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Conductor design for toroidal field coils of a high magnetic field tokamak TRT.

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Recently, the development of the concept project of the high magnetic field (HMF) tokamak continues in the Russian Federation. The value of the magnetic field on the plasma axis in the device is about 8 T. The maximum field on the winding of the toroidal field coils is about 16 T. The generation of a high magnetic field in a limited space of tokamak-type device with a given aspect ratio-R/a≈3.77 (R=2.15 m - the big radius of the tokamak, and a=0.57 m - the plasma "radius") leads to a significant increase in the engineering current density in the toroidal field coils. The mechanical stresses in the magnet increase accordingly. The balance between the required amounts of superconductor (HTS tape), construction material (steel), stabilizing material (copper, aluminum) and refrigerant (helium), which can be achieved in devices with a lower maximum field on the winding – Bmax≤12 T (ITER, DTT,…) becomes difficult to achieve. At the same time acceptable parameters of protective energy output should ensures, namely the maximum electrical voltage Umax≤+/-5 kV and the temperature in the "hot spot" - Tmax≤200 K. In addition, it is necessary to minimize heat losses in the stationary operation mode of the tokamak, which significantly depend on the number of current leads used in the toroidal magnet. Obviously, in each particular case, this task solves individually. In this paper, we propose original possible solutions of the problems listed above. A "cable-in-conduit" type of conductor (CICC) uses in the TRT toroidal magnetic system. The HTS cable consict of parallel non-twisted tapes, which are oriented mainly parallel to the vector of the toroidal magnetic field. The design of the conductor is developed accordance to the requirements for a real device and differs from the previously proposed by more compact dimensions.

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