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A novel clamping method for resistive magnets

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High field resistive magnets are traditionally build by stacking hundreds of so-called Bitter disks together to form a coil. Nowadays, these disks have strongly elongated cooling holes, arranged in a staggered pattern that improves the distributions of hoop stresses by the Lorentz force load on the disks. Near the outer diameter one finds larger holes, round or flattened, to accommodate a tie-rod. These tie-rods assist in the assembly of the coils and are usually pre-tensioned to ensure a net compressive clamping force at the end of the coil at all times. However, at high fields the axial magnetic clamping forces dominate all other clamping forces reducing the compressive stress and the end plates to a very low value. We describe a novel clamping method that employs a water-filled, pressurised bellow that exerts a constant compressive force to the coils and due to its large stroke compensates the normal changes in coil length during operation. This new clamping method is a key element for the mechanical design of the resistive insert coils of the HFML 45 T hybrid magnet. Ultimately, the benefit of this clamping method would be the replacement of the present tie-rods by a much smaller support element that only provides the necessary support during coil stacking and magnet assembly. We expect such an element to be much smaller than the current tie-rods, thus increasing the efficiency of the coils.

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