CLAIMS

1. Axial fluid machine to extract power from a working fluid moving at a supersonic speed to drive a shaft, comprising

- an annular duct with a central axis confined by an inner wall (308, 408, 501) and a concentric outer wall (409, 502), having an inlet port (301, 401, 508) at a first end of said duct for injecting said working fluid and an exhaust port (410) at an opposite end of said duct;

- at least one rotor coaxial with said annular duct and having a rotor surface that is substantially flush with said inner wall or said outer wall such that said inner wall or said outer wall is at least partly formed by said rotor surface, wherein this rotor is operatively connected to a shaft for transmitting rotational movement to this shaft;

wherein a free space is extending over at least 75% of the distance between said rotor surface and an opposite inner wall or outer wall of said annular duct,

characterized in that said inlet port (301, 401, 508) is presenting a flow direction for said working fluid that extends at least mainly parallel to said central axis, wherein said inlet port (301, 401, 508) leads directly to said annular duct.

2. Axial fluid machine according to claim 1, wherein said inlet port (301, 401, 508) has an annular cross-section and connects directly to said annular duct, wherein said inlet port (301, 401, 508) is coaxial with said annular duct.

3. Axial fluid machine according to claim 1 or 2, wherein said rotor surface is bladeless.

4. Axial fluid machine according any of claims 1 to 3, wherein said rotor surface has a surface texture that is smooth, rough (distributed or localized), porous, dimpled, wavy or any combination of such surface textures, to modify viscous interactions between the said working fluid and said rotor surface.

5. Axial fluid machine according to any of claims 1 to 4, wherein said rotor surface is provided in said outer wall of the annular duct, wherein a free side of the rotor surface is facing said inner wall.

6. Axial fluid machine according to any of claims 1 to 5, wherein said rotor surface is provided in said inner wall of the annular duct, wherein a free side of the rotor surface is facing said outer wall.

7. Axial fluid machine according to any of claims 1 to 6, wherein at least a first rotor is provided which has a rotor surface extending along said inner wall, and wherein at least a second rotor is provided with has a rotor surface extending along said outer wall.

8. Axial fluid machine according to any of claims 1 to 7, wherein upstream from said rotor surface said annular duct comprises at least an injector for a fuel and, preferably, an ignition system for initiating combustion of the working fluid comprising said fuel.

9. Axial fluid machine according to any of claims 1 to 8, being integrated into jet and/or rocket engines, incorporating a subsonic and/or supersonic combustor, with deflagration and/or detonation.

10. Axial fluid machine according to any of claims 1 to 8, being integrated into an energy production systems, incorporating a subsonic and/or supersonic combustor, with deflagration and/or detonation.

11. Method for extracting power from a working fluid wherein a flow of a working fluid is generated through an annular duct, with a central axis, from an inlet port towards an exhaust port between an inner wall and a concentric outer wall of the annular duct along an axial direction of the duct,

said flow having at least an axial velocity component along said axial direction and a tangential velocity component, wherein viscous interactions occur between said working fluid and at least one rotor surface extending flush with said inner wall and/or said outer wall when the working fluid travels through said annular duct,

wherein said viscous interactions generate a viscous drag force onto said rotor surface such that said tangential velocity component is converted into a rotational motion of said rotor surface around said central axis while said working fluid travels through said annular duct,

wherein shock waves (418) are generated in said working fluid to enhance viscous interactions between said working fluid and said rotor surface.

wherein said working fluid subsequently leaves said annular duct through said exhaust port,

wherein at least one driving shaft is powered by the rotational motion of said rotor surface.

12. Method according to claim 11, wherein said axial velocity component is larger than said tangential velocity component.

13. Method according to claim 11 or 12, wherein said working fluid is travelling through said annular duct at a supersonic speed.

14 Method according to any of claims 11 to 13, wherein said working fluid is plasma, gas, liquid or a heterogeneous combination of them.

15. Method according to any of claims 11 to 14, wherein said working fluid, having a tangential velocity component, generates a tangential viscous drag force component (417) that is acting on said rotor surface such that the latter is rotating at a tangential velocity that is lower than the tangential velocity component (403) of said working fluid.

16. Method according to any of claims 11 to 15, wherein said working fluid flows over said rotor surface in order to develop frictional forces between the rotor surface and the working fluid such that a torque is generated that is transmitted to said driving shaft.

17. Method according to any of claims 11 to 16, wherein combustion (305) of the working fluid is generated within said annular duct, in particular between said rotor surface and the opposing inner or outer wall.

18. Method according to claim 17, wherein said combustion is initiated upstream from said rotor surface.

CLAIMS

1. Axial fluid machine to extract power from a working fluid moving at a supersonic speed to drive a shaft, comprising

- an annular duct with a central axis confined by an inner wall and a concentric outer wall, having an inlet port at a first end of said duct for injecting said working fluid and an exhaust port at an opposite end of said duct;

- at least one rotor coaxial with said annular duct and having a rotor surface that is substantially flush with said inner wall or said outer wall such that said inner wall or said outer wall is at least partly formed by said rotor surface, wherein this rotor is operatively connected to a shaft for transmitting rotational movement to this shaft;

wherein a free space is extending over at least 75% of the distance between said rotor surface and an opposite inner wall or outer wall of said annular duct,

characterized in that said inlet port is presenting a flow direction for said working fluid that extends at least mainly parallel to said central axis, wherein said inlet port leads directly to said annular duct,

wherein upstream from said rotor surface said annular duct comprises at least an injector for a fuel and an ignition system for initiating combustion of the working fluid comprising said fuel.

2. Axial fluid machine according to claim 1, wherein said inlet port has an annular cross-section and connects directly to said annular duct, wherein said inlet port is coaxial with said annular duct.

3. Axial fluid machine according to claim 1 or 2, wherein said rotor surface is bladeless.

4. Axial fluid machine according any of claims 1 to 3, wherein said rotor surface has a surface texture that is smooth, rough (distributed or localized), porous, dimpled, wavy or any combination of such surface textures, to modify viscous interactions between the said working fluid and said rotor surface.

5. Axial fluid machine according to any of claims 1 to 4, wherein said rotor surface is provided in said outer wall of the annular duct, wherein a free side of the rotor surface is facing said inner wall.

6. Axial fluid machine according to any of claims 1 to 5, wherein said rotor surface is provided in said inner wall of the annular duct, wherein a free side of the rotor surface is facing said outer wall.

7. Axial fluid machine according to any of claims 1 to 6, wherein at least a first rotor is provided which has a rotor surface extending along said inner wall, and wherein at least a second rotor is provided with has a rotor surface extending along said outer wall.

8. Axial fluid machine according to any of claims 1 to 7, being integrated into jet and/or rocket engines, incorporating a subsonic and/or supersonic combustor, with deflagration and/or detonation.

9. Axial fluid machine according to any of claims 1 to 7, being integrated into an energy production systems, incorporating a subsonic and/or supersonic combustor, with deflagration and/or detonation.

10. Method for extracting power from a working fluid wherein a flow of a working fluid is generated through an annular duct, with a central axis, from an inlet port towards an exhaust port between an inner wall and a concentric outer wall of the annular duct along an axial direction of the duct,

said flow having at least an axial velocity component along said axial direction and a tangential velocity component, wherein viscous interactions occur between said working fluid and at least one rotor surface extending flush with said inner wall and/or said outer wall when the working fluid travels through said annular duct,

wherein said viscous interactions generate a viscous drag force onto said rotor surface such that said tangential velocity component is converted into a rotational motion of said rotor surface around said central axis while said working fluid travels through said annular duct,

wherein shock waves are generated in said working fluid to enhance viscous interactions between said working fluid and said rotor surface.

wherein said working fluid subsequently leaves said annular duct through said exhaust port,

wherein at least one driving shaft is powered by the rotational motion of said rotor surface.

11. Method according to claim 10, wherein said axial velocity component is larger than said tangential velocity component.

12. Method according to claim 10 or 11, wherein said working fluid is travelling through said annular duct at a supersonic speed.

13. Method according to any of claims 10 to 12, wherein said working fluid is plasma, gas, liquid or a heterogeneous combination of them.

14. Method according to any of claims 10 to 13, wherein said working fluid, having a tangential velocity component, generates a tangential viscous drag force component that is acting on said rotor surface such that the latter is rotating at a tangential velocity that is lower than the tangential velocity component of said working fluid.

15. Method according to any of claims 10 to 14, wherein said working fluid flows over said rotor surface in order to develop frictional forces between the rotor surface and the working fluid such that a torque is generated that is transmitted to said driving shaft.

16. Method according to any of claims 10 to 15, wherein combustion of the working fluid is generated within said annular duct, in particular between said rotor surface and the opposing inner or outer wall.

17. Method according to claim 16, wherein said combustion is initiated upstream from said rotor surface.