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Innovative Superconducting DC Cable Using the Longitudinal Magnetic Field Effect

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We have proposed the innovative superconducting DC cable using the longitudinal magnetic field effect. That is, the current-carrying capacity of the cable can be enhanced under a axial magnetic field produced by the current itself flowing in the inner conductor and outer shielding conductor. Because of the weak link properties in coated conductor that disturb a uniform current flow, the enhancement of the critical current density is limited. However, it was found that the current-carrying capacity can be enhanced appreciably in comparison with conventional cables by designing the structure of the cable so as to reduce the Lorentz force. This scheme can also be applied to BISCCO tapes. The optimal design for a cable with commercial BISCCO tapes will be discussed. One of the merits of this innovative cable is that the cable itself has a limiting function of fault currents. The current-carrying capacity can be enhanced by the longitudinal magnetic field. It means that, if the longitudinal magnetic field is reduced, the critical current density in the superconducting tapes is appreciably degraded, resulting in a smooth transition to the resistive state with reduction in the current. Such situation can be realized by arranging the copper conductor layers in a suitable structure that transport the current when the superconductors are in the resistive state. The possibility of the fault-current limiting function will also be discussed.

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