CLAIMS

1. An exposure apparatus that exposes an object with an exposure beam, the apparatus comprising:

a movable body which holds the object and moves along a predetermined plane including a first axis and a second axis orthogonal to each other;

a measurement system which is placed away from an exposure position where the exposure is performed in a direction parallel to the first axis that performs a predetermined measurement of the object; and

a periphery edge exposure system which is placed away from the measurement system in a direction parallel to the first axis that exposes at least some periphery shot areas of the object.

2. The exposure apparatus according to Claim 1 wherein

at least a part of an exposure operation by the periphery edge exposure system is performed in parallel with the measurement operation.

3. The exposure apparatus according to one of Claims 1 and 2 wherein

the measurement system includes a mark detection system which has a plurality of detection areas whose positions are different in a direction parallel to the second axis.

4. The exposure apparatus according to any one of Claims 1 to 3 wherein

the measurement system includes a detection device which detects positional information of the object in a direction parallel to a third axis orthogonal to the predetermined plane in a detection area extending in a direction parallel to the second axis or at a plurality of detection points whose positions are different in a direction parallel to the second axis.

5. The exposure apparatus according to any one of Claims 1 to 4 wherein

the periphery edge exposure system can simultaneously expose at least two places located apart in a direction parallel to the second axis of the object held by the movable body.

6. The exposure apparatus according to any one of Claims 1 to 5 wherein

the periphery edge exposure system has a plurality of mirror elements placed in the shape of a matrix along a surface parallel to the predetermined plane, and can perform switching of a first state in which the energy beam incident on each mirror element is reflected to a predetermined direction and a second state in which the energy beam is reflected to a direction different from the predetermined direction.

7. The exposure apparatus according to any one of Claims 1 to 6 wherein

the periphery shot areas of the object exposed by the periphery edge exposure system are shot areas which have an

area partially outside the effective area of the object.

8. The exposure apparatus according to any one of Claims 1 to 7 wherein

as the movable body, a first and a second movable bodies are provided which each hold the object and are independently movable within the predetermined plane, and the apparatus further comprises:

a controller which in parallel with exposure of an object held by one of the first and second movable bodies, performs the predetermined measurement of an object held by the other movable body of the first and second movable bodies while moving the other movable body at least in a direction parallel to the first axis, and also controls the periphery edge exposure system and exposes a shot area in the periphery of the object held by the other movable body which passes below the periphery edge exposure system while moving toward the exposure position.

9. An exposure apparatus that exposes an object with an exposure beam, the apparatus comprising:

a movable body which holds the object and is movable within a predetermined plane including a first axis and a second axis orthogonal to each other; and

a periphery edge exposure system which is arranged between an exposure position where the exposure is performed and an exchange position of the object placed away from the exposure position in a direction parallel to the first axis, and exposes at least a part of a periphery area which is

different from an area on the object where the exposure is performed, whereby

at least a part of an exposure operation of the periphery area is performed in parallel with a movement operation of the movable body from one of the exposure position and the exchange position to the other.

10. The exposure apparatus according to Claim 9, the apparatus further comprising:

a measurement system which is placed away from the exposure position in a direction parallel to the first axis, and measures positional information of the object, and

at least a part of an exposure operation of the periphery edge exposure is performed in parallel with the measurement operation.

11. The exposure apparatus according to Claim 10 wherein

the measurement system includes a mark detection system which has a plurality of detection areas whose positions are different in a direction parallel to the second axis.

12. The exposure apparatus according to any one of Claims 9 to 11 wherein

the periphery edge exposure system has a plurality of irradiation areas whose positions are different in a direction parallel to the second axis and are each irradiated with an energy beam that can simultaneously expose different areas of the periphery areas.

13. The exposure apparatus according to any one of Claims 9 to 12 wherein

as the movable body, a first and second movable bodies which respectively hold an object and are independently movable within the predetermined plane are provided, whereby

in parallel with an exposure operation of an object held by one of the first and second movable bodies, exposure of a periphery area of an object held by the other one of the first and second movable bodies is performed.

14. An exposure apparatus that exposes an object with an energy beam and forms a pattern on the object, the apparatus comprising:

a first movable body which holds an object and moves within a predetermined plane which includes a first axis and a second axis orthogonal to each other;

a second movable body which holds an object and moves independently from the first movable body within the plane;

a mark detection system which has a plurality of detection areas whose positions are different in a direction parallel to the second axis, and detects a mark on the object mounted on each of the first and second movable bodies; and

a controller which, in parallel with an exposure performed of an object held by one of the first and second movable bodies, detects a plurality of different marks of an object held by the other one of the first and second movable bodies with the mark detection system and measures positional information of the marks, while moving the other one of the

movable bodies in a direction parallel to the first axis.

15. The exposure apparatus according to Claim 14 wherein

on each of a surface substantially parallel to the plane of the first and second movable bodies, a grating section is placed in a pair at a predetermined distance in a direction parallel to the second axis with a direction parallel to the first axis serving as the longitudinal direction, the grating section having a two-dimensional grating whose periodic direction is in a direction parallel to the first axis and a direction parallel to the second axis, respectively, the apparatus further comprising:

an encoder system which has a first head section having a plurality of two-dimensional heads which are placed at different positions in a direction parallel to the second axis facing the surface substantially parallel to the plane, and measures positional information of one of the movable bodies within the plane, based on measurement values of the heads belonging to the first head section that respectively face the pair of grating sections of the one movable body at the time of exposure of an object held by the one movable body.

16. The exposure apparatus according to Claim 15 wherein

the encoder system further has a second head section having a plurality of heads which are placed at different positions in a direction parallel to the second axis facing the surface substantially parallel to the plane, and further

measures positional information of the other movable body within the plane, based on measurement values of the heads belonging to the second head section that respectively face the pair of grating sections of the other movable body at the time of mark detection of an object held by the other movable body.

17. The exposure apparatus according to any one of Claims 14 to 16, the apparatus further comprising:

a periphery edge exposure system which is placed away from the plurality of detection areas in a direction parallel to the first axis, and performs periphery edge exposure in parallel with the mark detection operation of the object.

18. An exposure apparatus that exposes an object with an energy beam and forms a pattern on the object, the apparatus comprising:

a first movable body which holds an object and moves within a predetermined plane which includes a first axis and a second axis orthogonal to each other;

a second movable body which holds an object and moves independently from the first movable body within the plane;

a planar motor which drives the first and second movable bodies within the plane; and

a controller which controls the planar motor, and also moves the first movable body along a first return path located on one side of an exposure position where the exposure is performed in a direction parallel to the second axis to a first exchange position where an object on the first movable body

is exchanged when exposure of an object held by the first movable body has been completed, as well as moving the second movable body along a second return path located on the other side of the exposure position in a direction parallel to the second axis to a second exchange position where an object on the second movable body is exchanged when exposure of an object held by the second movable body has been completed.

19. The exposure apparatus according to Claim 18, the apparatus further comprising:

an optical member which emits the energy beam; and

a liquid immersion device which supplies liquid in a space between the optical member and one of the first and second movable bodies, and forms a liquid immersion area, whereby

the controller controls the first and second movable bodies via the planar motor so that a switching is performed between a proximity state in which the first movable body and the second movable body are made to be in proximity in a direction parallel to the first axis by a predetermined distance or less and a separation state in which both movable bodies are separated, to pass the liquid immersion area from the one movable body to the other movable body after exposure has been completed on an object held by the one movable body.

20. The exposure apparatus according to Claim 19 wherein

in the proximity state in which the first movable body and the second movable body are in proximity after exposure of an object held by the first movable body has been completed,

the first movable body shifts to one side of the exposure position in a direction parallel to the second axis with respect to the second movable body, and

in the proximity state in which the first movable body and the second movable body are in proximity after exposure of an object held by the second movable body has been completed, the second movable body shifts to the other side of the exposure position in a direction parallel to the second axis with respect to the first movable body.

21. An exposure apparatus that exposes an object with an energy beam and forms a pattern on the object, the apparatus comprising:

a first movable body which holds an object and moves within a predetermined plane which includes a first axis and a second axis orthogonal to each other;

a second movable body which holds an object and moves independently from the first movable body within the plane;

a planar motor which drives the first and second movable bodies within the plane;

an optical member which emits the energy beam;

a liquid immersion device which supplies liquid in a space between the optical member and one of the first and second movable bodies, and forms a liquid immersion area; and

a controller which controls the planar motor so as to perform a switching between a proximity state in which the first movable body and the second movable body are made to be in proximity in a direction parallel to the first axis by a predetermined distance or less and a separation state in

which both movable bodies are separated, so as to pass the liquid immersion area from the one movable body to the other movable body, after exposure has been completed on an object held by the one movable body, and to move the one movable body separated from the other movable body along a return path positioned on one side of the exposure position in a direction parallel to the second axis to an exchange position where an object on the first and second movable bodies are exchanged.

22. The exposure apparatus according to Claim 21 wherein

in the proximity state, the one movable body is shifted to the one side in a direction parallel to the second axis with respect to the other movable body.

23. The exposure apparatus according to any one of Claims 18 to 22 wherein

on each of a surface substantially parallel to the plane of the first and second movable bodies, a grating section is placed in a pair at a predetermined distance in a direction parallel to the second axis with a direction parallel to the first axis serving as the longitudinal direction, the grating section having a two-dimensional grating whose periodic direction is in a direction parallel to the first axis and a direction parallel to the second axis, respectively, the apparatus further comprising:

an encoder system which has a first head section having a plurality of two-dimensional heads which are placed at different positions in a direction parallel to the second axis

facing the surface substantially parallel to the plane in the vicinity of an exposure position where the exposure is performed, and measures positional information of one of the movable bodies within the plane in the vicinity of the exposure position, based on measurement values of the two-dimensional heads belonging to the first head section that respectively face the pair of grating sections of the one of the movable bodies which holds the object subject to exposure.

24. The exposure apparatus according to Claim 23, the apparatus further comprising:

a mark detection system which is placed away from an exposure position where the exposure is performed in a direction parallel to the first axis, and has a plurality of detection areas whose positions are different in a direction parallel to the second axis, wherein

the encoder system further has a second head section having a plurality of two-dimensional heads which are placed at different positions in a direction parallel to the second axis facing the surface substantially parallel to the plane in the vicinity of the plurality of detection areas, and further measures positional information of the other movable body within the plane, based on measurement values of the two-dimensional heads belonging to the second head section that respectively face the pair of grating sections of the other movable body in the vicinity of the plurality of detection areas.

25. A movable body drive system which drives a movable

body substantially along a predetermined plane, the system comprising:

an encoder system which has a head irradiating a detection beam on a scale having a two-dimensional grating whose periodic directions are a first and a second directions orthogonal to each other within a plane parallel to the predetermined plane and receiving light from the scale, and measures positional information of the movable body at least in directions of two degrees of freedom within the predetermined plane including the first and second directions based on measurement values of the head; and

a drive device which drives the movable body along the predetermined plane based on measurement information of the encoder system.

26. The movable body drive system according to Claim 25 wherein

one of the scale and the head is placed on the movable body, and the other is placed faceable to the movable body.

27. The movable body drive system according to Claim 26 wherein

the scale is placed on a surface of the movable body substantially parallel to the predetermined plane, and the head is placed outside of the movable body faceable to the scale.

28. The movable body drive system according to Claim 27 wherein

the scale is placed on the surface of the movable body, with the first direction serving as a longitudinal direction,

the encoder system has a head unit including a plurality of the heads placed at positions of different detection points in the second axis direction, and

the plurality of the heads includes a head whose detection point in the second direction is set to a distance narrower than the width of the scale.

29. The movable body drive system according to Claim 28 wherein

the scale is placed in a pair on the surface of the movable body apart in the second direction, and

the encoder system measures positional information of the movable body in directions of three degrees of freedom within the predetermined plane, based on an output of two heads of the head unit that simultaneously face the pair of scales.

30. The movable body drive system according to Claim 29 wherein

the encoder system has a pair of the head units placed apart in the second direction, and also has at least one head faceable to the pair of scales, respectively.

31. The movable body drive system according to Claim 26 wherein

the head is placed on the movable body, and the scale is placed faceable to the movable body.

32. The movable body drive system according to Claim 31 wherein

the head is placed at different positions of the movable body in the first direction, and the scale is placed with the second direction serving as a longitudinal direction.

33. The movable body drive system according to Claim 32 wherein

the heads are placed on both sides of the movable body in the second direction, at different positions in the first direction.

34. The movable body drive system according to any one of Claims 25 to 33 wherein

the drive device drives the movable body along the predetermined plane, based on measurement information of the encoder system and correction information corresponding to positional information in a direction different from the first and second directions of the movable body at the time of measurement by the encoder system.

35. The movable body drive system according to Claim 34 wherein

the positional information in a direction different from the first and second directions of the movable body includes positional information related to at least one direction of a direction orthogonal to the predetermined plane of the movable body, a rotational direction in a surface parallel to the predetermined plane, a rotational direction around an

axis parallel to the first direction, and a rotational direction around an axis parallel to the second direction.

36. The movable body drive system according to any one of Claims 25 to 35 wherein

the drive device drives the movable body, further based on characteristics information of the head used in measurement which becomes a generation factor of measurement errors of the encoder system.

37. The movable body drive system according to Claim 36 wherein

the characteristics information includes optical properties of the head.

38. The movable body drive system according to any one of Claims 25 to 37 wherein

the drive device drives the movable body within the predetermined plane so as to compensate for measurement errors of the encoder system which occur due to the head used for measurement.

39. The movable body drive system according to any one of Claims 25 to 38 wherein

the drive device drives the movable body, further based on information related to the degree of flatness of the scale.

40. The movable body drive system according to any one of Claims 25 to 39 wherein

the drive device drives the movable body, further based on positional information of detection points of the heads used for measurement.

41. The movable body drive system according to Claim 40 wherein

the drive device drives the movable body so as to compensate for measurement errors of the encoder system which occur due to the position or displacement of the detection points.

42. The movable body drive system according to any one of Claims 25 to 41 wherein

the drive device drives the movable body, further based on positional information related to a reference surface serving as a reference of a position in a third direction orthogonal to the predetermined plane of the movable body and positional information related to a grating surface of the scale in the third direction.

43. The movable body drive system according to Claim 42 wherein

the drive device controls the position of the movable body so as to compensate for measurement errors of the encoder system which occur due to a difference of position of the reference surface and the grating surface in the third direction.

44. A pattern formation apparatus, comprising:

a movable body on which an object is mounted that can move substantially along a movement plane holding the object;

a patterning device which generates a pattern on the object; and

a movable body drive system according to any one of Claims 25 to 43 which drives the movable body for pattern formation to the object.

45. An exposure apparatus that forms a pattern on an object by an irradiation of an energy beam, the apparatus comprising:

a patterning device that irradiates the energy beam on the object; and

the movable body drive system according to any one of Claims 25 to 43, whereby

the movable body drive system drives the movable body on which the object is mounted for relative movement of the energy beam and the object.

46. An exposure apparatus that exposes an object with an energy beam, the apparatus comprising:

a movable body which can hold the object and is also substantially movable along a predetermined plane;

a measurement device which has a measurement position where a measurement beam is irradiated placed away from an exposure position where the energy beam is irradiated in a first direction within the predetermined plane, and measures positional information of the object;

an encoder system in which a scale having a

two-dimensional grating and whose longitudinal direction is in the first direction is placed on both sides of the movable body in a second direction orthogonal to the first direction within the predetermined plane, and a pair of head units having a plurality of heads whose positions in the second direction are different and at least one head faceable to each of the two scales is placed faceable to the movable body, and based on an output of two heads simultaneously facing the pair of scales, measures positional information of the movable body in directions of three degrees of freedom within the predetermined plane; and

a drive device which drives the movable body based on positional information of the object measured by the measurement device and positional information of the movable body measured by the encoder system.

47. An exposure apparatus that exposes an object with an energy beam, the apparatus comprising:

a movable body which can hold the object and is also substantially movable along a predetermined plane;

a measurement device which has a measurement position where a measurement beam is irradiated placed away from an exposure position where the energy beam is irradiated in a first direction within the predetermined plane, and measures positional information of the object;

an encoder system in which a pair of scales having a two-dimensional grating and whose longitudinal direction is in a second direction orthogonal to the first direction within the predetermined plane is placed faceable to the movable body,

and a plurality of heads whose positions in the first direction are different and at least one head is faceable to each of the two scales are placed on both sides of the movable body, and based on an output of two heads simultaneously facing the pair of scales, measures positional information of the movable body in directions of three degrees of freedom within the predetermined plane; and

a drive device which drives the movable body based on positional information of the object measured by the measurement device and positional information of the movable body measured by the encoder system.

48. The exposure apparatus according to one of Claims 46 and 47, the apparatus comprising:

a liquid immersion member which can form a liquid immersion area in a space between an optical member through which the energy beam passes and the object; and

a moveable member which can move independently from the movable body, whereby

by placing the movable member on one side of the movable body in the first direction and moving the movable body and the movable member in the first direction, the liquid immersion area is moved between the movable body and the movable member while being held in the space with the optical member.

49. The exposure apparatus according to Claim 48 wherein

the movable body is driven so that the liquid immersion area is not in contact with one of the scales and the heads

on the movable body, at the time when the liquid immersion area is moved between the movable body and the movable member.

50. The exposure apparatus according to one of Claims 48 and 49 wherein

at the time of movement of the liquid immersion area, the movable body and the moveable member are in proximity or in contact in the first direction.

51. The exposure apparatus according to any one of Claims 48 to 50 wherein

the movable member includes at least one of a measurement stage which has a measurement member and another movable body which can move independently from the movable body and can hold an object.

52. The exposure apparatus according to any one of Claims 48 to 51 wherein

the moveable member is placed on a side opposite to the measurement device with respect to the optical member in the first direction.

53. The exposure apparatus according to any one of Claims 46 to 52 wherein

the drive device drives the movable body, based on measurement information of the encoder system and correction information corresponding to positional information of the movable body in a direction different from the first and second directions at the time of measurement.

54. The exposure apparatus according to any one of Claims 46 to 53 wherein

the drive device drives the movable body, further based on at least one of characteristics information of the head and the scale which becomes a generation factor of measurement errors of the encoder system.

55. The exposure apparatus according to Claim 54 wherein

the characteristics information includes information related to at least one of optical properties of the head, position of a detection point of the head, formation error of the two-dimensional grating, and degree of flatness of the scale.

56. The exposure apparatus according to any one of Claims 46 to 55 wherein

the drive device drives the movable body so as to compensate for measurement errors of the encoder system which occur due to at least one of the head and the scale.

57. A device manufacturing method, including

exposing an object using the exposure apparatus according to any one of Claims 1 to 24 and 45 to 56; and

developing the exposed object.

58. An exposure method in which an object is exposed with an exposure beam, the method comprising:

a process in which the object is mounted on a movable body which moves along a predetermined plane including a first axis and a second axis orthogonal to each other; and

a process in which at least a part of a periphery shot area of the object is exposed, using a periphery edge exposure system placed away in a direction parallel to the first axis from a measurement system, which is placed away in a direction parallel to the first axis within the predetermined plane from an exposure position where the exposure is performed as well as performing a predetermined measurement on the object, while a movable body on which the object is mounted is moved along a direction parallel to the first axis.

59. The exposure method according to Claim 58 wherein at least a part of an exposure operation by the periphery edge exposure system is performed in parallel with the measurement operation.

60. The exposure method according to one of Claims 58 and 59 wherein

the predetermined measurement includes detecting a mark on the object using a mark detection system which has a plurality of detection areas whose positions are different in a direction parallel to the second axis.

61. The exposure method according to any one of Claims 58 to 60 wherein

the predetermined measurement includes detecting positional information of the object in a direction parallel

to a third axis orthogonal to the predetermined plane in a detection area extending in a direction parallel to the second axis or at a plurality of detection points whose positions are different in a direction parallel to the second axis.

62. The exposure method according to any one of Claims 58 to 61 wherein

the periphery edge exposure system can simultaneously expose at least two places located apart in a direction parallel to the second axis of the object held by the movable body.

63. The exposure method according to any one of Claims 58 to 62 wherein

the periphery edge exposure system has a plurality of mirror elements placed in the shape of a matrix along a surface parallel to the predetermined plane, and can perform switching of a first state in which the energy beam incident on each mirror element is reflected to a predetermined direction and a second state in which the energy beam is reflected to a direction different from the predetermined direction.

64. The exposure method according to any one of Claims 58 to 63 wherein

the periphery shot area of the object exposed by the periphery edge exposure system is a shot area which has an area partially outside the effective area of the object.

65. An exposure method in which an object is exposed

with an exposure beam, the method comprising:

a process in which a movable body that is movable within a predetermined plane including a first axis and a second axis orthogonal to each other is made to hold an object; and

a process in which at least a part of an exposure operation of the periphery area is performed in parallel with a movement operation of the movable body from one of an exposure position and an exchange position to the other, using a periphery edge exposure system which is arranged between the exposure position where the exposure is performed and the exchange position of the object placed away from the exposure position in a direction parallel to the first axis, and exposes at least a part of a periphery area which is different from an area on the object where the exposure is performed.

66. The exposure method according to Claim 65 wherein at least a part of an exposure operation of the periphery area is performed in parallel with a measurement operation by a measurement system which is placed away from the exposure position in a direction parallel to the first axis, and measures positional information of the object.

67. The exposure method according to Claim 66 wherein the measurement system includes a mark detection system which has a plurality of detection areas whose positions are different in a direction parallel to the second axis.

68. The exposure method according to any one of Claims 65 to 67 wherein

the periphery edge exposure system has a plurality of irradiation areas whose positions are different in a direction parallel to the second axis and are each irradiated with an energy beam that can simultaneously expose different areas of the periphery areas.

69. The exposure method according to any one of Claims 65 to 68 wherein

as the movable body, a first and a second movable bodies which respectively hold an object and are independently movable within the predetermined plane are provided, whereby

in parallel with an exposure operation of an object held by one of the first and second movable bodies, exposure of a periphery area of an object held by the other one of the first and second movable bodies is performed.

70. An exposure method in which an object is exposed with an energy beam and a pattern is formed on the object, the method comprising:

a process in which exposure is performed on an object held by one of a first and a second movable bodies which respectively hold an object and independently move within a predetermined plane including a first axis and a second axis orthogonal to each other, and in parallel, a plurality of different marks on an object held by the other movable body of the first and second movable bodies are detected with a mark detection system which has a plurality of detection areas whose positions are different in a direction parallel to the second axis and positional information of the marks is measured,

while the other of the first and second movable bodies is moved in a direction parallel to the first axis.

71. An exposure method in which an object is exposed with an energy beam and a pattern is formed on the object, the method comprising:

a process in which by controlling a planar motor which drives a first and a second movable bodies respectively holding an object independently within a predetermined plane including a first axis and a second axis orthogonal to each other, the first movable body is moved along a first return path located on one side of an exposure position where the exposure is performed in a direction parallel to the second axis to a first exchange position where an object on the first movable body is exchanged when exposure of an object held by the first movable body has been completed, and the second movable body is also moved along a second return path located on the other side of the exposure position in a direction parallel to the second axis to a second exchange position where an object on the second movable body is exchanged when exposure of an object held by the second movable body has been completed.

72. The exposure method according to Claim 71, the method further comprising:

a process in which the first and second movable bodies are controlled via the planar motor so that a switching is performed between a proximity state in which the first movable body and the second movable body are made to be in proximity in a direction parallel to the first axis by a predetermined

distance or less and a separation state in which both movable bodies are separated, to pass a liquid immersion area, which is formed by a liquid being supplied in a space between an optical member emitting the energy beam and one of the first and second movable bodies, from the one movable body to the other movable body after exposure has been completed on an object held by the one movable body.

73. The exposure method according to Claim 72 wherein

in the proximity state in which the first movable body and the second movable body are in proximity after exposure of an object held by the first movable body has been completed, the first movable body shifts to one side of the exposure position in a direction parallel to the second axis with respect to the second movable body, and

in the proximity state in which the first movable body and the second movable body are in proximity after exposure of an object held by the second movable body has been completed, the second movable body shifts to the other side of the exposure position in a direction parallel to the second axis with respect to the first movable body.

74. An exposure method in which an object is exposed with an energy beam, the method comprising:

holding the object with a movable body; and

driving the movable body with the movable body drive system according to any one of Claims 25 to 43, and exposing the object with the energy beam.

75. An exposure method in which an object is exposed with an energy beam, the method comprising:

holding an object with a movable body which is substantially movable along a predetermined plane;

measuring positional information of the object on the movable body at a measurement position where a measurement beam is irradiated that is placed away from an exposure position where the energy beam is irradiated in a first direction within the predetermined plane;

measuring positional information of the movable body in directions of three degrees of freedom within the predetermined plane with an encoder system in which a pair of scales having a two-dimensional grating and whose longitudinal direction is in the first direction is placed on the movable body separately in a second direction orthogonal to the first direction within the predetermined plane, and a pair of head units having a plurality of heads whose positions in the second direction are different and at least one head faceable to each of the pair of scales is placed faceable to the movable body; and

driving the movable body based on the positional information which has been measured and measurement information of the encoder system and exposing the object with the energy beam.

76. An exposure method in which an object is exposed with an energy beam, the method comprising:

holding an object with a movable body which is substantially movable along a predetermined plane;

measuring positional information of the object on the movable body at a measurement position where a measurement beam is irradiated that is placed away from an exposure position where the energy beam is irradiated in a first direction within the predetermined plane;

measuring positional information of the movable body in directions of three degrees of freedom within the predetermined plane, with an encoder system in which a pair of scales having a two-dimensional grating and whose longitudinal direction is in a second direction orthogonal to the first direction within the predetermined plane is placed faceable to the movable body, and a plurality of heads whose positions in the first direction are different and at least one head is faceable to each of the pair of scales are placed on both sides of the movable body; and

driving the movable body based on the positional information which has been measured and measurement information of the encoder system and exposing the object with the energy beam.

77. The exposure method according to one of Claims 75 and 76 wherein

exposure of the object is performed via a liquid immersion area formed in a space between an optical member through which the energy beam passes and the object, and

by placing a movable member on one side of the movable body in the first direction and moving the movable body and the movable member in the first direction, the liquid immersion area is moved between the movable body and the movable member

while being held in the space with the optical member.

78. The exposure method according to Claim 77 wherein the movable body is driven so that the liquid immersion area is not in contact with one of the scales and the heads on the movable body, at the time when the liquid immersion area is moved between the movable body and the movable member.

79. The exposure method according to one of Claims 77 and 78 wherein

at the time of movement of the liquid immersion area, the movable body and the moveable member are in proximity or in contact in the first direction.

80. The exposure method according to any one of Claims 75 to 79 wherein

the moveable member is placed on a side opposite to the measurement unit with respect to the optical member in the first direction.

81. The exposure method according to any one of Claims 75 to 80 wherein

the movable body is driven, based on the measurement information of the encoder system and correction information corresponding to positional information of the movable body in a direction different from the first and second directions at the time of the measurement.

82. The exposure method according to any one of Claims

75 to 81 wherein

the movable body is driven, further based on at least one of characteristics information of the head and the scale which becomes a generation factor of measurement errors of the encoder system.

83. The exposure method according to Claim 82 wherein

the characteristics information includes information related to at least one of optical properties of the head, position of a detection point of the head, formation error of the two-dimensional grating, and degree of flatness of the scale.

84. The exposure method according to any one of Claims 75 to 83 wherein

the movable body is driven so as to compensate for measurement errors of the encoder system which occur due to at least one of the head and the scale.

85. A device manufacturing method, the method including:

exposing an object and forming a pattern by the exposure method according to any one of Claims 58 to 84; and

developing an object on which the pattern has been formed.

CLAIMS

1. An exposure apparatus that exposes an object with an energy beam via a projection optical system and liquid, the apparatus comprising:

a first movable body and a second movable body each holding an object;

a local liquid immersion device that includes a nozzle unit having a recovery opening on a lower surface side, and supplies liquid to under the projection optical system via the nozzle unit and recovers the liquid via the recovery opening from a liquid immersion area formed with the supplied liquid under the projection optical system, the first and the second movable bodies being each placed facing the lower surface side;

a base board having a surface on which the first and the second movable bodies are placed, the surface being placed substantially parallel to a predetermined plane that is orthogonal to an optical axis of the projection optical system and includes a first direction and a second direction orthogonal to each other;

a drive system that includes a planar motor and moves each of the first and the second movable bodies from one of an exposure position and an exchange position to the other, the planar motor having a stator provided at the base board and a mover provide at the first and the second movable bodies, in the exposure position exposure of the object being performed via the projection optical system and the liquid of the liquid immersion area, and in the exchange position exchange of an object held by each of the first and the second movable bodies being performed;

a measurement system that measures positional information of the first and the second movable bodies; and

a controller that controls driving of the first and the second movable bodies by

the planar motor based on the positional information measured with the measurement system, and relatively moves the first and the second movable bodies so that toward one movable body of the first and the second movable bodies that is placed facing the projection optical system, the other movable body of the first and the second movable bodies approaches, and also moves the first and the second movable bodies that have approached each other relative to the nozzle unit so that the other movable body is placed facing the projection optical system instead of the one movable body, wherein

according to movement of the first and the second movable bodies that have approached each other relative to the nozzle unit, the liquid immersion area is moved from the one movable body to the other movable body while being maintained under the projection optical system,

a cable is connected to the first movable body from one side in the second direction, and a cable is connected to the second movable body from the other side in the second direction,

the controller controls driving of the first and second movable bodies by the planar motor so that the first movable body and the second movable body pass through return paths different from each other to move from the exposure position to the exchange position, and

the first movable body passes through a return path located on one side in the second direction with respect to the exposure position, and the second movable body passes through a return path located on the other side in the second direction with respect to the exposure position.

2. The exposure apparatus according to Claim 1, wherein

by the relative movement, the first and the second movable bodies approach each other in a predetermined direction and are placed to be shifted in a direction orthogonal to the predetermined direction, in the predetermined direction the first and the second movable bodies that have approached each other being moved relative to the nozzle unit.

3. The exposure apparatus according to Claim 1 or 2, wherein

the first and the second movable bodies that have approached each other are placed so that a positional relationship between the first and the second movable bodies in a direction orthogonal to the predetermined direction differs between replacement of the first movable body placed facing the projection optical system to the second movable body and replacement of the second movable body placed facing the projection optical system to the first movable body.

4. The exposure apparatus according to Claim 3, wherein

between the replacement of the first movable body to the second movable body and the replacement of the second movable body to the first movable body, the first and the second movable bodies that have approached each other are placed to be shifted reversed directions in a direction orthogonal to the predetermined direction.

5. The exposure apparatus according to Claim 3 or 4, wherein

in the replacement of the second movable body to the first movable body, the first movable body is placed to be shifted to one side in the direction orthogonal to the predetermined direction, with respect to the second movable body, and

in the replacement of the first movable body to the second movable body, the

second movable body is placed to be shifted to the other side in the direction orthogonal to the predetermined direction, with respect to the first movable body.

6. The exposure apparatus according to any one of Claims 3 to 5, wherein

the first and the second movable bodies that have approached each other are placed so that a positional relationship between the first and the second movable bodies in the predetermined direction is reversed between the replacement of the first movable body to the second movable body and the replacement of the second movable body to the first movable body.

7. The exposure apparatus according to any one of Claims 3 to 6, wherein

the first and the second movable bodies that have approached each other are moved in a same direction in the predetermined direction relative to the nozzle unit, in the replacement of the first movable body to the second movable body and the replacement of the second movable body to the first movable body.

8. The exposure apparatus according to any one of Claims 1 to 7, wherein

the first and the second movable bodies that have approached each other are moved relative to the nozzle unit, while a positional relationship between the first and the second movable bodies in the predetermined direction is substantially maintained.

9. The exposure apparatus according to any one of Claims 1 to 8, wherein

the nozzle unit is provided to surround an optical element of the projection optical system, the optical element contacting the liquid, and

the measurement system has a plurality of heads that are provided at each of the first and the second movable bodies, and irradiates a plurality of scales having a two-dimensional grating with measurement beams via the plurality of heads of the first movable body or the second movable body, respectively, in order to measure positional information of the first movable body or the second movable body that is moved below the projection optical system, the plurality of scales being placed around the nozzle unit to be substantially parallel to the predetermined plane.

10. The exposure apparatus according to any one of Claims 1 to 9, further comprising:

a mark detection system that is placed away from the projection optical system in the first direction, and detects a mark of an object held by each of the first and the second movable bodies, wherein

the measurement system irradiates a plurality of scales having a two-dimensional grating with measurement beams via the plurality of heads of the first movable body or the second movable body, respectively, in order to measure positional information of the first movable body or the second movable body that is moved below the mark detection system, the plurality of scales being placed around the mark detection system to be substantially parallel to the predetermined plane.

11. The exposure apparatus according to any one of Claims 1 to 8, wherein

the first and second movable bodies each have a mounting area of the object and a pair of scales that are placed on both sides of the mounting area and have a two-dimensional grating, on an upper surface side of the first or the second movable body,

and

the measurement system has a plurality of heads that are placed around the projection optical system, and irradiates the pair of scales with measurement beams via the heads that face the pair of scales, respectively, of the plurality of heads, in order to measure positional information of the first movable body or the second movable body that is moved below the projection optical system.

12. The exposure apparatus according to Claim 11, wherein

the pair of scales are each provided with a longitudinal direction in a predetermined direction, in the predetermined direction the first and the second movable bodies that have approached each other being moved relative to the nozzle unit, and

the plurality of heads include heads whose positions are different from each other in a direction orthogonal to the predetermined direction.

13. The exposure apparatus according to Claim 11 or 12, further comprising:

a mark detection system that is placed away from the projection optical system in the first direction, and detects a mark of an object held by each of the first and the second movable bodies, wherein

the measurement system has another plurality of heads that are placed around the mark detection system and are different from the plurality of heads, and irradiates the pair of scales with measurement beams via the another plurality of heads, respectively, in order to measure positional information of the first movable body or the second movable body that is moved below the mark detection system.

14. The exposure apparatus according to any one of Claims 11 to 13, wherein

the controller moves the first and the second movable bodies that have approached each other relative to the nozzle unit so that the liquid immersion area is moved from the one movable body to the other movable body without traversing the pair of scales of the first and the second movable bodies.

15. The exposure apparatus according to any one of Claims 1 to 14, wherein

the measurement system also measures positional information of the first and the second movable bodies in a third direction orthogonal to the predetermined plane.

16. The exposure apparatus according to any one of Claims 1 to 15, wherein

the exchange position includes a first exchange position and a second exchange position different from the first exchange position, in the first exchange position exchange of an object held by the first movable body being performed, and in the second exchange position exchange of an object held by the second movable body being performed.

17. A device manufacturing method, including:

exposing an object with the exposure apparatus according to any one of Claims 1 to 16; and

developing the object that has been exposed.

18. An exposure method of exposing an object with an energy beam via a projection optical system and liquid, the method comprising:

moving each of a first movable body and a second movable body from one of

an exposure position and an exchange position to the other, with a planar motor, the first and the second movable bodies being placed on a base board having a surface placed substantially parallel to a predetermined plane that is orthogonal to an optical axis of the projection optical system and includes a first direction and a second direction orthogonal to each other, the planar motor having a stator provided at the base board and a mover provide at the first and the second movable bodies, in the exposure position exposure of the object being performed via the projection optical system and a liquid immersion area, the exchange position being different from the exposure position in the first direction, and in the exchange position, exchange of an object held by each of the first and the second movable bodies being performed, and the liquid immersion area being formed under the projection optical system with liquid supplied via a nozzle unit having a recovery opening on a lower surface side, and the first and the second movable bodies being each placed facing the lower surface side; and

with the planar motor, relatively moving the first and the second movable bodies so that toward one movable body of the first and the second movable bodies that is placed facing the projection optical system, the other movable body of the first and the second movable bodies approaches, and moving the first and the second movable bodies that have approached each other relative to the nozzle unit so that the other movable body is placed facing the projection optical system instead of the one movable body, wherein

according to movement of the first and the second movable bodies that have approached each other relative to the nozzle unit, the liquid immersion area is moved from the one movable body to the other movable body while being maintained under the projection optical system,

the first movable body and the second movable body each have an object, and a cable is connected to the first movable body from one side in the second direction, a cable is

connected to the second movable body from the other side in the second direction,

the first movable body and the second movable body pass through return paths different from each other to move from the exposure position to the exchange position, the first movable body passes through a return path located on one side in the second direction with respect to the exposure position, and the second movable body passes through a return path located on the other side in the second direction with respect to the exposure position.

19. The exposure method according to Claim 18, wherein

by the relative movement, the first and the second movable bodies approach each other in a predetermined direction and are placed to be shifted in a direction orthogonal to the predetermined direction, in the predetermined direction the first and the second movable bodies that have approached each other being moved relative to the nozzle unit.

20. The exposure method according to Claim 18 or 19, wherein

the first and the second movable bodies that have approached each other are placed so that a positional relationship between the first and the second movable bodies in a direction orthogonal to the predetermined direction differs between replacement of the first movable body placed facing the projection optical system to the second movable body and replacement of the second movable body placed facing the projection optical system to the first movable body.

21. The exposure method according to Claim 20, wherein

between replacement of the first movable body to the second movable body and replacement of the second movable body to the first movable body, the first and the

second movable bodies that have approached each other are placed to be shifted in reversed directions in a direction orthogonal to the predetermined direction.

22. The exposure method according to Claim 20 or 21, wherein

in the replacement of the second movable body to the first movable body, the first movable body is placed to be shifted to one side in the direction orthogonal to the predetermined direction, with respect to the second movable body, and

in the replacement of the first movable body to the second movable body, the second movable body is placed to be shifted to the other side in the direction orthogonal to the predetermined direction, with respect to the first movable body.

23. The exposure method according to any one of Claims 20 to 22, wherein

the first and the second movable bodies that have approached each other are placed so that a positional relationship between the first and the second movable bodies in the predetermined direction is reversed between the replacement of the first movable body to the second movable body and the replacement of the second movable body to the first movable body.

24. The exposure method according to any one of Claims 20 to 23, wherein

the first and the second movable bodies that have approached each other are moved in a same direction in the predetermined direction relative to the nozzle unit, in the replacement of the first movable body to the second movable body and the replacement of the second movable body to the first movable body.

25. The exposure method according to any one of Claims 18 to 24, wherein

the first and the second movable bodies that have approached each other are moved relative to the nozzle unit, while a positional relationship between the first and the second movable bodies in the predetermined direction is maintained.

26. The exposure method according to any one of Claims 18 to 25, wherein

the nozzle unit is provided to surround an optical element of the projection optical system, the optical element contacting the liquid, and

in order to measure positional information of the first movable body or the second movable body that is moved below the projection optical system, by a measurement system having a plurality of heads that are provided at each of the first and the second movable bodies, measurement beams are irradiated on a plurality of scales having a two-dimensional grating, via the plurality of heads of the first movable body or the second movable body, respectively, the plurality of scales being placed around the nozzle unit to be substantially parallel to the predetermined plane.

27. The exposure method according to any one of Claims 18 to 26, wherein

a mark of an object held by each of the first and the second movable bodies is detected with a mark detection system that is placed away from the projection optical system in the first direction, and

in order to measure positional information of the first movable body or the second movable body that is moved below the mark detection system, by the measurement system, measurement beams are irradiated on a plurality of scales having a two-dimensional grating, via the plurality of heads of the first movable body or the second movable body,

respectively, the plurality of scales being placed around the mark detection system to be substantially parallel to the predetermined plane.

28. The exposure method according to any one of Claims 18 to 25, wherein

the first and second movable bodies each have a mounting area of the object and a pair of scales that are placed on both sides of the mounting area and have a two-dimensional grating, on an upper surface side of the first or the second movable body, and

in order to measure positional information of the first movable body or the second movable body that is moved below the projection optical system, by a measurement system that has a plurality of heads placed around the projection optical system, measurement beams are irradiated on the pair of scales via the heads that face the pair of scales, respectively, of the plurality of heads.

29. The exposure method according to Claim 28, wherein

the pair of scales are each provided with a longitudinal direction in a predetermined direction, in the predetermined direction the first and the second movable bodies that have approached each other being moved relative to the nozzle unit, and

the plurality of heads include heads whose positions are different from each other in a direction orthogonal to the predetermined direction.

30. The exposure method according to Claim 28 or 29, wherein

a mark of an object held by each of the first and the second movable bodies is detected with a mark detection system that is placed away from the projection optical system

in the first direction, and

in order to measure positional information of the first movable body or the second movable body that is moved below the mark detection system, by the measurement system having another plurality of heads that are placed around the mark detection system and are different from the plurality of heads, measurement beams are irradiated on the pair of scales via the another plurality of heads, respectively.

31. The exposure method according to any one of Claims 28 to 30, wherein

the first and the second movable bodies that have approached each other are moved relative to the nozzle unit so that the liquid immersion area is moved from the one movable body to the other movable body without traversing the pair of scales of the first and the second movable bodies.

32. The exposure method according to any one of Claims 18 to 31, wherein

positional information of the first and the second movable bodies in a third direction orthogonal to the predetermined plane is also measured by the measurement system.

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33. The exposure method according to any one of Claims 18 to 32, wherein

the exchange position includes a first exchange position and a second exchange position different from the first exchange position, in the first exchange position exchange of an object held by the first movable body being performed, and in the second exchange position exchange of an object held by the second movable body being performed.

34. A device manufacturing method, including:

exposing an object with the exposure method according to any one of Claims 18 to 33; and

developing the object that has been exposed.