Magnetic Ring-Spinning Revolutionizing the Tradition

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In today's spinning technology, at least 4 types of spinning systems are commercially available. These are the traditional ring spinning, rotor spinning, air-jet spinning and friction spinning. Among them, ring spinning stands alone in providing high quality yarn suitable for any type of textile end product. Other more recent systems enjoy much higher production speed than traditional ring spinning, but yarn quality restricts their use to only narrow ranges of textile products. The primary technological limitation of ring spinning lies in the speed of the ring-traveler system. The traveler is a C-shaped thin piece of metal that is used for a limited period of time, disposed and replaced on a frequent basis. Three specific issues must be addressed to overcome this limitation:

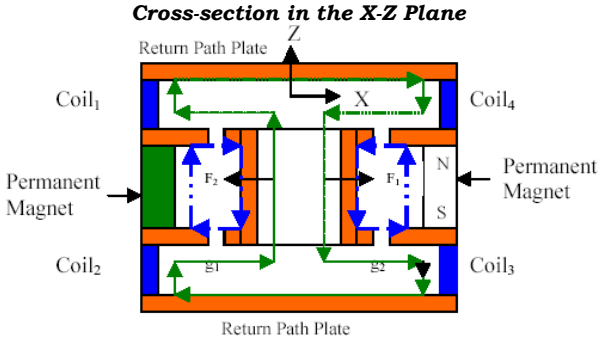
- the dependence of the yarn linear speed (or delivery speed) on the rotational speed of the traveler
- the continuous need to stabilize yarn tension during spinning and the dependence of this stability on the traveler speed
- the impact of traveler speed on fiber behavior in the spinning triangle

Research to date has only provided about a 15% improvement in traveler speed without affecting the traveler/ring contact thermal load capacity. Ring spinning is still at a production rate disadvantage of 15 to 20 times in comparison with other spinning systems. Therefore, the challenge is how to break the traditional paradigm of ring spinning and revolutionize its principle in such a way that very high speed can be achieved without sacrificing the traditional quality of ring spun yarns.

Our design approach is to totally eliminate the traveler from the ring spinning system and replacing it with a magnetically suspended lightweight annular disc that rotates in a carefully pre-defined magnetic field (See Figure below). By creating a non-touching environment of the rotating element for ring spinning this system provides super high spinning rotation without the limitations of the current traveler system.

By replacing the traveler in ring spinning with a disc that rotates in a magnetic field, we hope to maintain the high quality of ring spun yarn, but at much higher speeds.

Magnetic Ring Spinning System
Cross-section in the X-Z Plane



In the magnetic ring spinning system a bias flux is generated from both permanent magnets across the air gap (shown in blue paths in Figure above), supporting the weight of the rotating disk in the axial direction. In case the floating ring is displaced from its central position, the permanent magnets will create a destabilizing force that attracts the ring even further away from the center. The control system will read out this deviation from the center position, using two displacement sensors mounted radially to the floating ring, and generate a current signal to the power amplifiers. The power amplifiers supply the electric coils with current to generate a corrective flux (green dotted path in Figure). This corrective flux subtracts and adds to the fluxes caused by the permanent magnets. By subtracting flux at the small gap side and adding flux at the large gap side, the total magnetic force will tend to bring the floating ring to its central position. We have now constructed the first prototype (See Photo below) and are optimizing its performance.

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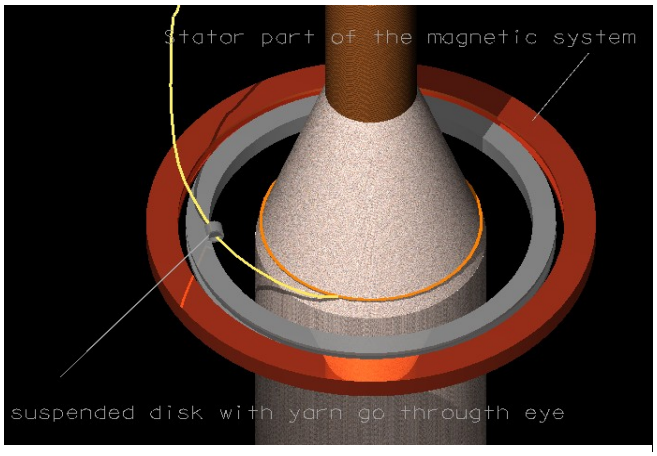
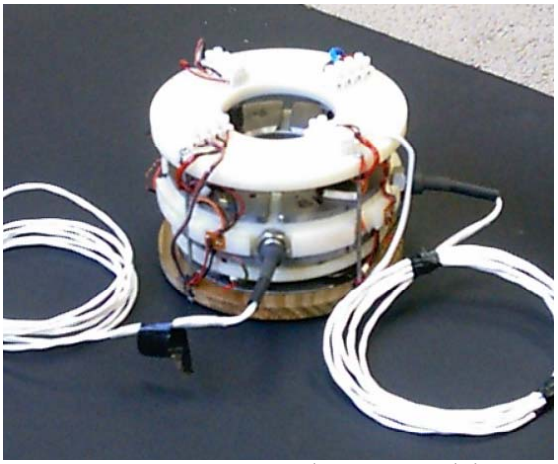


Close View of Magnetically Suspended Spinning Ring



First Prototype Control System Model

Industry Interactions: 2 [Unifi, Velcro]
Academic non-NTC Interactions: 2

Project Web Address:
http://www.eng.auburn.edu/~fhady/Magnetic-report-2002.pdf

Patent:
1. *Magnetically Elevated Ring Spinning System* has been assigned disclosure number AU#02-035 on 23 Sep 2002. See http://ott.auburn.edu/ringspinning.htm

For Further Information:
2. El Mogahzy and Chwning, Fiber-To-Yarn Engineering (Book-in-Press) (2000), El Mogahzy, Beltwide Proceedings, 1997, 1999, 2000, and El Mogahzy, EFS Research Forum, 1995, 1998, and 1999, Stalder, Textile Asia, 1991, Lord, EFS Research Forum, 1998
3. Y. El Mogahzy, and F. Abdel-Hady, *New Spinning Technologies in the Context of the Role of Fibers*, Annual Textile Institute Conference, Cairo, Egypt (March 2002).

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