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A metamaterial magnetic flux concentrator is investigated in detail in combination with a Halbach cylinder of infinite length. A general analytical solution to the field is determined and the magnetic figure of merit is determined for a Halbach cylinder with a flux concentrator. It is shown that an ideal flux concentrator will not change the figure of merit of a given magnet design, while the non-ideal will always lower it. The geometric parameters producing maximum figure of merit, i.e., the most efficient devices, are determined. The force and torque between two concentric Halbach cylinders with flux concentrators is determined and the maximum torque is found. Finally, the effect of non-ideal flux concentrators and the practical use of flux concentrators, as well as demagnetization issues, is discussed. © 2013 AIP Publishing LLC.

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