Partial No-insulation (PNI) Winding Technique for Premature-Quench-Free MRI and NMR Magnets
Technology #16137

Applications

This invention has applications in magnetic resonance imaging for medical diagnostics as well as nuclear magnetic resonance imaging for biomedical research.

Problem Addressed

Low-temperature superconducting (LTS) magnets are the dominant type of magnets used in magnetic resonance (MR) imaging devices in both clinical and research settings. However, the low thermal stability of existing LTS magnets make them susceptible to prematurely losing superconductivity, or quenching, due to the propagation of localized temperature increases. This not only necessitates expensive ‘training’ quenches in the manufacture of new magnets, but also results in a significant rejection rate as magnets unable to achieve stable operation despite training have to be discarded. This invention provides a novel superconducting magnet design that overcomes this limitation.

Technology

One kind of LTS magnet is made up of NbTi wire wound around a cylindrical core. The NbTi wire contains a high proportion of copper, which is necessary for thermal stabilization of the magnet. Conventionally, the NbTi wire used in the windings have an insulated coating, even though the use of non-insulated windings is known to improve thermal stability by allowing the stabilizing effect of copper to be shared between adjacent wires. Nevertheless, insulated wires were selected because magnets with non-insulated windings suffer from a delay in charging and increased resistive losses compared to conventional magnets. This invention describes a magnet design utilizing partially insulated windings that mitigates these problems while retaining most of the thermal stability benefits associated with the non-insulated design. This novel design has the potential to reduce the consumption of liquid helium -- an increasingly expensive commodity -- during the manufacturing process, and to produce lighter-weight magnets.

Advantages

- Reduces or eliminates the need of premature quenches during manufacture
- Reduces charging delay and resistive losses compared to non-insulated magnets
- Potential for lighter-weight magnets with lower copper content

Categories For This Invention:

Electronics & Circuits
Superconductors
Life Sciences
Imaging
MRI

Intellectual Property:

Partial insulation superconducting magnet
Issued US Patent
9,324,486
Partial insulation superconducting magnet
Issued US Patent
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Publications:

Partial-Insulation Winding Technique for NbTi Coils
IEEE Transactions on Applied Superconductivity
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External Links:

Francis Bitter Magnet Lab
http://web.mit.edu/fbml/iwasa.shtml

Image Gallery: