

CLAIMS

1. A process apparatus comprising:

a front end with a load opening for loading, from an exterior of the process apparatus, production workpieces into the process apparatus;

a process section with a process environment arranged for processing the production workpieces, the process section being offset at a distance from and coupled to the front end via an interior transport path configured at least for transport of the production workpieces between the front end and the process section;

a load lock between the front end and the process section with the interior transport path extending through the load lock, the load lock having, in the distance offsetting the process section from the front end, an intermediate entry with an opening shunting the interior transport path to the exterior separate from the front end; and

a predetermined interchangeable transport carrier cassette, having an interchangeable cassette frame, configured so as to be entered within the load lock from the exterior through the intermediate entry opening, the entry and removal of the predetermined interchangeable transport carrier cassette through the intermediate entry opening loads and unloads the load lock with a transport path interface that interfaces, in the load lock, the interior transport path coincident with the

predetermined interchangeable transport carrier cassette loaded in the load lock.

2. The process apparatus of claim 1, wherein the transport path interface is a non-production workpiece process component coupled to the interchangeable cassette frame and carried by the predetermined interchangeable transport carrier cassette so as to transport the transport path interface to and from the process apparatus and repeatably position, on loading of the load lock through the intermediate entry opening, the transport path interface relative to a transport plane of the interior transport path so as to interface the interior transport path with the transport path interface at the repeatable position.

3. The process apparatus of claim 2, wherein the non-production workpiece process component is interchangeably coupled to the interchangeable cassette frame with other non-production workpiece process components.

4. The process apparatus of claim 2, wherein the non-production workpiece process component is swapped from the load lock by swapping the predetermined interchangeable transport carrier cassette in the load lock with another interchangeable transport carrier cassette through the intermediate entry opening.

5. The process apparatus of claim 2, wherein the non-production workpiece process component is a consumable of a process in the process section.

6. The process apparatus of claim 2, wherein the non-production workpiece process component is a temporary shelf of the load lock.

7. The process apparatus of claim 2, wherein the non-production workpiece process component is a component of a transport device configured to transport the production workpieces on the interior transport path.

8. The process apparatus of claim 2, further comprising a deterministic coupling connected to the interchangeable cassette frame that joins the interchangeable cassette frame and the load lock with the predetermined interchangeable transport carrier cassette loaded in the load lock and effects, at least in part, the repeatable position of the transport path interface.

9. The process apparatus of claim 8, wherein the deterministic coupling kinematically couples the predetermined interchangeable transport carrier cassette and transport path interface in at least two orthogonal constraint axis relative to the transport plane and is located in the load lock with the predetermined interchangeable transport carrier cassette loaded in the load lock.

10. The process apparatus of claim 8, wherein the deterministic coupling is sealed from an interior of the load lock.

11. The process apparatus of claim 8, wherein the deterministic coupling has at least one pin dependent from the interchangeable cassette frame or the load lock and is configured so as to

matingly engage within the load lock a complementing receptacle of the load lock or the interchangeable cassette frame, and each of the at least one pin mated to each of the complementing receptacle is sealed from an interior of the load lock.

12. The process apparatus of claim 11, wherein the at least one pin includes more than one pins in a deterministic pin arrangement on the interchangeable cassette frame or the load lock that is positionally deterministic to the transport path interface carried by the predetermined interchangeable transport carrier cassette and effects the repeatable position of the transport path interface.

13. The process apparatus of claim 1, wherein the predetermined interchangeable transport carrier cassette is one or more of:

interchangeable between each of the load lock of the process apparatus,

interchangeable between the load lock of the process apparatus and another sealed or unsealed chamber of the process apparatus, and

interchangeable between the load lock of the process apparatus and another sealed or unsealed chamber of another process apparatus.

14. A process apparatus comprising:

a workpiece load chamber with a load opening for loading, from an exterior of the process apparatus, production workpieces into the process apparatus;

a process section with a process environment arranged for processing the production workpieces, the process section being offset at a distance from and coupled to the workpiece load chamber via an interior transport path configured at least for transport of the production workpieces between the load opening and process section; and

a lock chamber, between the load opening and process section, having a sealable aperture communicating with a sealed interior of the process section with the interior transport path extending through the sealable aperture of the lock chamber into the process section, the lock chamber having in the distance offsetting the process section from the workpiece load chamber, an intermediate entry with an opening shunting the interior transport path to the exterior separate from the workpiece load chamber;

wherein the lock chamber has a selectable configuration selectable through the intermediate entry opening between different predetermined configurations each having a different non-production workpiece process component within the lock chamber, the selectable configuration being effected with loading of at least one interchangeable transport carrier cassette, carrying one of the different non-production workpiece

process components, through the intermediate entry opening into the lock chamber.

15. The process apparatus of claim 14, wherein the lock chamber has a kinematic coupling that kinematically couples, substantially coincident with loading, the at least one interchangeable transport carrier cassette in the lock chamber, the one of the different non-production workpiece process components being deterministically set in a predetermined repeatable position by the kinematic coupling relative to a locating feature locating the sealable aperture with respect to the interior transport path.

16. The process apparatus of claim 15, wherein the at least one interchangeable transport carrier cassette has an interchangeable cassette frame with a mating portion of the kinematic coupling deterministically coupling the interchangeable transport carrier cassette and the one of the different non-production workpiece process components carried by the interchangeable transport carrier cassette substantially coincident with loading the at least one interchangeable transport carrier cassette in the lock chamber.

17. The process apparatus of claim 16, wherein the interchangeable cassette frame has supports connected thereto that are arranged to engage and stably hold the one of the different non-production workpiece process components carried by the interchangeable transport carrier cassette, and different interchangeable transport carrier cassettes have different

supports connected to the interchangeable cassette frame, each of the different supports being arranged to engage and stably hold corresponding different non-production workpiece process components for transport with the interchangeable transport carrier cassette and in the lock chamber with the interchangeable transport carrier cassette loaded in the lock chamber.

18. The process apparatus of claim 16, wherein the one of the different non-production workpiece process components is coupled to the interchangeable cassette frame and carried by the at least one interchangeable transport carrier cassette so as to transport the one of the different non-production workpiece process components to and from the process apparatus and repeatably position, on loading of the lock chamber through the intermediate entry opening, the one of the different non-production workpiece process components relative to a transport plane of the interior transport path so as to interface the interior transport path with the one of the different non-production workpiece process components at the repeatable position.

19. The process apparatus of claim 16, wherein the one of the different non-production workpiece process components is interchangeably coupled to the interchangeable cassette frame with other non-production workpiece process components.

20. The process apparatus of claim 14, wherein each of the different non-production workpiece process components is

configured so as to be interchangeably carried by the interchangeable transport carrier cassette and deterministically positioned by the interchangeable transport carrier cassette loaded through the intermediate entry opening in the lock chamber.

21. The process apparatus of claim 14, wherein the one of the different non-production workpiece process components is swapped from the lock chamber by swapping the at least one interchangeable transport carrier cassette in the lock chamber with another of the at least one interchangeable transport carrier cassette through the intermediate entry opening.

22. The process apparatus of claim 14, wherein the one of the different non-production workpiece process components is a consumable of a process in the process section.

23. The process apparatus of claim 14, wherein the one of the different non-production workpiece process components is a temporary shelf of the lock chamber.

24. The process apparatus of claim 14, wherein the one of the different non-production workpiece process components is a component of a transport device configured to transport the production workpieces on the interior transport path.

25. The process apparatus of claim 14, further comprising a deterministic coupling connected to an interchangeable cassette frame of the at least one interchangeable transport carrier cassette, the deterministic coupling joins the interchangeable

cassette frame and the lock chamber with the at least one interchangeable transport carrier cassette loaded in the lock chamber and effects, at least in part, a predetermined repeatable position of the one of the different non-production workpiece process components.

26. The process apparatus of claim 25, wherein the deterministic coupling kinematically couples the at least one interchangeable transport carrier cassette and non-production workpiece process component in at least two orthogonal constraint axis relative to a transport plane of the interior transport path and is located in the lock chamber with the at least one interchangeable transport carrier cassette loaded in the lock chamber.

27. The process apparatus of claim 25, wherein the deterministic coupling is sealed from an interior of the lock chamber.

28. The process apparatus of claim 25, wherein the deterministic coupling has at least one pin dependent from the interchangeable cassette frame or the lock chamber and is configured so as to matingly engage within the lock chamber a complementing receptacle of the lock chamber or the interchangeable cassette frame, and each of the at least one pin mated to each of the complementing receptacle is sealed from an interior of the lock chamber.

29. The process apparatus of claim 28, wherein the at least one pin includes more than one pins in a deterministic pin

arrangement on the interchangeable cassette frame or the lock chamber that is positionally deterministic to the one of the different non-production workpiece process components carried by the at least one interchangeable transport carrier cassette and effects the predetermined repeatable position of the one of the different non-production workpiece process components.

30. The process apparatus of claim 14, wherein the at least one interchangeable transport carrier cassette is one or more of:

interchangeable between each of the lock chamber of the process apparatus,

interchangeable between the lock chamber of the process apparatus and another sealed or unsealed chamber of the process apparatus, and

interchangeable between the lock chamber of the process apparatus and another sealed or unsealed chamber of another process apparatus.

31. The process apparatus of claim 14, wherein the lock chamber comprises one of a metrology chamber, a load lock chamber, an inspection station, an aligner station, buffer station, and transport chamber.

32. A method comprising:

providing a workpiece load chamber, the workpiece load chamber having a load opening for loading, from an exterior of a process apparatus, production workpieces into the process apparatus;

providing a process section, the process section having a process environment arranged for processing the production workpieces, the process section being offset at a distance from and coupled to the workpiece load chamber via an interior transport path configured at least for transport of the production workpieces between the load opening and process section;

providing a lock chamber, between the load opening and process section, the lock chamber having a sealable aperture communicating with a sealed interior of the process section with the interior transport path extending through the sealable aperture of the lock chamber into the process section, the lock chamber having in the distance offsetting the process section from the workpiece load chamber, an intermediate entry with an opening shunting the interior transport path to the exterior separate from the workpiece load chamber; and

inserting at least one interchangeable transport carrier cassette into the lock chamber so as to effect a selectable configuration of the lock chamber, the selectable configuration being selectable through the intermediate entry opening between different predetermined configurations each having a different non-production workpiece process component within the lock chamber, the selectable configuration being effected with loading of the at least one interchangeable transport carrier cassette, carrying one of the different non-production workpiece process components, through the intermediate entry opening into the lock chamber.

33. The method of claim 32, wherein the lock chamber has a kinematic coupling that kinematically couples, substantially coincident with loading, the at least one interchangeable transport carrier cassette in the lock chamber, the one of the different non-production workpiece process components being deterministically set in a predetermined repeatable position by the kinematic coupling relative to a locating feature locating the sealable aperture with respect to the interior transport path.

34. The method of claim 33, wherein the at least one interchangeable transport carrier cassette has an interchangeable cassette frame with a mating portion of the kinematic coupling deterministically coupling the interchangeable transport carrier cassette and the one of the different non-production workpiece process components carried by the interchangeable transport carrier cassette substantially coincident with loading the at least one interchangeable transport carrier cassette in the lock chamber.

35. The method of claim 34, wherein the interchangeable cassette frame has supports connected thereto that are arranged to engage and stably hold the one of the different non-production workpiece process components carried by the interchangeable transport carrier cassette, and different interchangeable transport carrier cassettes have different supports connected to the interchangeable cassette frame, each of the different supports being arranged to engage and stably hold corresponding different non-production workpiece process components for

transport with the interchangeable transport carrier cassette and in the lock chamber with the interchangeable transport carrier cassette loaded in the lock chamber.

36. The method of claim 34, wherein the one of the different non-production workpiece process components is coupled to the interchangeable cassette frame and carried by the at least one interchangeable transport carrier cassette so as to transport the one of the different non-production workpiece process components to and from the process apparatus and repeatably position, on loading of the lock chamber through the intermediate entry opening, the one of the different non-production workpiece process components relative to a transport plane of the interior transport path so as to interface the interior transport path with the one of the different non-production workpiece process components at the repeatable position.

37. The method of claim 34, wherein the one of the different non-production workpiece process components is interchangeably coupled to the interchangeable cassette frame with other non-production workpiece process components.

38. The method of claim 32, wherein each of the different non-production workpiece process components is configured so as to be interchangeably carried by the interchangeable transport carrier cassette and deterministically positioned by the interchangeable transport carrier cassette loaded through the intermediate entry opening in the lock chamber.

39. The method of claim 32, further comprising swapping the one of the different non-production workpiece process components is from the lock chamber by swapping the at least one interchangeable transport carrier cassette in the lock chamber with another of the at least one interchangeable transport carrier cassette through the intermediate entry opening.

40. The method of claim 32, wherein the one of the different non-production workpiece process components is a consumable of a process in the process section.

41. The method of claim 32, wherein the one of the different non-production workpiece process components is a temporary shelf of the lock chamber.

42. The method of claim 32, wherein the one of the different non-production workpiece process components is a component of a transport device configured to transport the production workpieces on the interior transport path.

43. The method of claim 32, further comprising deterministically coupling the at least one interchangeable transport carrier cassette to the lock chamber with a deterministic coupling connected to an interchangeable cassette frame of the at least one interchangeable transport carrier cassette, the deterministic coupling joins the interchangeable cassette frame and the lock chamber with the at least one interchangeable transport carrier cassette loaded in the lock chamber and effects, at least in part, a predetermined

repeatable position of the one of the different non-production workpiece process components.

44. The method of claim 43, wherein the deterministic coupling kinematically couples the at least one interchangeable transport carrier cassette and non-production workpiece process component in at least two orthogonal constraint axis relative to a transport plane of the interior transport path and is located in the lock chamber with the at least one interchangeable transport carrier cassette loaded in the lock chamber.

45. The method of claim 43, wherein the deterministic coupling is sealed from an interior of the lock chamber.

46. The method of claim 43, wherein the deterministic coupling has at least one pin dependent from the interchangeable cassette frame or the lock chamber and is configured so as to matingly engage within the lock chamber a complementing receptacle of the lock chamber or the interchangeable cassette frame, and each of the at least one pin mated to each of the complementing receptacle is sealed from an interior of the lock chamber.

47. The method of claim 46, wherein the at least one pin includes more than one pins in a deterministic pin arrangement on the interchangeable cassette frame or the lock chamber that is positionally deterministic to the one of the different non-production workpiece process components carried by the at least one interchangeable transport carrier cassette and effects the predetermined repeatable position of the one of the different non-production workpiece process components.

48. The method of claim 32, further comprising interchanging the at least one interchangeable transport carrier cassette between each of the lock chamber of the process apparatus.

49. The method of claim 32, further comprising interchanging the at least one interchangeable transport carrier cassette between the lock chamber of the process apparatus and another sealed or unsealed chamber of the process apparatus.

50. The method of claim 32, further comprising interchanging the at least one interchangeable transport carrier cassette between the lock chamber of the process apparatus and another sealed or unsealed chamber of another process apparatus.

51. The method of claim 32, wherein the lock chamber comprises one of a metrology chamber, a load lock chamber, an inspection station, an aligner station, buffer station, and transport chamber.