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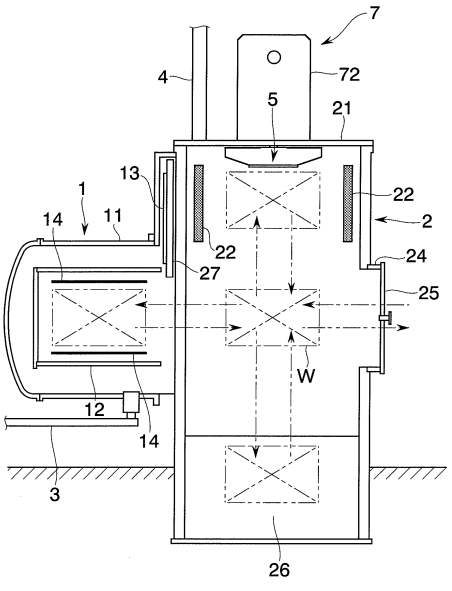
(54) Thermal treatment furnace

(57) The present invention provides a thermal treatment furnace suitable for quenching a large subject to be thermally treated, which is provided with a thermal engine 6, and a fan 5 is driven by the thermal engine 6 to stir high pressure cooling gas for a period during which the subject to be thermally treated W is cooled.

Fig.1



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Description

BACKGROUND OF THE INVENTION

1) Field of the Invention

[0001] The present invention relates to a thermal treatment furnace for subjecting a subject to be thermally treated to quenching and the like.

2) Description of the Related Art

[0002] As an apparatus for subjecting a subject to be thermally treated such as a mold to quenching, a vacuum thermal treatment furnace is known (see the following patent document). In the typical vacuum thermal treatment furnace, after the subject to be thermally treated is heated for a predetermined time in the furnace being formed a vacuum, the subject to be thermally treated is put into an oil tank, or the low temperature cooling gas is stirred using a fan during charging therein, thereby rapidly cooling the subject to be thermally treated.

[0003] To cool the subject to be thermally treated using gas has many merits that the subject to be thermally treated is not contaminated by oil, and the cooling speed is lowered so that thermal deformation of the subject to be thermally treated can be avoided.

[0004] [Patent Document 1] Japanese Patent Application Laid-Open No.H10-183236

[0005] The demand for making it possible to perform the thermal treatment for a larger subject is increasing. Due to demand in terms of industrial producing performance, an attempt has been made to collectively produce a member (such as a door of an automobile) which is a constituent element of a product without dividing the member into a plurality of part to reduce the producing cost. For this reason, a larger mold is required. It is also required to increase the thermal treatment furnace in size so that such a large mold can be subjected to the thermal treatment.

[0006] To rapidly cool the large subject to be thermally treated, it is absolutely necessary to increase the pressure of cooling gas to be charged into an inner chamber. There is a problem concerning how the fan for stirring high pressure gas charged into the large inner chamber should be driven. Originally, the fan for stirring the cooling gas is driven by an electric motor, but in order to stir the high pressure gas, an electric motor having output much greater than that of the current motor must be employed. Further, if an attempt is made to obtain high output, voltage to be applied to the electric motor also becomes high (especially great mechanical output is required for driving the fan, and voltage to be applied also must be increased at the same time), but it is difficult to obtain an electric motor having rated voltage of more than 400V, and it is required for providing massive power receiving equipment and power distributing equipment inside and outside of a factory.

[0007] In the quenching treatment of a subject to be thermally treated, the cooling step is only a portion of the entire steps. Usually, it takes one to two hours for increasing the temperatures in the furnace and of the subject, it takes several hours for a soaking step, and it takes one to two hours for a cooling step of the subject. That is, the time for driving the fan using the electric motor is only about one to two hours, time during which the electric motor and the fan are stopped is longer. Although the electric motor is operated only for several hours a day, from the standpoint of an electric company which generates and supplies electricity, it is necessary to always keep holding electricity-generating ability and electricity-supplying ability so that no problem is generated whenever the electric motor is operated. In other words, it is necessary to spend heavy costs for infrastructure equipment for securing electricity-supplying ability so as cope with peak power demand. This cost of course increase the electric bill. The actual electric bill is a sum of a charge on an as-used basis corresponding to consumed electricity and a basic charge corresponding to the equipment electricity. An electric motor of high output increases the equipment electricity value and thus, time during which the electric motor is not operated a day is long irrespective of high basic charge. Users of thermal treatment furnaces bear illogical costs.

[0008] Further, when a thermal treatment furnace is operated in various countries where the electricity circumstances are not stable as compared with Japan, this becomes a risk factor. If the electricity supply becomes unstable when the cooling step is carried out, a subject to be thermally treated in the furnace is damaged, and critical loss is generated.

SUMMARY OF THE INVENTION

[0009] The present invention contrived with an innovative idea based on an attempt first focusing on the above noted problems, provides a thermal treatment furnace having a thermal engine, for subjecting a subject to be thermally treated to a quenching treatment, wherein the thermal engine drives a fan for a period during which the subject to be thermally treated is cooled.

[0010] With this structure, it becomes unnecessary to provide massive power receiving equipment and power distributing equipment inside and outside of a factory. This also reduces illogical social costs for providing infrastructure whose

non-operating time is longer than operating time. Recently, an attempt is made to level the electricity demand to avoid a new power generating equipment, and the invention can contribute to leveling of the electricity demand. Energy loss in a power sending path, energy loss in power reception, and energy loss in electricity-mechanical conversion can be reduced as compared with a case in which power generated by a thermal power station is supplied and received (converted) to drive an electric motor and fan. The thermal engine for driving a fan is only operated temporarily in the cooling step, and it is sufficiently possible to appropriately suppress or eliminate harmful material discharged from the thermal engine with rational cost. According to thermal engines disposed in various locations (where thermal treatment furnaces are operated), it is easy to prevent pollution caused by factory management, inspection and constraints as compared with massive thermal power station.

[0011] The thermal treatment furnace of the present invention is suitable for being operated in various countries where electricity circumstances are unstable as compared with Japan.

[0012] As secondary effect, it is possible to control the revolving speed of a fan by applying a known revolving speed control mechanism used in an automobile or a ship, and to flexibly control the cooling speed of a subject to be thermally treated. This is especially effective in a quenching processing of a material in which the cooling speed must be adjusted. That is, it is possible to suppress the generation of thermal deformation while securing desired quenching effect (hardening effect).

[0013] According to the invention, it becomes unnecessary to provide massive power receiving equipment and power distributing equipment inside and outside of a factory. This also reduces illogical social costs for providing infrastructure whose non-operating time is longer than operating time. This is preferable for operation in various countries where the electricity circumstances are not stable as compared with Japan.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic side sectional view of a thermal treatment furnace according to an embodiment of the present invention;

Fig. 2 is a schematic front sectional view showing the thermal treatment furnace of the embodiment; and

Fig. 3 is a schematic side sectional showing a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] An embodiment of the present invention will be explained with reference to the drawings. A thermal treatment furnace of the embodiment is a vacuum thermal treatment furnace in which a subject to be thermally treated W in its vacuum state is heated and then, the subject to be thermally treated W is put into an oil tank 26, or cooling fluid is stirred by a fan 5 while the cooling fluid being charged therein, thereby rapidly cooling the subject to be thermally treated W. As shown in Figs. 1 and 2, the thermal treatment furnace is of a double structure including a heating chamber 1 for heating the subject to be thermally treated W, and a cooling chamber 2 for cooling the subject to be thermally treated W heated in the heating chamber 1. The thermal treatment furnace is provided with a thermal insulation body 12, a heater 14, a vacuum exhaust system 3 and the like, as a part of the heating chamber 1, and provided with an oil tank 26, a fluid introducing system 4, the fan 5 and the like; as a part of the cooling chamber 2.

[0016] More specifically, the substantially box-like thermal insulation body 12 is disposed in a furnace barrel 11 which is an outer shell of the heating chamber 1, and disposed inside is the heater 14, thereby constituting a thermal treatment space for heating the subject to be thermally treated W. A thermal insulating lid 13 being openable and closable is provided on the side of the cooling chamber 2 of the thermal insulation body 12. The thermal insulating lid 13 can be opened and closed. The thermal insulation body 12 and the thermal insulating lid 13 are made of graphite felt for example. The vacuum exhaust system 3 is formed by serially connecting a dispersion pump (not shown), a mechanical booster pump (not shown) and a hydraulic rotation vacuum pump (not shown) and so on, and the vacuum exhaust system 3 is connected to the furnace barrel 11 through a valve such that they can be connected and disconnected to and from each other. The heater 14 is a graphite heater or the like capable of heating the subject to be thermally treated W to a desired temperature. The heater 14 is disposed at a location surrounding the subject to be thermally treated W in the thermal treatment space.

[0017] The furnace barrel 11 is in communication with a housing 21 which is an outer shell of the cooling chamber 2. The furnace barrel 11 and the housing 21 are divided by a partition door 27 which integrally operated with the thermal insulating lid 13. The housing 21 is expanded in the vertical direction. In an upper region of the housing 21, a gas quenching space is formed by providing a fluid introducing system 4 in which cooling fluid (e.g., inert gas such as N2) is charged, the fan 5 for stirring and circulating the charged cooling fluid, and a heat exchanger 22 for cooling fluid which circulates in the housing 21. The fluid introducing system 4 sends inert gas for cooling the subject to be thermally treated

W subjected to the thermal treatment from a gas cylinder (not shown) into the housing 21. A valve is provided in an intermediate portion of the fluid introducing system 4 of course. The fan 5 is disposed on an upper end of the housing 21, and a drive shaft 51 of the fan5 penetrates the housing 21 and projects upward. A vacuum seal 23 is provided on a portion of the fan 5 where the drive shaft 51 penetrates the housing 21. A passage (e.g., water cooling opening in the shaft (not shown)) through which refrigerant flows may be provided in the drive shaft 51 as means for cooling the drive shaft 51 of the fan 5. An inlet/outlet 24 through which the subject to be thermally treated W is brought into and out from the housing 21 is provided at a necessary location of the housing 21. The inlet/outlet 24 is tightly closed by an opening and closing door 25. In addition, a lower region of the housing 21 is formed with the oil tank 26 for accumulating quenching oil as the oil quenching space, but this oil tank 26 is not absolutely necessary.

[0018] In this embodiment, a thermal engine 6 which outputs driving force for driving the fan 5 is provided. A transmitting mechanism 7 is interposed between an output shaft 61 of the thermal engine 6 and the drive shaft 51 of the fan 5 to connect the output shaft 61 and the drive shaft 51 with each other.

[0019] The thermal engine 6 burns fuel to take out mechanical energy to rotate the output shaft 61 (especially internal combustion engine), but its concrete structure is not limited. It is possible to employ various thermal engines such as diesel engine, gasoline engine and gas turbine engine as the thermal engine 6 in accordance with design specification and other circumstances. Preferably, a known revolving speed control mechanism (not shown) used for an automobile and a ship is applied to control the revolving speed of the output shaft 61. The thermal engine 6 is supported by a pedestal 62 which is separated from the furnace barrel 11 and the housing 21.

[0020] The transmitting mechanism 7 transmits rotation driving force which is outputted from the thermal engine 6 to the drive shaft 51 of the fan 5. In this embodiment, the transmitting mechanism 7 comprises a clutch and bevel gears. In the illustrated example, a clutch box 71 accommodating the clutch is disposed on a pedestal 62, and a gear box 72 accommodating the bevel gears is disposed on the housing 21. The structure of the transmitting mechanism 7 is not limited to the above-described structure. The clutch and the bevel gear are not absolutely necessary. Gears other than the bevel gears may be employed of course. It is also possible to use winding transmitting means such as a belt and a chain.

[0021] The reason why the thermal engine 6 is supported by the pedestal 62 and the transmitting mechanism 7 is interposed between the thermal engine 6 and the fan 5 is that when the thermal engine 6 is operated, its vibration can be prevented from being transmitted to the housing 21 and the furnace barrel 11.

[0022] Process of the quenching treatment using the vacuum thermal treatment furnace of the embodiment will be explained. The subject to be thermally treated W sent from the inlet/outlet 24 is transferred into the thermal treatment space in the heating chamber 1 by a transfer mechanism (not shown), the thermal insulating lid 13 of the thermal insulation body 12 and the partition door 27 are closed, and the subject to be thermally treated W is heated. After the heating operation is completed, the thermal insulating lid 13 and the partition door 27 are opened, and the subject to be thermally treated W is transferred into a gas quenching space in the housing 21 by the transfer mechanism. Then, when the thermal engine 6 is started, the fan 5 is rotated. If the revolution speed of the fan 5 reaches a predetermined revolving speed, cooling fluid, i.e., inert gas is allowed to flow into the inner chamber (i.e. , into the cooling chamber 2) of the thermal treatment furnace by the fluid introducing system 4, the fan 5 stirs the inert gas, and the subject to be thermally treated W is rapidly cooled. After the cooling operation is completed, the internal pressure in the thermal treatment furnace is reduced to the atmospheric pressure, and the subject to be thermally treated W is transferred to a portion near the inlet/outlet 24 by the transfer mechanism. When the heated subject to be thermally treated W is to be cooled, it is possible to carry out the oil quenching for bringing the subject to be thermally treated W into the oil tank 26.

[0023] According to this embodiment, the thermal treatment furnace comprises the heating chamber 1 for heating the subject to be thermally treated W, the cooling chamber 2 into which the subject to be thermally treated W heated in the heating chamber 1 is transferred, the fan 5 for stirring fluid charged into the cooling chamber 2 for cooling the subject'to be thermally treated W, the thermal engine 6 for outputting the driving force which drives the fan 5 for a period during which the subject to be thermally treated W in the cooling chamber 2, is cooled using the fan 5 and the transmitting mechanism 7 for transmitting the driving force which is outputted from the thermal engine 6 to the drive shaft 51 of the fan 5. Therefore, it becomes unnecessary to provide massive power receiving equipment and power distributing equipment inside and outside of a factory. This also reduces illogical social costs for providing infrastructure whose non-operating time is longer than operating time. This is preferable for operation in various countries where the electricity circumstances are not stable as compared with Japan.

[0024] It should be note that the present invention is not limited to the above-described embodiment. For example, a single chamber thermal treatment furnace in which the heating chamber 1 and the cooling chamber 2 are not separated from each other as shown in Fig. 3 may be employed. In this thermal treatment furnace as illustrated, the drive shaft 51 of the fan 5 and the output shaft 61 of the thermal engine 6 are directed in substantially a horizontal direction, and they are substantially in parallel to each other. Accordingly, it is possible to use spur gears, helical gears or herringbone gears as an element of the transmitting mechanism 7 which connects the drive shaft 51 of the fan 5 and the output shaft 61 of the thermal engine 6 to each other. Moreover, as in this illustrated example, when the drive shaft 51 of the fan 5 and the output shaft 61 of the thermal engine 6 are substantially in parallel to each other, they can directly be connected to

each other without interposing the transmitting mechanism 7.

[0025] Concrete structures of other parts are not limited to those of this embodiment, and the invention can variously be modified in a range not departing from the subject matter of the invention.

[0026] The present invention provides a thermal treatment furnace suitable for quenching a large subject to be thermally treated, which is provided with a thermal engine 6, and a fan 5 is driven by the thermal engine 6 to stir high pressure cooling gas for a period during which the subject to be thermally treated W is cooled.

Claims

1. A thermal treatment furnace which heats a subject to be thermally treated, and then, cools off the subject to be thermally treated with cooling fluid being charged, comprising:

an inner chamber into which the subject to be thermally treated is transferred and the cooling fluid is charged;
a fan for stirring the cooling fluid charged into the inner chamber to cool the subject to be thermally treated; and
a thermal engine for outputting a driving force to drive the fan for a period during which the subject to be thermally treated is cooled using the fan.

2. A thermal treatment furnace which heats a subject to be thermally treated, and then, cools off the subject to be thermally treated with cooling fluid being charged, comprising:

an inner chamber into which the subject to be thermally treated is transferred and the cooling fluid is charged;
a fan for stirring the cooling fluid charged into the inner chamber to cool the subject to be thermally treated; and
a thermal engine for outputting a driving force to drive the fan for a period during which the subject to be thermally treated is cooled using the fan; and
a transmitting mechanism for transmitting the driving force which is outputted from the thermal engine to a drive shaft of the fan.

Fig.1

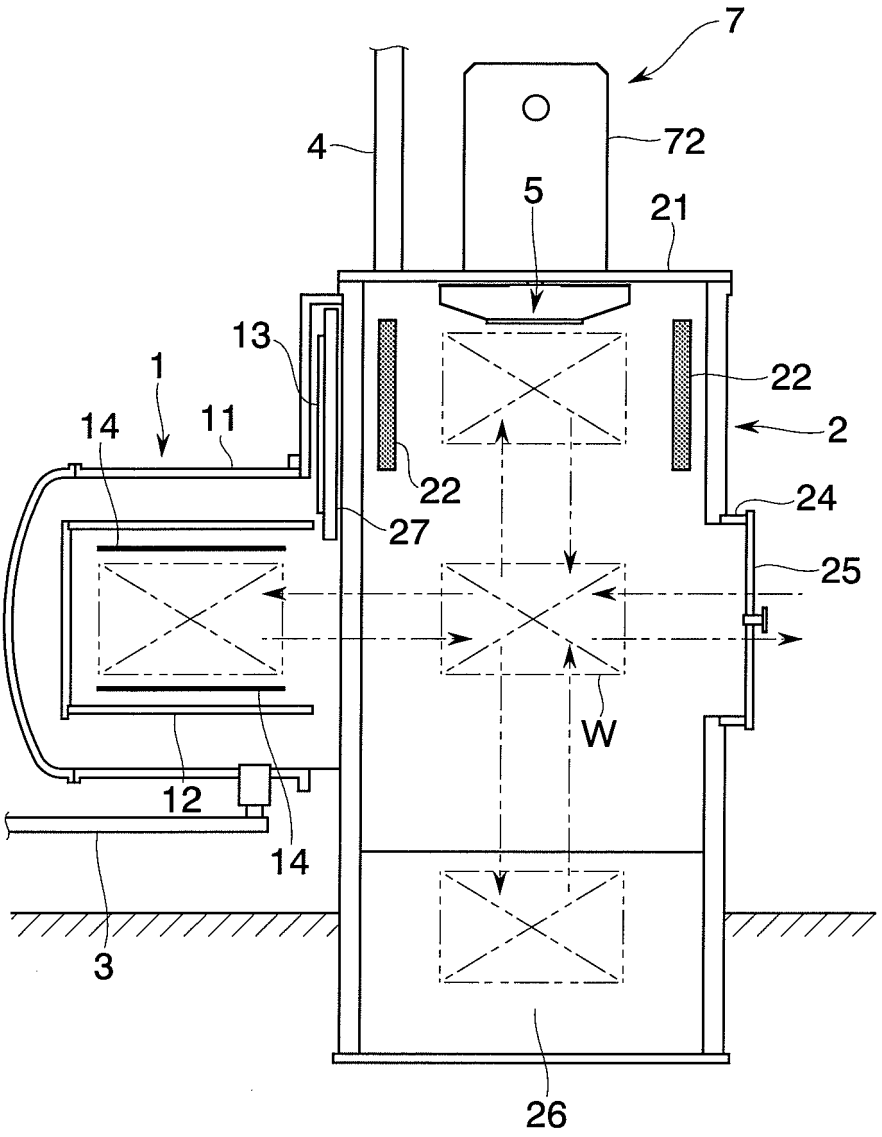


Fig.2

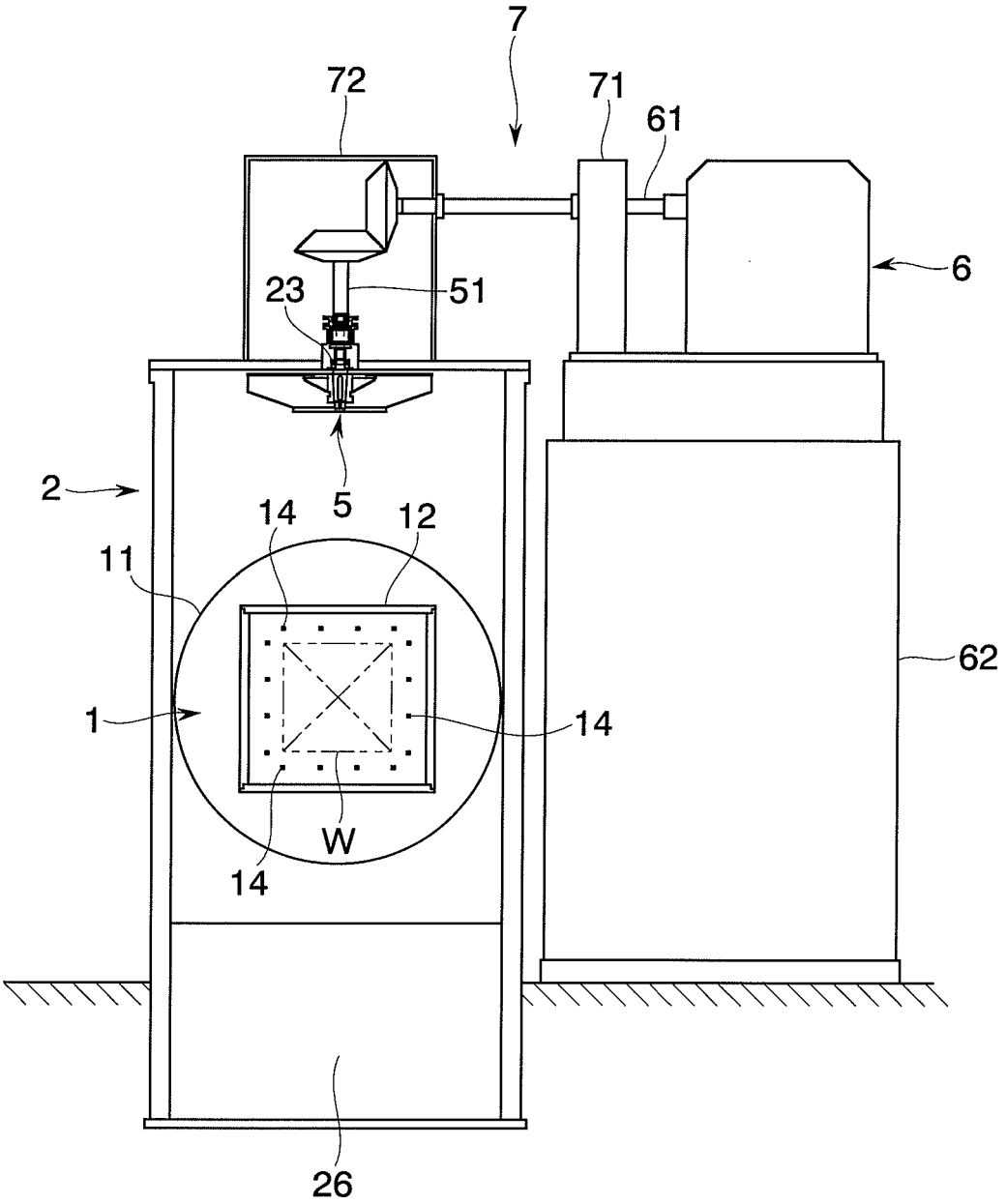
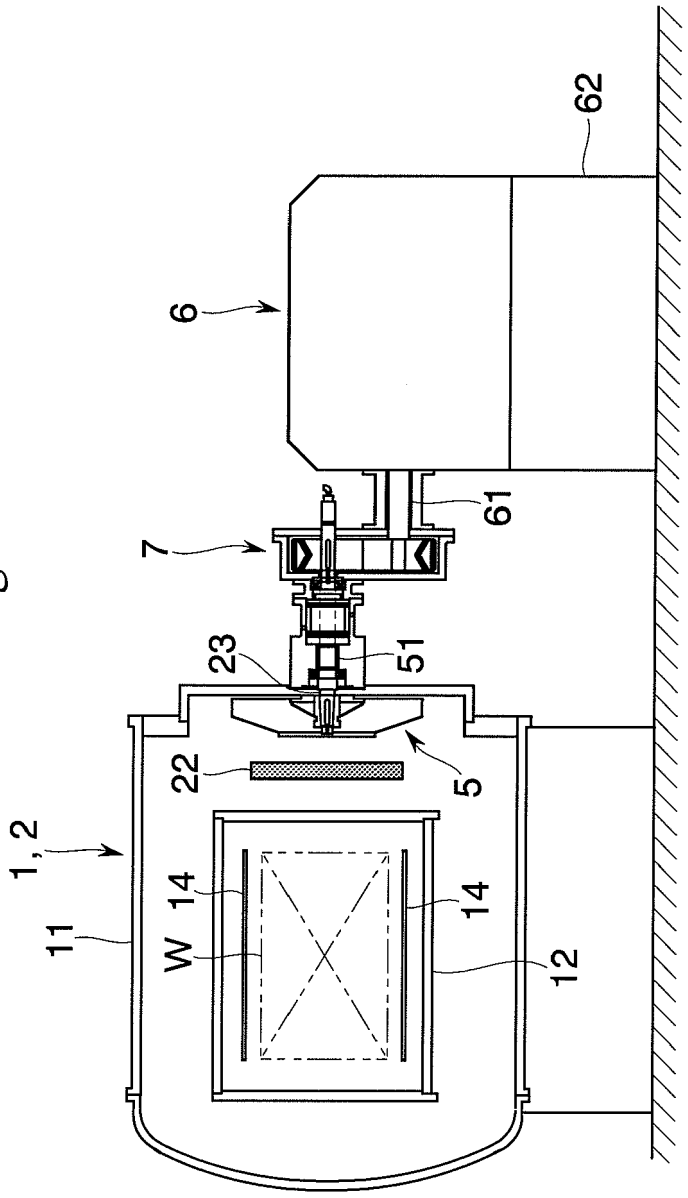


Fig.3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H10183236 A **[0004]**