hence the spring dimensioning starts with the maximum deflection allowed “δ”.



a) b)

Figure 1: a) tensile-torsion device exploded assembly view; b) tensile-torsion device isometric view



a) b)

Figure 2: Working principle; a) initial condition; b) after pulling force is applied

The spring deflection δ is determined using formula expressed by relation (1):

$$\delta = \theta \frac{D_m}{2} = \frac{8F_t D_m{}^3 n}{Gd^4} \quad (1)$$

$$\delta < a \quad (2)$$

Where:

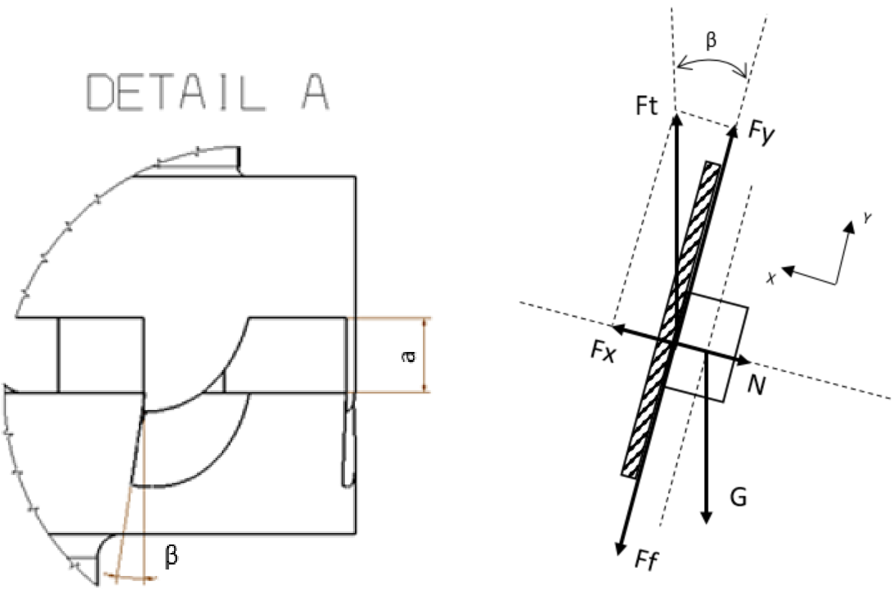
F_t - pulling force;

G – Modulus of rigidity;

n –number of turns;

d –wire diameter;

D_m -winding diameter;



a) b)

Figure 3: Sliding move **-**vectors decomposition

$$N = F_x \quad (3)$$

$$F_x = F_t \times \sin \beta \quad (4)$$

$$F_f = \mu \times F_t \times \sin \beta \quad (5)$$

$$M_r = N \times r \quad (6)$$

Where:

r -guide plate radius;

μ -friction coefficient;

M_r -developed torque;

3. CONCLUSION

This paper work proposes a technical solution for a set of jaws which are self-guiding in tensile-torsion test conditions, where linear motion is converted to rotation. The compound loads are the closest to the real life structure functioning. The torsion load given by the guide plate is directly influenced by the attack angle β and by the normal force N, friction forces not being considered in this work.

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