HEATING PLASMA FOR FUSION POWER USING NEUTRAL BEAM INJECTION

TECHNICAL FIELD

[1] This disclosure generally relates to fusion reactors and more specifically to heating plasma for compact fusion power using neutral beam injection.

BACKGROUND

[2] Fusion power is power that is generated by a nuclear fusion process in which two or more atomic nuclei collide at very high speed and join to form a new type of atomic nucleus. A fusion reactor is a device that produces fusion power by confining and controlling plasma. Typical fusion reactors are large, complex, and cannot be mounted on a vehicle.

SUMMARY OF PARTICULAR EMBODIMENTS

[2a] According to a first aspect of the present invention, there is provided a fusion reactor comprising:

an enclosure comprising a centerline running down a center axis of the enclosure;

two internal magnetic coils suspended within the enclosure and centered on the centerline, the two internal magnetic coils each having a toroidal shape;

a plurality of encapsulating magnetic coils centered on the centerline, the encapsulating magnetic coils having a larger diameter than the internal magnetic coils;

a center magnetic coil centered on the centerline and located proximate to the midpoint of the enclosure;

one or more heat injectors coupled to the enclosure; and

two mirror magnetic coils centered on the centerline;

wherein the magnetic coils are operable, when supplied with electrical currents, to form magnetic fields for confining plasma within the enclosure; and

wherein each of the one or more heat injectors is operable to inject a beam of neutral particles into the enclosure.

[2b] According to a second aspect of the present invention, there is provided a fusion reactor comprising:

two internal magnetic coils suspended within an enclosure;

a center magnetic coil coaxial with the two internal magnetic coils and located proximate to a midpoint of the enclosure;

a plurality of encapsulating magnetic coils coaxial with the internal magnetic coils, the encapsulating magnetic coils being operable to preserve the magnetohydrodynamic (MHD) stability of the fusion reactor by maintaining a magnetic wall that prevents plasma within the enclosure from expanding;

two mirror magnetic coil coaxial with the internal magnetic coils; and

one or more heat injectors operable to inject a beam of neutral particles toward the center of the enclosure.

[2c] According to a third aspect of the present invention, there is provided a method comprising:

energizing two internal magnetic coils suspended within an enclosure;

energizing a center magnetic coil coaxial with the two internal magnetic coils and located proximate to a midpoint of the enclosure;

energizing a plurality of encapsulating magnetic coils coaxial with the internal magnetic coils, the encapsulating magnetic coils being operable, when energized, to preserve the magnetohydrodynamic (MHD) stability of the fusion reactor by

maintaining a magnetic wall that prevents plasma within the enclosure from expanding;

energizing two mirror magnetic coil coaxial with the internal magnetic coils; and

injecting a beam of neutral particles toward the center of the enclosure.

[3] According to one embodiment, a fusion reactor includes two internal magnetic coils suspended within an enclosure, a center magnetic coil coaxial with the two internal magnetic coils and located proximate to a midpoint of the enclosure, a plurality of encapsulating magnetic coils coaxial with the internal magnetic coils, and two mirror magnetic coil coaxial with the internal magnetic coils. The fusion reactor further includes one or more heat injectors operable to inject a beam of neutral particles toward the center of the enclosure.

[4] Technical advantages of certain embodiments may include providing a compact fusion reactor that is less complex and less expensive to build than typical fusion