The steady-state modeling of multiphase induction machines (IMs) with m phases under open-line fault conditions is usually carried out based on symmetrical component theory. Hence, the estimation of the machine characteristic curves usually involves complex mathematical calculations and inversion of high-order matrices, which complicates the analysis. Moreover, the effect of the different subspaces' impedances on the machine performance cannot be easily recognized using this modeling technique. Instead, this paper presents the first attempt to derive a simple equivalent circuit for a five-phase IM under open-line conditions that includes the effect of all subspaces in a single circuit. The derivation is carried out for both star and pentagon connections. The equivalent circuit can be a simple technique to explain the advantages obtained from a pentagon connection compared to the star connection under open-circuit faults. It can also be used to derive a simple expression for torque gain and torque ripple magnitude for different stator connections based on the circuit parameters. The derived equivalent circuits are verified using a 1-kW five-phase prototype machine.