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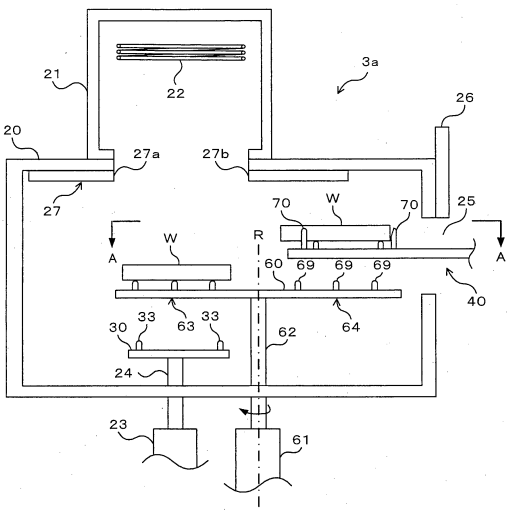
(54) Carburizing and quenching facility

(57) To shorten the time taken for a carburizing and quenching treatment of an object to be treated, a carburizing and quenching facility 1 is provided that includes: a treatment chamber where at least one treatment related to a carburizing and quenching treatment is performed on an object to be treated W; a transfer apparatus to transfer an object to be treated W; a mounting table 30 that is provided in the treatment chamber and on which an object to be treated W transferred into the treatment chamber is mounted; and a lifting and lowering device that lifts and lowers the mounting table 30 and in which a transfer arm 40 to transfer an object to be treated W into the treatment chamber and outside the treatment chamber is provided in the transfer apparatus, the carburizing and quenching facility 1 includes: a turntable 60 that is disposed in the treatment chamber and performs deliveries of an object to be treated W to and from the mounting table 30 and the transfer arm 40; and a turntable drive device that rotates the turntable 60, in which the turntable 60 includes: a first support part 63 that supports an object to be treated W that has already undergone a treatment; and a second support part 64 that supports an object to be treated to undergo a treatment next, and in plan view, the turntable 60 is provided in a positional relationship such that the first support part 63, a support post 62 of the turntable 60, and the second support part 64 are disposed in a linear arrangement so as to sandwich a rotation axis R of the turntable 60 by the first support part 63 and the second support part 64.

FIG.2



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Description

[0001] The present invention relates to a carburizing and quenching facility in which a carburizing and quenching treatment of an object to be treated is performed.

[0002] In order to improve abrasion resistance of a low-alloy steel or the like, (which will be referred to as an "object to be treated" hereinafter), it is general to perform a carburizing treatment bringing carbon into a surface layer of an object to be treated to be solid-dissolved. Normally, when the carburizing treatment is performed, a preheat treatment, a quenching treatment, and the like are also performed. In the present description, a series of treatments to be performed generally when performing the carburizing treatment of an object to be treated, including the above preheat treatment, quenching treatment, and the like is referred to as a "carburizing and quenching treatment."

[0003] In recent years, it has been required that the carburizing and quenching treatment should be incorporated as one process of a machining process of an object to be treated and of the object to be treated, the machining and the carburizing and quenching treatment should be performed on-line. A carburizing and quenching facility capable of structuring such an on-line machining manufacturing system has been described in Patent Document 1 and Patent Document 2, for example.

[0004] In the carburizing and quenching facilities described in Patent Document 1 and Patent Document 2, what is called a batch-type treatment method in which heat treatments such as a carburizing treatment and a quenching treatment are each performed in an independent treatment chamber is employed. In these carburizing and quenching facilities, the carburizing treatment necessary for the longest treatment time in the carburizing and quenching treatment process is performed in a plurality of carburizing chambers in a divided manner, and thereby the carburizing and quenching treatment according to a line speed of the machining process is performed.

[Patent Document 1] Japanese Laid-open Patent Publication No. 10-53809

[Patent Document 2] Japanese Laid-open Patent Publication No. 2002-294429

[0005] In order to improve productivity, it is necessary to further shorten the time of the carburizing and quenching treatment incorporated into the on-line machining manufacturing system, but in the conventional carburizing and quenching facility, linkage of transfers of an object to be treated into individual treatment chambers has not been considered. Therefore, it has been in a difficult situation to shorten the carburizing and quenching treatment time.

[0006] For example, in the carburizing and quenching facilities described in Patent Document 1 and Patent Document 2, when an object to be treated that has undergone a carburizing treatment is transferred from the carburizing chamber and when an object to be treated to undergo a carburizing treatment next is transferred into the carburizing chamber, a transfer port door that is provided in the carburizing chamber and opens and closes an opening through which an object to be treated passes through is opened. In such a case, the carburizing and quenching treatment time is prolonged because the time for transferring the object to be treated is taken, and furthermore every time the transfer port door is opened, the temperature of the carburizing chamber decreases.

[0007] At this time, when the temperature in the carburizing chamber is below an appropriate carburizing temperature (850°C to 1100°C or so), efficiency of carburization on the object to be treated decreases, resulting in that a carburizing treatment time has to be secured to some extent in order to perform a sufficient carburizing treatment of the object to be treated. When the volume of the carburizing chamber is small in particular, the temperature decrease of the carburizing chamber caused when the transfer port door is opened also increases, so that a longer carburizing treatment time has to be secured.

[0008] Further, when an interval after transfer of the object to be treated from the carburizing chamber until transfer of the following object to be treated into the carburizing chamber is short, in a state where the temperature of the carburizing chamber does not increase sufficiently until the following object to be treated is transferred into the carburizing chamber, the following object to be treated as a result is transferred into the carburizing chamber. That is, because the transfer port door is opened in order to transfer the following object to be treated into the carburizing chamber, the temperature of the carburizing chamber decreases again, resulting in that the carburizing efficiency further decreases. Therefore, it becomes necessary to secure a longer carburizing treatment time.

[0009] Further, it is also conceivable to provide more carburizing chambers than ever before in order to shorten the time taken for the carburizing and quenching treatment, but due to the problems of installation cost and installation space of carburizing chambers, it is also sometimes difficult to install more carburizing chambers.

[0010] Further, in the above explanation, the problem caused when the object to be treated is transferred into/from the carburizing chamber has been explained, but the similar problem is also caused when the object to be treated is transferred into/from other treatment chambers (a temperature increasing chamber, a quenching chamber, a tempering chamber, and the like). That is, in the conventional carburizing and quenching facility, a treatment time in each of the treatment chambers has needed to be secured to some extent, so that it has been difficult to shorten the time taken for the entire carburizing and quenching treatment.

[0011] The present invention has been made in consideration of the above-described circumstances, and has an object to shorten the time taken for a carburizing

and quenching treatment of an object to be treated.

[0012] The present invention to solve the above-described object is a carburizing and quenching facility that includes: a treatment chamber where at least one treatment related to a carburizing and quenching treatment is performed on an object to be treated; a transfer apparatus to transfer an object to be treated; a mounting table that is provided in the treatment chamber and on which an object to be treated transferred into the treatment chamber is mounted; and a lifting and lowering device to lift and lower the mounting table and in which a transfer arm to transfer an object to be treated into the treatment chamber and outside the treatment chamber is provided in the transfer apparatus and a carburizing and quenching treatment of an object to be treated is performed, the carburizing and quenching facility includes: a turntable that is disposed in the treatment chamber and performs deliveries of an object to be treated to and from the mounting table and the transfer arm; and a turntable drive device that rotates the turntable, in which the turntable includes: a first support part that supports an object to be treated that has already undergone a treatment; and a second support part that supports an object to be treated to undergo a treatment next, and in plan view, the turntable is provided in a positional relationship such that the first support part, a support post of the turntable, and the second support part are disposed in a linear arrangement so as to sandwich a rotation axis of the turntable by the first support part and the second support part.

According to the present invention, it is possible to perform transfer of an object to be treated from the treatment chamber and transfer of the following object to be treated into the treatment chamber simultaneously when a transfer port door is opened.

[0013] A lifting and lowering mechanism to lift and lower the turntable may also be provided in the turntable drive device. The external shape of the turntable is a rectangular shape in plan view, and the first support part and the second support part may also be provided to sandwich the rotation axis of the turntable. The first support part and the second support part may also be provided at point-symmetric positions about the rotation axis of the turntable as a symmetric point in plan view.

[0014] The object to be treated has a circular shape, and on at least one of the first support part and the second support part, at least three turntable support pins to support the object to be treated may also be provided. On the transfer arm, at least three transfer support pins to support the object to be treated may also be provided, and on the mounting table, at least three mounting table support pins to support the object to be treated may also be provided.

[0015] The object to be treated has a shape formed of a circular top surface part and a cylindrical side surface part, and on at least one of the first support part and the second support part, the turntable support pins may also be provided on the circumference having substantially the same diameter as the inside diameter of the side surface part of the object to be treated. Further, on the mounting table, the mounting table support pins may also be provided on the circumference having substantially the same diameter as the inside diameter of the side surface part of the object to be treated. Further, on the transfer arm, the transfer support pins may also be provided on the circumference having substantially the same diameter as the inside diameter of the side surface part of the object to be treated.

[0016] According to the present invention, it is possible to perform transfer of an object to be treated from a treatment chamber and transfer of the following object to be treated into the treatment chamber simultaneously when a transfer port door is opened. This makes it possible to shorten the time taken for transfer-in/out of the objects to be treated. Further, it is possible to reduce the opening and closing frequency of the transfer port door, so that it is possible to suppress temperature decrease in the treatment chamber. This makes it possible to shorten the time taken until the temperature in the treatment chamber reaches an appropriate temperature, resulting in that the treatment time in the treatment chamber can be shortened.

FIG. 1 is a schematic layout view of individual treatment chambers and the like in a carburizing and quenching facility according to an embodiment of the present invention;

FIG. 2 is a schematic view illustrating the inside of a first carburizing chamber;

FIG. 3 is a cross-sectional view taken along A-A in FIG. 2;

FIG. 4 is an explanatory view of auxiliary pins on a transfer arm;

FIG. 5(a) to FIG. 5(f) are views illustrating a transfer action of an object to be treated in a carburizing treatment process according to the embodiment of the present invention;

FIG. 6(a) and FIG. 6(b) are views illustrating the transfer action of the object to be treated in the carburizing treatment process according to the embodiment of the present invention;

FIG. 7 is a view illustrating a supporting aspect of an object to be treated formed of a circular top surface part and a cylindrical side surface part;

FIG. 8 is a vertical cross-sectional view taken along B-O-B in FIG. 7.

[0017] Hereinafter, an embodiment of the present invention will be explained based on a carburizing and quenching facility 1 in which a carburizing and quenching treatment is performed on an object to be treated W being circular when seen in plan view. Incidentally, in the present description and drawings, the same numerals and symbols are given to components having substantially the same functions and constitutions, and thereby repeated explanations are omitted.

[0018] As illustrated in FIG. 1, the carburizing and

quenching facility 1 includes a temperature increasing chamber 2, carburizing chambers 3 (a first carburizing chamber 3a, a second carburizing chamber 3b, and a third carburizing chamber 3c), and a quenching chamber 4, (which will be each sometimes called an "individual treatment chamber" hereinafter), and the individual treatment chambers are disposed in a line in order. Further, the carburizing and quenching facility 1 includes a transfer apparatus 5 that performs transfer of the object to be treated W into the individual treatment chamber and transfer of the object to be treated W from the individual treatment chamber. The transfer apparatus 5 is constituted by a transfer part 6 provided with a transfer arm 40 that supports and moves the object to be treated and a transfer path 7 provided in parallel with the disposition line of the individual treatment chambers. The transfer apparatus 5 has a constitution to move the transfer part 6 along the transfer path 7. The transfer part 6 has a mechanism to extend the transfer arm 40 to the individual treatment chamber in the horizontal direction.

[0019] In the carburizing and quenching facility 1, the object to be treated W on which a predetermined treatment has been performed in the single treatment chamber (for example, the temperature increasing chamber 2) is transferred to the treatment chamber positioned downstream from the above treatment chamber, (which is, for example, the first carburizing chamber 3a), sequentially, and a predetermined treatment is performed in each of the individual treatment chambers, and thereby a carburizing and quenching treatment of the object to be treated W is finished. Incidentally, with regard to a carburizing treatment in this embodiment, the carburizing treatment is performed in the first to third carburizing chambers 3a to 3c in order, and thereby a series of carburizing treatments is completed.

[0020] Hereinafter, there will explained the carburizing and quenching facility 1 based on the constitution of the first carburizing chamber 3a. FIG. 2 is a schematic view illustrating the inside of the first carburizing chamber 3 a. Incidentally, the transfer arm 40 in FIG. 2 is in a state of extending up to a predetermined position enabling deliveries of the object to be treated W to/from a later-described turntable 60. Further, the turntable 60 in FIG. 2 can deliver the object to be treated W to/from the transfer arm 40, and is in a state where its rotation is stopped at a position enabling deliveries of the object to be treated W to/from a later-described mounting table 30. That is, the turntable 60 in FIG. 2 is in a delivery posture enabling deliveries of the object to be treated W.

[0021] The first carburizing chamber 3a is constituted by two chambers of a delivery part 20 where delivery of the object to be treated W transferred by the transfer arm 40 is performed and a heat treatment part 21 adjacently provided on a top part of the delivery part 20. In the heat treatment part 21, for example, an induction heating coil 22 to heat the object to be treated W is provided.

[0022] There is an opening between the delivery part 20 and the heat treatment part 21, and when a partition door 27 provided on a ceiling surface of the delivery part 20 is in an open state, the atmosphere in the delivery part 20 and the atmosphere in the heat treatment part 21 communicate with each other. The partition door 27 is a drawn-type sliding door, and in each tip part of door main bodies 27a and 27b, a semicircular hole having substantially the same diameter as that of a lifting and lowering rod 24 of a lifting and lowering device 23, (which is not illustrated), is provided so that the partition door 27 can be closed even when the later-described mounting table 30 goes up.

[0023] Below the heat treatment part 21, the mounting table 30 on which the object to be treated W is mounted is provided, and the mounting table 30 is connected to the lifting and lowering rod 24 of the lifting and lowering device 23 provided outside the first carburizing chamber 3a. That is, the mounting table 30 is constituted to be able to go up and down by the lifting and lowering device 23. The lifting and lowering rod 24 is provided to penetrate a bottom surface of the delivery part 20 of the first carburizing chamber 3a, and a gap in a penetration part between the lifting and lowering rod 24 and the delivery part 20 is sealed. Incidentally, the shape of the lifting and lowering rod 24 is not limited in particular, and the lifting and lowering rod 24 may also be one with a square transverse section. That is, the lifting and lowering rod 24 only needs to be a member connectable to the mounting table 30 (a lifting and lowering member).

[0024] In a sidewall of the delivery part 20 on the transfer apparatus side, a transfer port 25 through which the transfer arm 40 can pass is provided. Further, on the exterior of the sidewall of the delivery part 20 on the transfer apparatus side, a transfer port door 26 to open and close the transfer port 25 is provided. The transfer port door 26 is provided to be movable up and down by a door opening and closing mechanism (not illustrated).

[0025] Further, in the delivery part 20, the turntable 60 on which the object to be treated W is mountable is provided. A center bottom surface of the turntable 60 is connected to a drive rod 62 of a drive device 61 provided outside the first carburizing chamber 3a (a support post of the turntable 60), and the drive device 61 has a constitution to rotate and lift and lower the drive rod 62. That is, the turntable 60 is constituted to be able to rotate and go up and down by the drive device 61. The drive rod 62 is provided to penetrate the bottom surface of the delivery part 20 of the first carburizing chamber 3a between the mounting table 30 and the transfer port 25, and a gap between the drive rod 62 and the bottom surface of the delivery part 20 is sealed. Incidentally, the shape of the drive rod 62 is not limited in particular, and the drive rod 62 may also be one with a square transverse section. That is, the drive rod 62 only needs to be a member connectable to the turntable 60 (a drive member).

[0026] Further, the turntable 60 includes a first support part 63 to support a first object to be treated W and a second support part 64 to support a second object to be treated W. The first support part 63 is positioned above

the mounting table 30, and the second support part 64 is at a position line-symmetric to the first support part 63 about a rotation axis R of the drive rod 62 when seen on a vertical section illustrated in FIG. 2. Incidentally, the transfer arm 40 illustrated in FIG. 2 is positioned above the second support part 64. When the object to be treated W is delivered to the mounting table 30 and the transfer arm 40 from the turntable 60 and when the object to be treated W is delivered to the turntable 60 from the mounting table 30 and the transfer arm 40, the delivery of the object to be treated W is performed on the first support part 63 or the second support part 64 of the turntable 60.

[0027] FIG. 3 is a cross-sectional view taken along A-A in FIG. 2 (a plan view of an A-A cross section). Incidentally, in FIG. 3, the outline of the object to be treated W of the case when the object to be treated W is supported on the first support part 63 of the turntable 6 and the outline of the object to be treated W of the case when the object to be treated W is supported on the second support part 64 of the turntable 60 are each illustrated by a dotted line. Further, the outline of the mounting table 30 of the case when it is assumed that the mounting table 30 is positioned below the second support part 64 of the turntable 60 is also illustrated by a dotted line. Further, the outline of the drive rod 62 connected to the turntable 60 is illustrated by a dashed-dotted line.

[0028] As illustrated in FIG. 3, the mounting table 30 is formed integrally by a circular plate 31 in the center in plan view and three projecting parts projecting radially from the circular plate 31, (which will be described as "support blades 32" hereinafter). Angles each formed by the support blades are equal to one another (120° in this embodiment), and on tips of the individual support blades 32, mounting table support pins 33 to support the object to be treated W are provided. That is, the object to be treated W is three-point supported by the mounting table support pins 33. Incidentally, heat-resistant stainless steel or the like is applied to the material of the individual support blades 32 and mounting table support pins 33.

[0029] The turntable 60 has a rectangular shape in plan view, and is provided in a positional relationship such that the first support part 63, the drive rod 62, and the second support part 64 are disposed in a linear arrangement so as to sandwich the rotation axis R of the drive rod 62 by the first support part 63 and the second support part 64. In the first support part 63 and the second support part 64 of the turntable 60, a first space part 65 and a second space part 66 each allowing the mounting table 30 that goes up and down to pass through are provided respectively. The first space part 65 has a shape such that a base part of the turntable 60 is cut out along the outline of the mounting table 30 in plan view, and the second space part 66 has a shape point-symmetric to the first space part 65 about the rotation axis R of the drive rod 62 in plan view as a symmetric point.

[0030] Further, as illustrated in FIG. 3, in the first support part 63 and the second support part 64 of the turntable 60, a first cutout part 67 and a second cutout part 68 are provided respectively in order for the turntable 60 going up and down to be prevented from coming into contact with individual projecting parts 44 of the later-described transfer arm 40. The first cutout part 67 has a shape such that an end part of the turntable 60 is cut out along the outline of the individual projecting parts 44 in plan view, and the second cutout part 68 has a shape point-symmetric to the first cutout part 67 about the rotation axis R of the drive rod 62 in plan view as a symmetric point.

[0031] Thus, the first space part 65 and the second space part 66 each having a point-symmetric shape, and the first cutout part 67 and the second cutout part 68 each having a point-symmetric shape are provided in the turntable 60, so that even when the turntable 60 rotates by 180°, parts do not come into contact with each other when the mounting table 30 goes up and down and when the turntable 60 goes up and down.

[0032] Further, the first support part 63 and the second support part 64 of the turntable 60 are disposed at point-symmetric positions about the rotation axis R of the drive rod 62 in plan view as a symmetric point, so that even when the turntable 60 rotates by 180°, the position on the horizontal plane of the first support part 63 or the second support part 64 coming above the mounting table 30 does not change. That is, only the going up and down movement of the mounting table 30 without horizontal movement makes it possible to perform the delivery of the object to be treated W. Therefore, it is not necessary to provide a horizontal moving mechanism, a rotation mechanism, or the like of the mounting table 30.

[0033] Further, the first support part 63 and the second support part 64 are disposed at point-symmetric positions about the rotation axis R of the drive rod 62 in plan view as a symmetric point, so that when the object to be treated W is placed on both the first support part 63 and the second support part 64, the two objects to be treated are supported at the positions farthest from each other. This makes it possible to prevent temperature decrease of the heat-treated object to be treated caused by an effect of the object to be treated that has not undergone a heat treatment yet. Incidentally, as is this embodiment, as long as the first support part 63, the drive rod 62 of the turntable 60, and the second support part 64 are provided in such a positional relationship as to be disposed in a line arrangement in plan view, the objects to be treated supported on the individual support parts 63 and 64 can be separated from each other to some extent even if the individual support parts 63 and 64 are not disposed at the point-symmetric positions. Therefore, it is possible to prevent the temperature decrease of the heat-treated object to be treated.

[0034] Further, on predetermined positions of the first support part 63 and the second support part 64 of the turntable 60, turntable support pins 69 to support the objects to be treated W are provided, and the object to be treated W is three-point supported by the turntable support pins 69. Incidentally, heat-resistant stainless steel

or the like is applied to the material of the turntable support pins 69.

[0035] As illustrated in FIG. 2 and FIG. 3, a tip part 41 of the transfer arm 40 positioned above the second support part 64 of the turntable 60 has a three-pronged shape in plan view. A three-pronged shape part projects from a transfer arm main body 45 toward the center of the circular plate 31 of the mounting table 30 on the assumption that the mounting table 30 is in the second space part 66 of the turntable 60 (the projecting parts 44). The projecting parts 44 are each provided to be able to support the object to be treated W between the support blades of the mounting table 30 in plan view, and angles each formed by the projecting parts are equal to one another (120° in this embodiment). On the vicinities of the tips of the individual projecting parts 44, transfer support pins 50 to support the object to be treated W when the object to be treated W is transferred are provided, and the object to be treated W is three-point supported by the transfer support pins 50.

[0036] Further, as illustrated in FIG. 2 to FIG. 4, at positions facing the side surface of the object to be treated W supported on the transfer support pins 50, auxiliary pins 70 to lead the object to be treated W to be mounted at an appropriate position of the transfer support pins 50 are provided. The appropriate position means the position where the center of the object to be treated W and the center of the mounting table 30 (the circular plate 31) agree with each other, for example. Further, the individual auxiliary pins 70 also have a function of preventing the object to be treated W from falling. Further, a part of each of the auxiliary pins 70 on the side facing the side surface of the object to be treated W is formed into such a tapered shape as to be thinner as it goes up to an upper end of the pin (tapered parts 70a).

[0037] As illustrated in FIG. 4, when the object to be treated W deviates from the appropriate mounting position when the object to be treated W is mounted on the transfer support pins 50, for example, the object to be treated W moves along the tapered parts 70a of the individual auxiliary pins 70, to thereby be led to the correct position. Thereby, every time the delivery of the object to be treated W is performed between the turntable 60 and the transfer arm 40, the mounting position of the object to be treated W on the transfer support pins 50 does not vary among objects to be treated, and the mounting positions are always the same. Further, at the point of the object to be treated W being mounted on the transfer support pins 50, by the auxiliary pins 70 facing (or being in contact with) the side surface of the object to be treated W, the positional deviation and the falling of the object to be treated W are regulated. Therefore, during the transfer of the object to be treated W, the deviation from the mounting position of the object to be treated W on the transfer support pins 50 and the falling of the object to be treated W are regulated. Incidentally, heat-resistant stainless steel or the like is applied to the materials of the transfer support pins 50 and the auxiliary pins 70.

[0038] Further, the individual mounting table support pins 33 and the individual turntable support pins 69 on the first support part 63 and the second support part 64 of the turntable 60 are preferably provided to be disposed on the same circumference in plan view when the delivery of the object to be treated W is performed. This makes it possible to reduce tilting of the object to be treated W and the like when the object to be treated W is delivered to the turntable 60 from the mounting table 30 and the object to be treated W is delivered to the mounting table 30 from the turntable 60, and to suppress deviation of the object to be treated W from the appropriate mounting position. Similarly, the individual transfer support pins 50 and the individual turntable support pins 69 on the first support part 63 and the second support part 64 of the turntable 60 are preferably provided to be disposed on the same circumference in plan view when the delivery of the object to be treated W is performed.

[0039] The carburizing and quenching facility 1 is constituted as above. Incidentally, the carburizing and quenching facility 1 includes not-illustrated constitutions necessary for performing a general vacuum carburizing treatment, which are an exhaust mechanism, a carburizing gas introduction mechanism, and the like. Further, in the above explanation, constitutions of the temperature increasing chamber 2, the second carburizing chamber 3b, the third carburizing chamber 3c, and the quenching chamber 4 that are illustrated in FIG. 1 are not explained, but the basic constitution of each of the treatment chambers is similar to that of the first carburizing chamber 3a. For example, in the quenching chamber 4, in place of the above-described induction heating coil 22, a cooling gas introduction mechanism is provided in the heat treatment part 21, and thereby gas quenching is performed.

[0040] Next, with reference to FIG. 5(a) to FIG. 5(f) and FIG. 6(a) and FIG. 6(b), there will be explained one example of a transfer method of objects to be treated W1 and W2 in a carburizing treatment process to be performed by using the carburizing and quenching facility 1. Incidentally, in FIG. 5(a) to FIG. 5(f) and FIG. 6(a) and FIG. 6(b), illustrations of some components such as the support pins of the object to be treated W and the induction heating coil are omitted.

[0041] First, as illustrated in FIG. 5(a), on the object to be treated W1, a carburizing treatment is performed in the heat treatment part 21 of the first carburizing chamber 3a. Next, as illustrated in FIG. 5(b), the partition door 27 is opened and the mounting table 30 on which the object to be treated W1 is mounted is lowered. At this time, the mounting table 30 passes through the first space part 65 of the turntable 60, and the object to be treated W1 is delivered to the first support part 63 of the turntable 60 from the mounting table 30. Thereafter, the transfer port door 26 is opened.

[0042] Subsequently, as illustrated in FIG. 5(c), the transfer arm 40 on which the object to be treated W2 is supported is moved forward to transfer the object to be

treated W2 into the delivery part 20 of the first carburizing chamber 3a. At this time, the transfer arm 40 is moved forward until the object to be treated W2 is positioned above the second support part 64 of the turntable 60. Incidentally, the object to be treated W2 is in a state where the temperature of the object to be treated W2 is increased up to the temperature suitable for the carburizing treatment in the temperature increasing chamber 2 positioned upstream from the first carburizing chamber 3a.

[0043] Next, as illustrated in FIG. 5(d), the turntable 60 is lifted above the transfer arm 40. At this time, the turntable 60 goes up in such a manner that the individual projecting parts 44 of the transfer arm 40 pass through the second cutout part 68 of the turntable 60, and the object to be treated W2 is delivered to the second support part 64 of the turntable 60 from the transfer arm 40.

[0044] Then, as illustrated in FIG. 5(e), the turntable 60 is rotated 180°. Thereafter, as illustrated in FIG. 5(f), the turntable 60 is lowered below the transfer arm 40. At this time, the object to be treated W1 is delivered to the transfer arm 40 from the first support part 63 of the turntable 60.

[0045] Subsequently, as illustrated in FIG. 6(a), the transfer arm 40 is moved backward to transfer the object to be treated W1 on which the carburizing treatment has been performed from the delivery part 20. Then, as illustrated in FIG. 6(b), the mounting table 30 on which the object to be treated W2 is mounted is lifted up to the heat treatment part 21. At this time, the object to be treated W2 is delivered to the mounting table 30 from the second support part 64 of the turntable 60. Thereafter, the partition door 27 and the transfer port door 26 are closed, and after evacuation is performed, a carburizing treatment is performed on the object to be treated W2.

[0046] According to this embodiment as above, it is possible to perform transfer of the object to be treated W1 from the first carburizing chamber 3a and transfer of the object to be treated W2 into the first carburizing chamber 3a simultaneously when the transfer port door 26 is opened. Thereby, it is possible to reduce the opening and closing frequency of the transfer port door 26 as compared to a conventional carburizing method in which transfer-out of the object to be treated W1 and transfer-in of the object to be treated W2 are performed at different timings. As a result, it is possible to shorten the time taken for transferring in/out of the objects to be treated W1 and W2, and it becomes possible to shorten a treatment time in the first carburizing chamber 3a.

[0047] Further, the transfer of the object to be treated into the first carburizing chamber 3a and the transfer of the object to be treated from the first carburizing chamber 3a can be performed at the same timing, so that the transfer of the object to be treated W1 from the heat treatment part 21 into the delivery part 20 and the transfer of the object to be treated W2 from the delivery part 20 into the heat treatment part 21 can also be performed by opening the partition door 27 one time. That is, the opening and closing frequency of the partition door 27 can also be reduced. Thereby, the frequency of which the heat treatment part 21 is affected by the atmosphere of the delivery part 20 lower in temperature than the heat treatment part 21 is reduced, and thus it is possible to suppress temperature decrease in the heat treatment part 21. Therefore, it is possible to shorten the time taken until the temperature inside the heat treatment part 21 reaches the temperature suitable for carburizing, resulting in that the treatment time in the first carburizing chamber 3a can be shortened.

[0048] Further, the transfer-out of the object to be treated W1 and the transfer-in of the object to be treated W2 are performed not only in the first carburizing chamber 3a, but also in the temperature increasing chamber 2, the second carburizing chamber 3b, the third carburizing chamber 3c, and the quenching chamber 4 that are illustrated in FIG. 1 in the same manner. Therefore, the treatment time in each of the treatment chambers can also be shortened, so that it becomes possible to drastically shorten the time taken for the entire carburizing and quenching treatment.

[0049] Further, as is this embodiment, in the carburizing and quenching facility 1 where the object to be treated W is treated individually, the frequency of which the transfer-in/out of the object to be treated W are performed is increased, so that the effect of shortening the treatment time obtained by performing the transfer-in/out of the object to be treated W at the same timing is particularly increased.

[0050] In the foregoing, the preferred embodiment of the present invention has been explained, but the present invention is not limited to such an example. It is apparent that a person skilled in the art is able to devise various variation or modification examples within the range of technical ideas described in the claims, and it should be understood that such examples belong to the technical scope of the present invention as a matter of course.

[0051] For example, the above-described embodiment is designed that the carburizing treatment is performed on the object to be treated W in the first to third carburizing chambers 3a to 3c in order, and thereby a series of carburizing treatments is completed, but in carburizing chambers 3a to 3c of each of the first carburizing chamber 3a, the second carburizing chamber 3b, and the third carburizing chamber 3c, a carburizing treatment on the single object to be treated W may also be completed. In this case, the object to be treated W2 transferred from the temperature increasing chamber 2 is transferred into, of the first to third carburizing chambers 3a to 3c, the carburizing chambers 3a to 3c without the object to be treated W being transferred thereinto.

[0052] Further, the disposition and the number of the individual treatment chambers are not limited to the ones explained in the above-described embodiment. For example, even in the case where the carburizing chambers 3 are constituted into a single carburizing chamber, or even in the case where the transfer method of the object to be treated W explained in the above-described em-

bodiment is applied to a treatment chamber not explained in the above-described embodiment (for example, a tempering chamber), the transfer-in/out time of the object to be treated W can be shortened. That is, the present invention is not limited to uses of the treatment chambers, but is applied to the treatment chamber where at least one treatment related to the carburizing and quenching treatment is performed on the object to be treated, and thereby it is possible to enjoy the operation and effect explained in the above-described embodiment. Incidentally, the treatments related to the carburizing and quenching treatment are treatments necessary for a general carburizing and quenching treatment such as preheating, carburizing, diffusion, cooling, and quenching (including gas quenching). Further, the above-described embodiment is designed to perform a vacuum carburizing treatment in the carburizing and quenching facility 1, but the carburizing method is not limited to this.

[0053] Further, in the above-described embodiment, the partition door 27 is a drawn-type sliding door, but may also be a double-door type door opening inward or outward, for example. Further, the place where the partition door 27 is provided is also not limited in particular, and the partition door 27 only needs to be provided so as to block the atmosphere communicating with the delivery part 20 and the heat treatment part 21. Further, the treatment chamber where the treatment of the object to be treated W is performed does not need to be constituted by two chambers of the delivery part 20 and the heat treatment part 21 as is the above-described embodiment. For example, a constitution in which the delivery and the heat treatment of the object to be treated W are performed in a single chamber may also be applied. Even in this case, the transfer-in/out of the object to be treated can be performed by opening the transfer port door one time, so that it is possible to shorten the time taken for the transfer-in/out of the object to be treated. Further, the opening and closing frequency of the transfer port door is reduced, so that the frequency of which the atmosphere in the treatment chamber comes into contact with the atmosphere outside the treatment chamber that is lower in temperature than that in the treatment chamber is also reduced, thereby making it possible to prevent the temperature decrease in the treatment chamber.

[0054] Further, in the above-described embodiment, by lifting and lowering the turntable 60, the object to be treated W is delivered between the turntable 60 and the transfer arm 40, but it is also possible that a lifting and lowering mechanism is not provided for the turntable 60 but is provided for the transfer arm 40 and by lifting and lowering the transfer arm 40, the object to be treated W is delivered between the turntable 60 and the transfer arm 40, for example. As a matter of course, the lifting and lowering mechanism may also be provided for both the turntable 60 and the transfer arm 40.

[0055] That is, the method of delivering the object to be treated W between the turntable 60 and the transfer arm 40 is changed appropriately according to the shape of each of the treatment chambers, a heating means of the object to be treated W, and the like, and as along as a relative moving mechanism that relatively brings the turntable 60 and the transfer arm 40 close to each other in order to mount the object to be treated W transferred by the transfer arm 40 on the turntable 60 is provided, the object to be treated W can be delivered. Incidentally, a transfer procedure of the object to be treated W is also not limited to the one explained in the above-described embodiment.

[0056] Further, the number of the support blades 32 of the mounting table 30 and the angles each formed by the support blades, and the number of projecting parts 44 of the transfer arm 40 and the angles each formed by the projecting parts are not limited to the ones explained in the above-described embodiment. Further, the shape of the mounting table 30 and the shape of the transfer arm 40 are also not limited to the ones explained in the above-described embodiment. Further, the shape of the turntable 60 is changed appropriately according to the shape of the mounting table 30 and the shape of the transfer arm 40.

[0057] Further, the number and the disposition of the mounting table support pins 33, the number and the disposition of the transfer support pins 50, and the number and the disposition of the turntable support pins 69 are changed appropriately according to the shape and the size of the object to be treated W. That is, the number of them and the disposition of them only need to be the number (at least three) and the disposition capable of supporting the object to be treated W in a state where the object to be treated W does not tilt when the object to be treated W is mounted on the individual support pins. Further, in the above-described embodiment, a part of the auxiliary pin 70 of the side facing the side surface of the object to be treated W is formed into a tapered shape, but the entire auxiliary pin 70 of the side facing the side surface of the object to be treated W may also be formed into a tapered shape.

[0058] Further, even if the individual support pins are not provided, the transfer action of the object to be treated explained in the above-described embodiment can be performed. However, by supporting the object to be treated by the individual support pins, a contact area with the object to be treated can be made small, so that temperature changes inside the object to be treated to be caused when the object to be treated is heated and cooled can be made uniform. Thereby, it is possible to suppress occurrence of heat treatment strain of the object to be treated. Further, the contact area between the individual support pins and the object to be treated is small, thereby making it possible to advance carburizing on the lower surface of the object to be treated and carburizing on the other parts of the object to be treated uniformly. Thereby, it is possible to improve the quality of carburizing treatment of the object to be treated.

[0059] Further, in the above-described embodiment, the object to be treated W is treated individually, but it is

also possible that a jig capable of being supported on the transfer arm 40 or the mounting table 30 is used and by the jig, two or more of the objects to be treated W are fixed, and thereby two or more of the objects to be treated are treated simultaneously. Incidentally, in the carburizing and quenching facility where the object to be treated W is treated individually, the frequency of the object to be treated W being transferred in and out is increased, so that the effect of shortening the treatment time explained in the above-described embodiment is particularly increased.

[0060] Further, in the "circular object to be treated" explained in the above-described embodiment, an object to be treated formed of a circular top surface part W_t and a cylindrical side surface part W_s illustrated in FIG. 7 and

[0061] FIG. 8, for example, is also included, in addition to objects to be treated having a columnar shape and having a circular ring shape. A concrete example of the circular object to be treated is a gear of a machine part and the like.

[0062] As illustrated in FIG. 7 and FIG. 8, when the object to be treated W is one having a shape formed of the circular top surface part W_t and the cylindrical side surface part W_s, namely an object to be treated W having a downward recessed shape such that a circular tray is inverted, the three transfer support pins 50 on the transfer arm 40 are disposed on the transfer arm 40 so as to come into contact with (or so as to be in a state extremely close to) the top surface part W_t and the side surface part W_s inside the downward recessed part, to thereby three-point support the object to be treated W. As long as the transfer support pins 50 are disposed on the circumference having substantially the same diameter as the inside diameter of the side surface part W_s of the object to be treated W as above, the transfer support pins 50 can support the object to be treated W in such a state as to come into contact with the side surface part W_s of the object to be treated W, so that it is possible to perform positional regulation of the object to be treated W.

[0063] Further, when the object to be treated W has a shape formed of the circular top surface part W_t and the cylindrical side surface part W_s, the mounting table support pins 33 and the turntable support pins 69 are also disposed in the same manner as that of the transfer support pins 50. That is, at least the three mounting table support pins 33 and the three turntable support pins 69 only need to be disposed so as to come into contact with (or so as to be in a state extremely close to) the top surface part W_t and the side surface part W_s inside the downward recessed part of the object to be treated W. Thereby, it is possible to support the object to be treated W on the mounting table 30 and to perform positional regulation of the object to be treated W.

[0064] Further, the shape of the object to be treated W is not limited to the circular shape. Even if the object to be treated W has another shape, as long as the transfer arm 40, the mounting table 30, and the turntable 60 that are capable of supporting the object to be treated W are included and it is constituted so that the object to be treated W can be delivered between the transfer arm 40 and the turntable 60 and between the mounting table 30 and the turntable 60, it is possible to enjoy the effect explained in the above-described embodiment. For example, the object to be treated W may also be an object to be treated W with its vertical cross-sectional shape being a downward recessed shape that is formed of not the "circular top surface part W_t" and the "cylindrical side surface part W_s" illustrated in FIG. 7 and FIG. 8 but a "top surface part" and a "side surface part."

[0065] In this case, as long as the transfer support pins 50 are disposed so as to perform positional regulation of the aforementioned object to be treated by coming into contact with or coming close to an inner wall of the side surface part of the object to be treated when the object to be treated is supported on the transfer arm 40, the positional regulation of the object to be treated W can be performed by the transfer support pins 50. For example, in the case of the object to be treated being an angular cylindrical object to be treated with its quadrangular transverse cross section, the four transfer support pins 50 are provided and it is constituted so that the single transfer support pin 50 may come into contact with a single inner side surface of the "side surface part," and thereby positional regulation of the object to be treated can be performed. Further, as long as the mounting table support pins 33 are disposed so as to perform positional regulation of the aforementioned object to be treated by coming into contact with or coming close to the inner wall of the side surface part of the object to be treated when the object to be treated is supported on the mounting table 30, the positional regulation of the object to be treated W can be performed by the mounting table support pins 33. Similarly, as long as the turntable support pins 69 are disposed so as to perform positional regulation of the aforementioned object to be treated by coming into contact with or coming close to the inner wall of the side surface part of the object to be treated when the object to be treated is supported on the turntable 60, the positional regulation of the object to be treated W can be performed by the turntable support pins 69.

[Industrial Applicability]

[0066] The present invention can be applied to a carburizing and quenching treatment of an object to be treated.

[Explanation of Codes]

[0067]

1	carburizing and quenching facility
2	temperature increasing chamber
3	carburizing chamber
3a	first carburizing chamber
3b	second carburizing chamber

3c	third carburizing chamber
4	quenching chamber
5	transfer apparatus
6	transfer part
7	transfer path
20	delivery part
21	heat treatment part
22	induction heating coil
23	lifting and lowering device
24	lifting and lowering rod
25	transfer port
26	transfer port door
27	partition door
27a	door main body
27b	door main body
30	mounting table
31	circular plate
32	support blade
33	mounting table support pin
40	transfer arm
41	transfer arm tip part
44	projecting part
45	transfer arm main body
46	side part projecting part
47	first opening
48	second opening
49	space part
50	transfer support pin
60	turntable
61	drive device
62	drive rod (turntable support post)
63	first support part
64	second support part
65	first space part
66	second space part
67	first cutout part
68	second cutout part
69	turntable support pin
70	auxiliary pin
70a	tapered part
R	rotation axis
W (W1, W2)	object to be treated
W_t	top surface part
W_s	side surface part

Claims

1. A carburizing and quenching facility that includes: a treatment chamber where at least one treatment related to a carburizing and quenching treatment is performed on an object to be treated; a transfer apparatus to transfer an object to be treated; a mounting table that is provided in the treatment chamber and on which an object to be treated transferred into the treatment chamber is mounted; and a lifting and lowering device to lift and lower the mounting table and in which a transfer arm to transfer an object to be treated into the treatment chamber and outside the treatment chamber is provided in the transfer apparatus and a carburizing and quenching treatment of an object to be treated is performed, the carburizing and quenching facility comprising:

a turntable that is disposed in the treatment chamber and performs deliveries of an object to be treated to and from the mounting table and the transfer arm; and
a turntable drive device that rotates the turntable, wherein
the turntable includes: a first support part that supports an object to be treated that has already undergone a treatment; and a second support part that supports an object to be treated to undergo a treatment next, and
in plan view, the turntable is provided in a positional relationship such that the first support part, a support post of the turntable, and the second support part are disposed in a linear arrangement so as to sandwich a rotation axis of the turntable by the first support part and the second support part.

2. The carburizing and quenching facility according to claim 1, wherein
in the turntable drive device, a lifting and lowering mechanism to lift and lower the turntable is provided.

3. The carburizing and quenching facility according to claim 1 or 2,
wherein
the first support part and the second support part are provided at point-symmetric positions about the rotation axis of the turntable in plan view as a symmetric point.

4. The carburizing and quenching facility according to any one of claims 1 to 3, wherein
on at least one of the first support part and the second support part, at least three turntable support pins to support the object to be treated are provided.

5. The carburizing and quenching facility according to claim 4, wherein
the object to be treated has a shape formed of a top surface part and a side surface part, and the turntable support pins are provided so as to perform positional regulation of the object to be treated by coming into contact with or coming close to an inner wall of the side surface part of the object to be treated when the object to be treated is supported on the transfer arm.

6. The carburizing and quenching facility according to any one of claims 1 to 5, wherein
on the transfer arm, at least three transfer support pins to support the object to be treated are provided.

7. The carburizing and quenching facility according to claim 6, wherein
the object to be treated has a shape formed of a top surface part and a side surface part, and the transfer support pins are provided so as to perform positional regulation of the object to be treated by coming into contact with or coming close to an inner wall of the side surface part of the object to be treated when the object to be treated is supported on the transfer arm.

8. The carburizing and quenching facility according to any one of claims 1 to 7, wherein
on the mounting table, at least three mounting table support pins to support the object to be treated are provided.

9. The carburizing and quenching facility according to claim 8, wherein
the object to be treated has a shape formed of a top surface part and a side surface part, and the mounting table support pins are provided so as to perform positional regulation of the object to be treated by coming into contact with or coming close to an inner wall of the side surface part of the object to be treated when the object to be treated is supported on the mounting table.

FIG.1

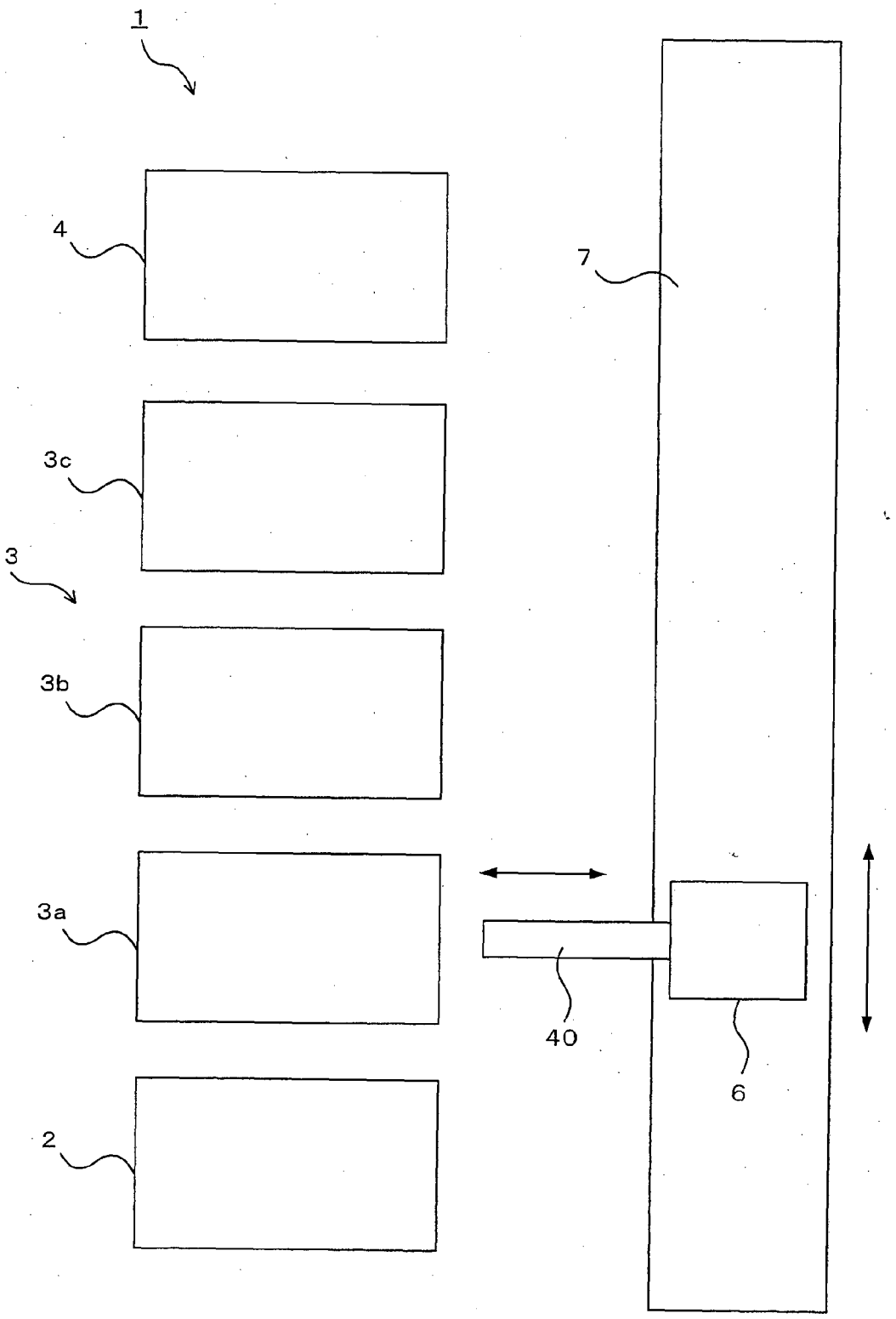
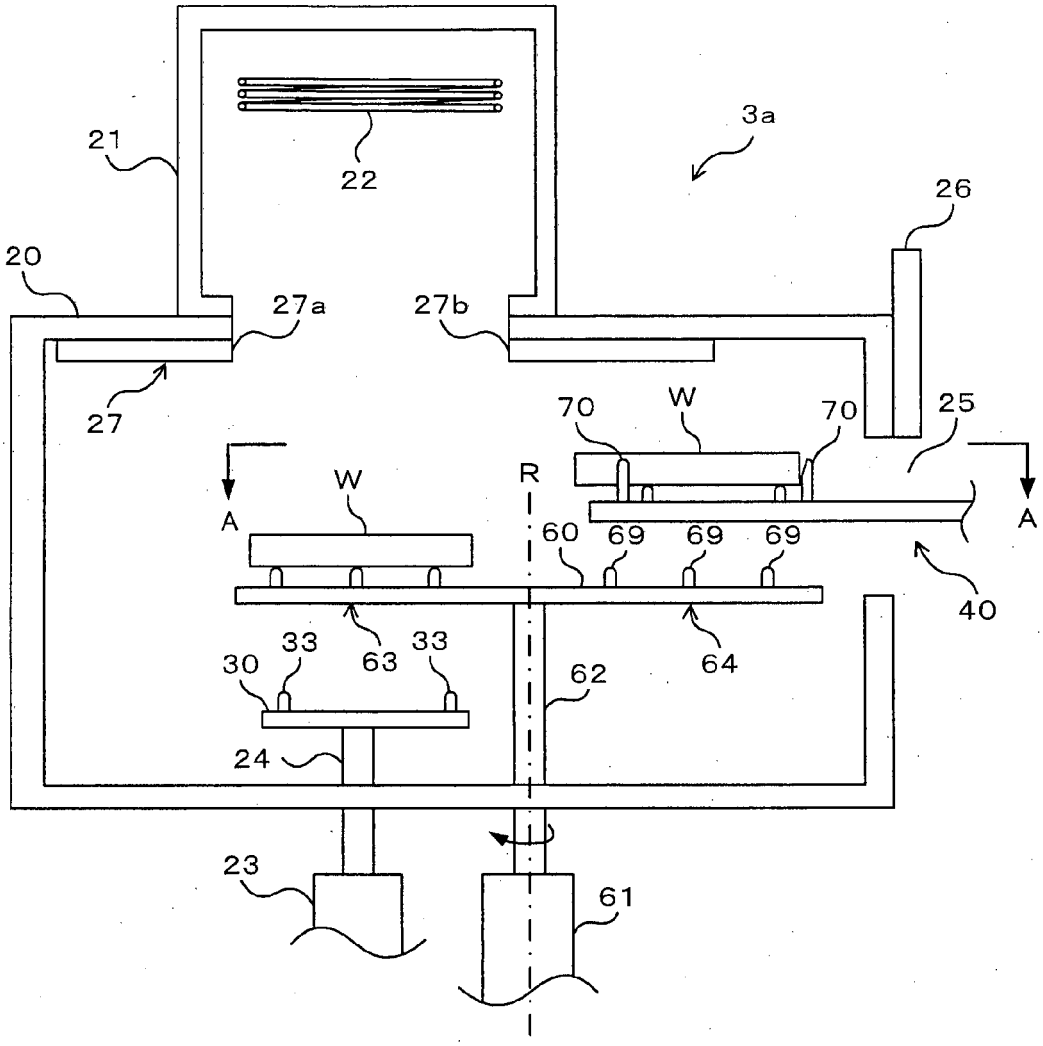


FIG.2


3a
21
22
26
20
27a
27b
27
70
W
70
25
W
R
A
A
60
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63
64
30
62
24
23
61

FIG.3

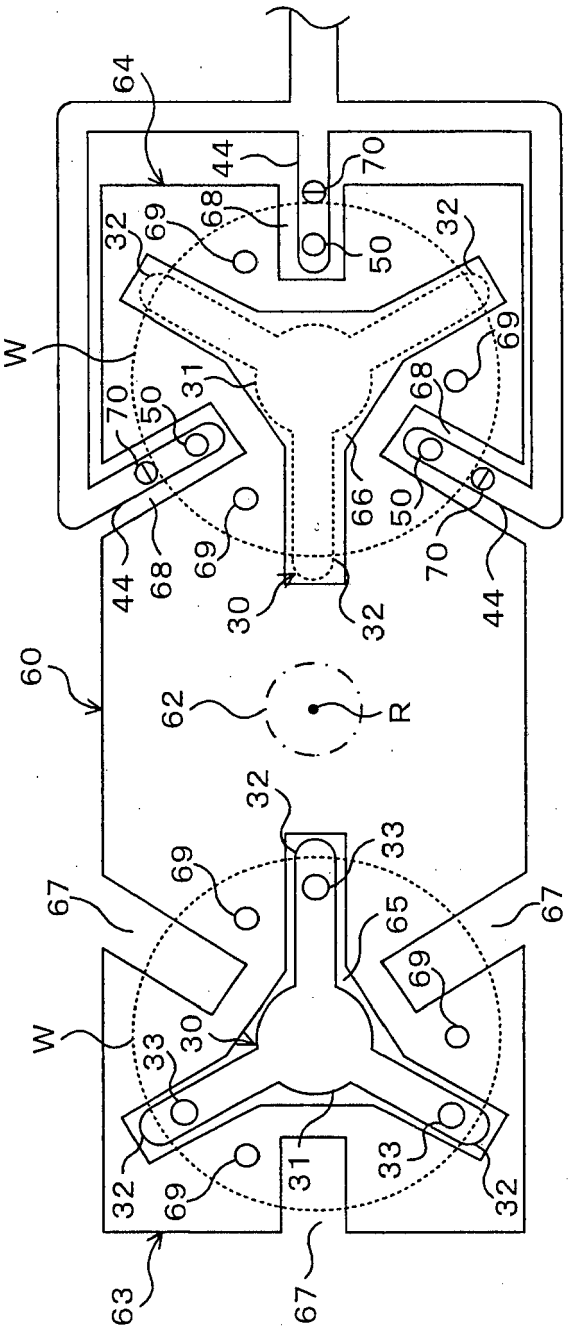


FIG.4

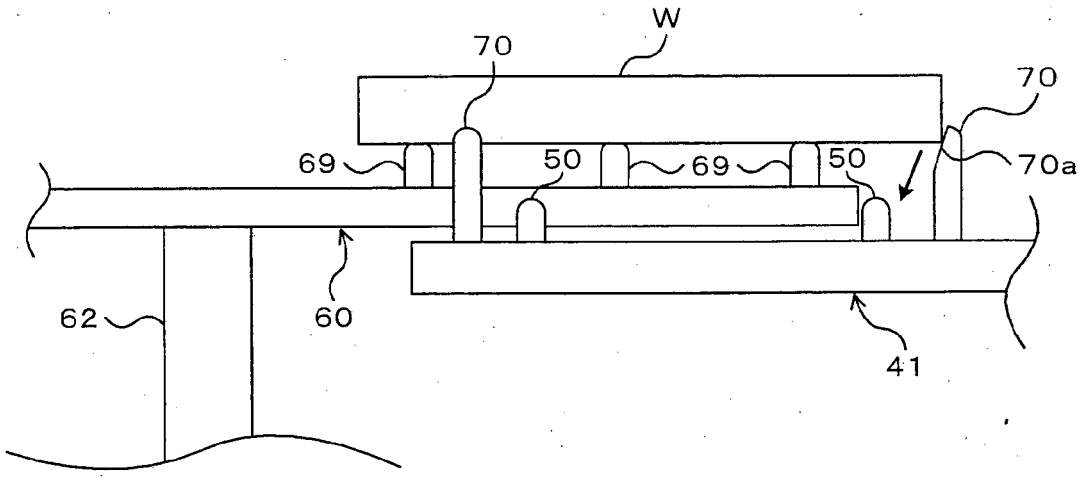
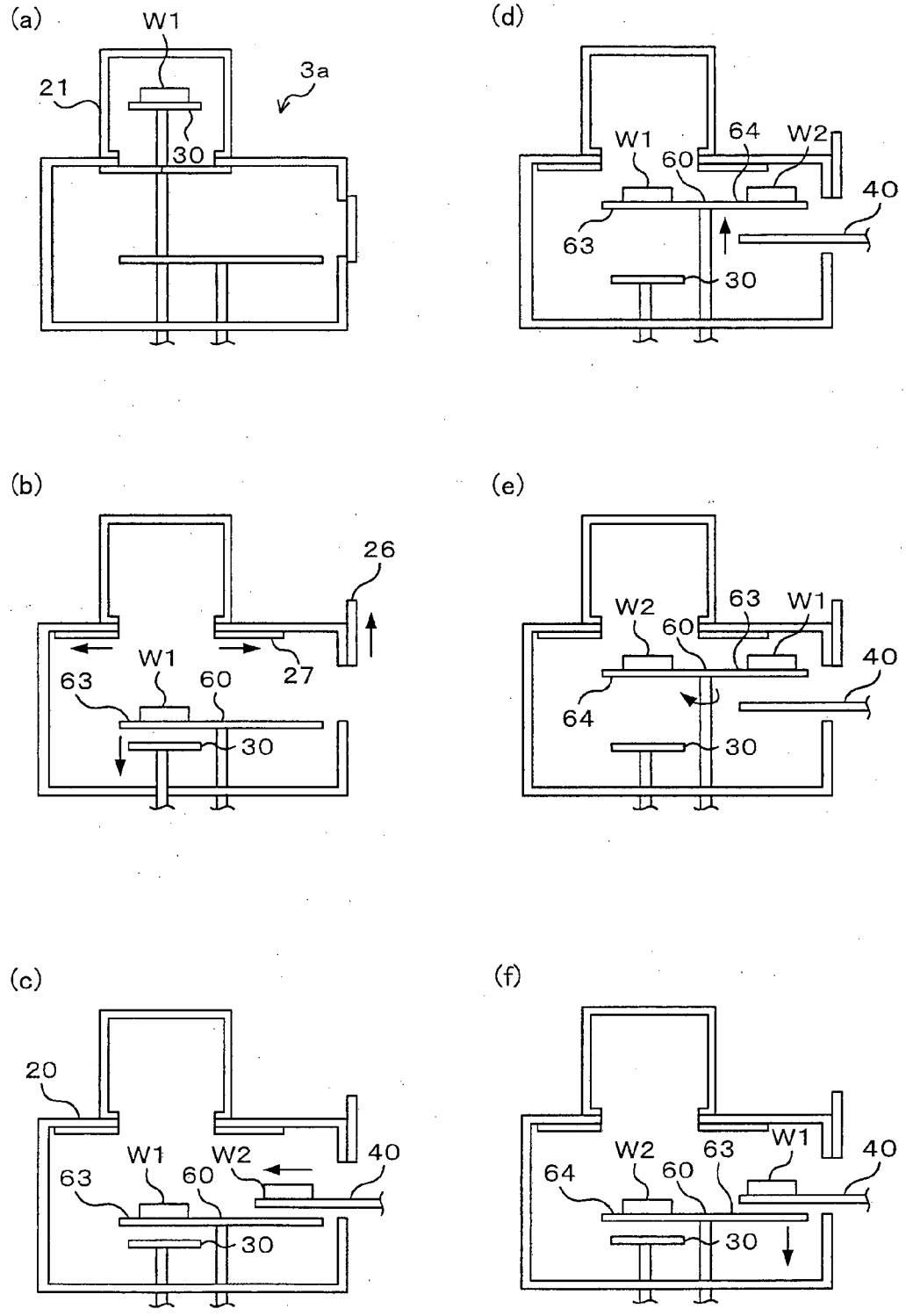


FIG.5


(a)
W1
21
3a
30
(b)
26
W1
63
60
27
30
(c)
20
W1
W2
40
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60
30
(d)
W1
64
W2
60
40
63
30
(e)
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(f)
W1
W2
63
40
64
60
30

FIG.6

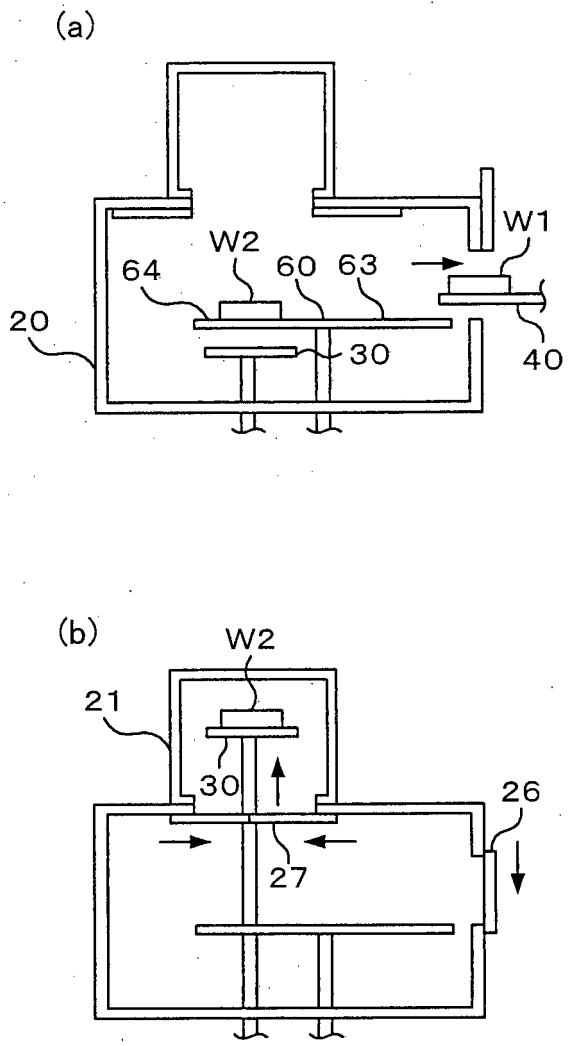


FIG.7

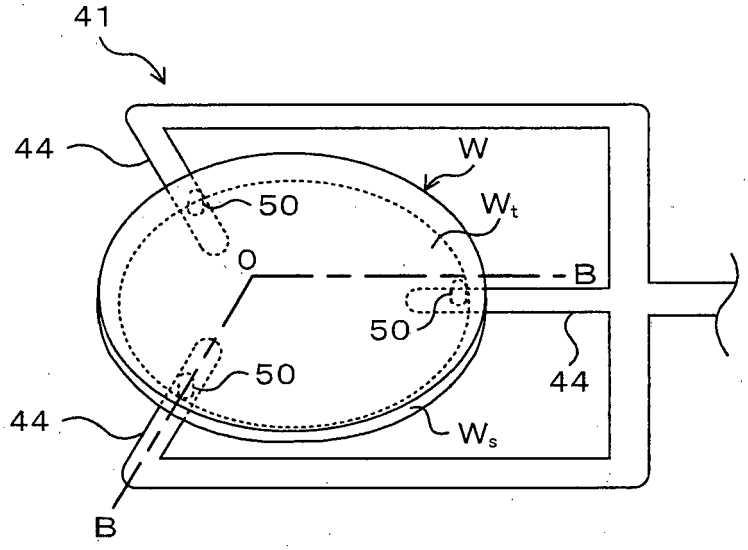
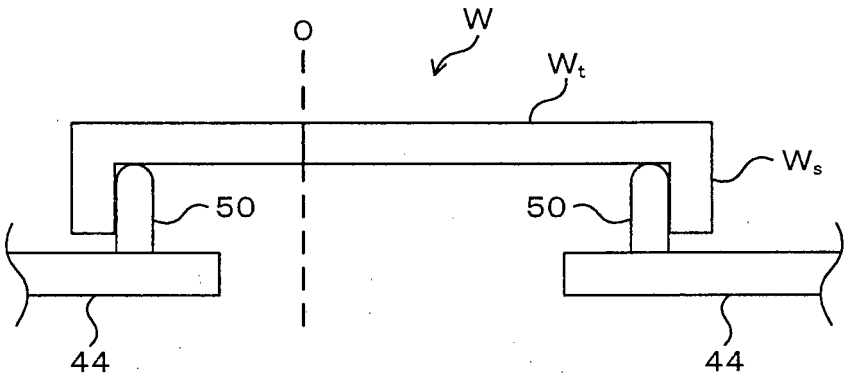


FIG.8



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EUROPEAN SEARCH REPORT

Application Number
EP 15 00 0648

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 103 59 458 A1 (ALD VACUUM TECHN AG [DE]) 28 July 2005 (2005-07-28) * paragraphs [0004] - [0008], [0014], [0015]; claims 1-3; figure 2 *	1-9	INV. C21D1/773 C21D1/78 C21D9/00 C23C8/20 C23C8/22 C21D1/62 F27B9/02 F27B9/04 F27D3/00
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C21D
C23C
F27B
F27D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 July 2015	Catana, Cosmin

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