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Interlacing Metallic Filaments by Rotational Permanent Magnetic Field

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Abstract: In this paper the feasibility of interlacing current-carrying metallic (conductive) filaments in a rotational permanent magnetic field is investigated. The work contains two parts. Firstly, the effect of magnetic forces on current-carrying metallic filaments in a rotational permanent magnetic field is theoretically studied. In addition, the behavior of a filament under magnetic forces is mechanically analyzed. Secondly, in accordance with the theoretical analysis, a prototype of the proposed system is designed and tested. The experimental results prove the capability of the method to interlace metallic filaments. The proposed method can be employed as a kernel in order to reach a frictionless twister system for other conductive filaments.

Keywords: Metalic filament, Interlacing, Permanent magnet, Rotational magnetic field

Introduction

In recent years, applications of conductive yarns in textile products are widely developed especially in electronic and smart clothing [1]. Combinations of textile structures that are lightweight, flexible, strong, and conformable with electronics have aroused keen interest from many disciplines. With technological innovations appearing in both textile and electronics, integration of these has started giving benefits. Innovations like electrical blankets and heating jackets [2], wearable electronics [2], textile based antennas [3], life-shirts [4], wearable music players [5], and smart shirts [6,7], just to name a few.

Textiles used for clothing should be flexible and elastic in order to achieve a high comfort of wearing. However, there are some general difficulties in using metallic filaments as conductive materials in textiles for clothing. When metallic filament yarns are woven into a fabric, they feel slippery to touch and clammy when worn next to the skin. These filaments can not be twisted by conventional twisters to get curl because of a high friction between metallic filaments and twisters.

The main idea for doing this work is to exert twist to metallic filaments by a mechanism which can operate without any twister. Thus, filaments are not abraded in twist zone.

Methodology

By considering the electrical conductivity of filaments and the effect of rotational magnetic field on a wire with electrical current, it seems that the principle of rotational magnetic force on current-carrying wires can be employed to interlace conductive filaments. As illustrated in Figure 1, a rotational magnetic field is produced by revolving two strong rectangular permanent magnets.

The magnets are placed on two separate adjustable aluminum holders to be able to change the distance between them. The holders along with magnets are placed on a revolving plate to form the required rotational magnetic field. In Figure 2, the metallic filaments, which are carrying opposite currents, are fed between the rotational permanent magnets.

The forces induced in the filaments by the rotational magnetic field interlace the filaments. These induced forces are:

- magnetic force between two current-carrying filaments,
- magnetic force between current-carrying filaments and rotational magnetic field,

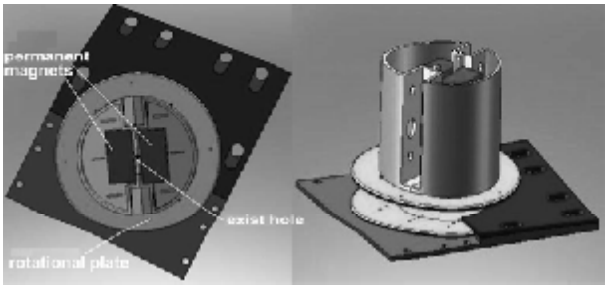

Figure 1. Unit designed for interlacing metallic filament.

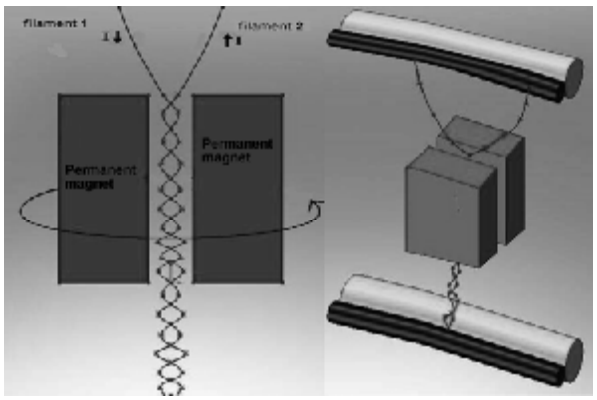

Figure 2. Schematic of interlacing zone.

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