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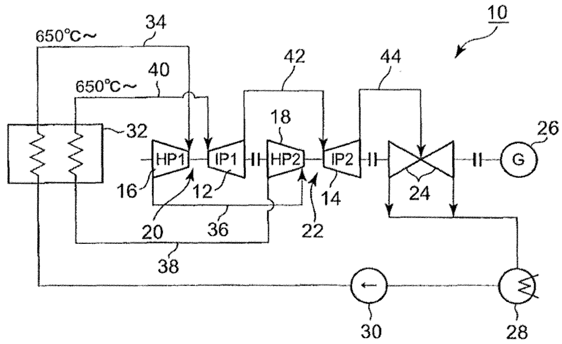
(54) STEAM TURBINE EQUIPMENT

(57) Provided is a steam turbine facility capable of suppressing the possibility of vibration occurrence and a drastic increase in facility cost, thereby realizing an increase in size of the facility, even if steam conditions of 650°C or higher are adopted. In a steam turbine facility including a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine, the high-pressure turbine is separated into a first high-pressure turbine part on a high-temperature and high-pressure side and a second high-pressure turbine part on a low-temperature and low-pressure side, the intermediate-pressure turbine is separated into a first intermediate-pressure turbine part on the high-temperature and high-pressure side and a second intermediate-pressure turbine part on the low-temperature and low-temperature side, the first high-pressure turbine part and the first intermediate-pressure turbine part are integrated to form a first integrated part, the second high-pressure turbine part and the second intermediate-pressure turbine part are integrated to form a second integrated part, at least any one of the rotors and casings of the turbines into which steam with a temperature of 650°C or higher is introduced are constructed by joining together a plurality of members formed from Ni-based alloy through welding.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a steam turbine facility including a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine.

Background Art

[0002] Three methods of atomic power, thermal power, and hydraulic power generation, are now used as main power generation methods, and from the viewpoint of resource quantity and energy density, the three power generation methods are also expected to be used as main power generation methods in the future. Especially, since thermal power generation is safe, and its utility value is high as a power generation method with a high capacity to respond to load changes, it is expected that thermal power generation will also continue to play an important role in the power generation field in the future.

[0003] In general, a steam turbine facility, which is used in a coal-fired power station including steam turbines, is provided with a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine. In such a steam turbine facility, steam in the 600°C class is used. A rotor and a casing of the high-pressure turbine or the intermediate-pressure turbine, which is exposed to high temperatures, are formed from a ferrite-based material which has thermal resistance to 600°C steam and excellent manufacturability and is economically competitive.

[0004] Recently, however, a technique which adopts steam conditions of 650°C class or 700°C class is being demanded, in order to reduce emissions of CO_2 and improve thermal efficiency. Patent Document 1 has disclosed a steam turbine facility capable of operating at a high temperature in which a reheat steam condition is 650°C or higher.

[0005] FIG. 14 is a schematic system view illustrating a conventional steam turbine facility disclosed in Patent Document 1. In a steam turbine facility 110 illustrated in FIG. 14, a intermediate-pressure turbine is separated into a first intermediate-pressure turbine 112 on a high-temperature and high-pressure side and a second intermediate-pressure turbine 114 on a low-temperature and low-pressure side. Additionally, the high-pressure turbine 116 and the second intermediate-pressure turbine 114 are integrated to form an integrated structure 122. The integrated structure 122 is connected together on the same axis as the first intermediate-pressure turbine 112 on the high-temperature and high-pressure side, the low-pressure turbine 124, and the generator 126.

[0006] Main steam superheated to a temperature in the 600°C class by a boiler 132 is introduced into the high-pressure turbine 116 through a main steam pipe 134. The steam introduced into the high-pressure turbine 116 performs expansion work and is then exhausted and returned to the boiler 132 through a low-temperature reheat pipe 138. The steam returned to the boiler 132 is reheated by the boiler 132 such that the temperature thereof increases to the 700°C class. The reheated steam is sent to the first intermediate-pressure turbine 112 through a high-temperature reheat pipe 140. A rotor of the first intermediate-pressure turbine 112 is formed from a material (austenitic heat resisting steel) capable of withstanding steam heated to a high temperature class of 700°C. The steam sent to the first intermediate-pressure turbine 112 performs expansion work and is then exhausted and sent to the second intermediate-pressure turbine 114 through an intermediate-pressure part connection pipe 142 in a state where the temperature thereof decreased to 550°C class. The steam sent to the second intermediate-pressure turbine 114 performs expansion work and is then exhausted and introduced to the low-pressure turbine 124 through a crossover pipe 144. The steam introduced into the low-pressure turbine 124 performs expansion work and is then exhausted and sent to a condenser 128. The steam sent to the condenser 128 is condensed by the condenser 128, and is then returned to the boiler 132 in a state where the pressure thereof is raised by a water feed pump 130. The generator 126 is rotationally driven by the expansion work of the respective turbines to generate power.

[0007] In such a steam turbine facility, the intermediate-pressure turbine is divided, and only the first intermediate-pressure turbine 112 is formed from a material capable of withstanding steam with a temperature of 650°C or higher. Therefore, a steam condition of 650°C or higher may be adopted, and the use amount of the material capable of withstanding steam with a temperature of 650°C or higher may be reduced. Therefore, it is possible to reduce the manufacturing costs of the entire facility.

[0008] In the technique disclosed in Patent Document 1, however, the high-pressure turbine is not formed from a material capable of withstanding steam with a temperature of 650°C or higher. Therefore, it is difficult to apply the technique to a case where steam with a temperature of 650°C or higher is used as main steam.

[0009] Moreover, considering a steam turbine facility with a large capacity, the facility illustrated in FIG. 14 is difficult to implement. When such a material as Ni-based alloy capable of withstanding steam with a temperature of 650°C or higher is used to form the first intermediate-pressure turbine 112, it is difficult to manufacture a turbine rotor or casing weighing 10t or more in terms of the limitation of material manufacturing, and it is impossible to manufacture a large-sized turbine rotor or casing.

[0010] Therefore, as illustrated in FIG. 15, the first intermediate-pressure turbine 112 may be further divided into the primary and secondary first intermediate-pressure turbines 112 and 113. In this case, however, the number of casings increases, and thus the number of buildings or pipes increases. Therefore, the manufacturing costs of the facility inevitably increase. Additionally, as the number of rotors (divided turbines) increases, it is highly likely that vibration occurs.

[0011] Additionally, a ferrite-based material may be used instead of using the Ni-based alloy. In this case, however, a large amount of cooling steam needs to be introduced into the casings. As a result, the internal efficiency of the turbines decreases.

Prior Art Document

Patent Document

[0012]

[Patent Document 1] Japanese Patent No. 4074208

Summary of the Invention

[0013] Accordingly, the invention was made in view of the problems of the conventional technique, and the object thereof is to provide a steam turbine facility capable of suppressing the possibility of vibration occurrence and a drastic increase in facility cost, thereby realizing an increase in size of the facility, even if steam conditions of 650°C or higher are adopted.

[0014] In order to solve these problems, the invention provides a steam turbine facility including a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine. The high-pressure turbine is separated into a first high-pressure turbine part on a high-temperature and high-pressure side and a second high-pressure turbine part on a low-temperature and low-pressure side, the intermediate-pressure turbine is separated into a first intermediate-pressure turbine part on the high-temperature and high-pressure side and a second intermediate-pressure turbine part on the low-temperature and low-temperature side, the first high-pressure turbine part and the first intermediate-pressure turbine part are integrated to form a first integrated part, at least the second high-pressure turbine part and the second intermediate-pressure turbine part are integrated to form a second integrated part, at least any one of the rotors and casings of the first high-pressure turbine part and the first intermediate-pressure turbine part, into which steam with a temperature of 650°C or higher is introduced, are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0015] In such a configuration, at least any one of the rotors and the casings of the turbines into which the steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding. Therefore, even under the steam condition in which the steam with a temperature of 650°C or higher is introduced into the high-pressure turbine and the intermediate-pressure turbine, it is possible to increase the size of the facility without increasing the numbers of casings, rotors (divided turbines), and blade stages.

[0016] Additionally, in the steam turbine facility, steam with a temperature of 650°C or higher is introduced into the first high-pressure turbine and the first intermediate-pressure turbine. Additionally, the first high-pressure turbine and the first intermediate-pressure turbine are integrated, and the second high-pressure turbine and the second intermediate-pressure turbine, into which steam with a temperature of less than 650°C is introduced and which may be formed from a ferrite-based material, are integrated. Therefore, since the amount of high-grade Ni-based alloy materials used is reduced, it is possible to suppress a drastic increase in facility costs. Additionally, since at least any one of the rotors and the casings of the turbines into which the steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, it is possible to increase the internal efficiency of the turbines, without introducing a large amount of cooling steam into the turbines.

[0017] Additionally, the steam turbine facility may further include an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced. The very-high-pressure turbine, the first integrated part, the second integrated part, and the low-pressure turbine may be connected together on the same axis.

[0018] Accordingly, it is possible to use further high-pressure steam.

[0019] Additionally, steam with a temperature of 650°C or higher may be introduced into the first high-pressure turbine part and the first intermediate-pressure turbine part forming the first integrated part, and steam with a temperature of less than 650°C may be introduced into the second high-pressure turbine part and the second intermediate-pressure turbine part forming the second integrated part. The second integrated part and the low-pressure turbine may be connected on a different axis from the first integrated part, and the first integrated part may be arranged at a position closer to a boiler than the connection structure of the second integrated part and the low-pressure turbine, the boiler superheating the steam introduced into the high-pressure turbine and the intermediate-pressure turbine.

[0020] As the first high-pressure turbine part and the first intermediate-pressure turbine part into which the steam with a temperature of 650°C or higher is introduced are arranged close to the boiler, it is possible to shorten the pipe connecting the boiler to the first high-pressure turbine part and the pipe connecting the boiler to the first intermediate-pressure turbine part. Accordingly, it is possible to reduce the amount of material used in the pipes. Since the steam with a temperature of 650°C or higher passes through the pipe connecting the boiler to the first high-pressure turbine part and the pipe connecting the boiler to the first intermediate-pressure turbine part, it is necessary to manufacture the pipes with Ni-based alloy that is a high-grade material. However, as the amount of high-grade material used is reduced by shortening the pipes, it is possible to reduce the manufacturing costs of the entire facility.

[0021] Additionally, the steam turbine facility may further include an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced. The first integrated part and the very-high-pressure turbine may be connected together on the same axis.

[0022] Accordingly, it is possible to use further high-pressure steam.

[0023] Additionally, in the steam turbine facility, the second integrated part may be further integrated with the low-pressure turbine. In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs.

[0024] Moreover, the invention provides a steam turbine facility including a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine. The high-pressure turbine is separated into a first high-pressure turbine part on a high-temperature and high-pressure side and a second high-pressure turbine part on a low-temperature and low-pressure side, the intermediate-pressure turbine is separated into a first intermediate-pressure turbine part on the high-temperature and high-pressure side and a second intermediate-pressure turbine part on the low-temperature and low-temperature side, the first high-pressure turbine part and the first intermediate-pressure turbine part are integrated to form a first integrated part, at least any one of the rotors and casings of the steam-introduction-side turbines of the first high-pressure turbine part and the first intermediate-pressure turbine part, into which steam with a temperature of 650°C or higher is introduced, are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding. The second intermediate-pressure turbine part and the low-pressure turbine may be integrated.

[0025] The second high-pressure turbine and the second intermediate-pressure turbine may not be integrated in order to easily cope with large capacity.

[0026] Additionally, when the second intermediate-pressure turbine part and the low-pressure turbine are integrated, the number of casings and rotors may be reduced, which makes it possible to reduce the facility costs.

[0027] Moreover, the invention provides a steam turbine facility including a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine. The turbines into which steam with a temperature of 650°C or higher is introduced are connected together on the same axis, the turbines into which steam with a temperature of less than 650°C are connected together on the same axis different from that of the turbines into which the steam with a temperature of 650°C or higher is introduced, the turbines into which the steam with a temperature of 650°C or higher is introduced are arranged at positions closer to the boiler than the turbines into which the steam with a temperature of less than 650°C is introduced, the boiler superheating the steam introduced into the high-pressure turbine and the intermediate-pressure turbine, at least any one of the rotors and casings of the turbines into which the steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0028] All the turbines into which the steam with a temperature of 650°C or higher is introduced are arranged close to the boiler, it is possible to shorten pipes connecting the boiler to the turbines into which the steam with a temperature of 650°C or higher is introduced. Therefore, it is possible to reduce the amount of material used in the pipes. Since steam with a temperature of 650°C or higher passes through the pipes connecting the boiler to the turbines into which the steam with a temperature of 650°C or higher is introduced, it is necessary to manufacture the pipes with Ni-based alloy that is a high-grade material. However, since the amount of material used is reduced by shortening the pipes, it is possible to reduce the manufacturing costs of the entire facility.

[0029] Additionally, rotors or casings of the turbines into which the steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding. Therefore, even under the steam condition in which the steam with a temperature of 650°C or higher is introduced into the first intermediate-pressure turbine part, it is possible to increase the size of the facility, without increasing the numbers of casings, rotors, and blade stages.

[0030] Moreover, the invention provides a steam turbine facility including a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine. At least the high-pressure turbine and the intermediate-pressure turbine are integrated to form an integrated structure, the integrated structure and the low-pressure turbine are connected together on the same axis, at least any one of the rotors and casings of the turbines into which steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding. The high-pressure turbine, the intermediate-pressure turbine, and the low-pressure turbine may be integrated. In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs.

[0031] Additionally, the steam turbine facility may further include an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced. The first integrated part and the very-high-pressure turbine may be connected together on the same axis.

[0032] Accordingly, it is possible to use further high-pressure steam.

[0033] According to the aspects of the invention, even if steam conditions in the 650°C or 700°C class are adopted, it is possible to provide a steam turbine facility capable of suppressing the possibility of vibration occurrence and a drastic increase in facility cost, thereby realizing an increase in size of the facility.

Brief Description of the Drawings

[0034]

[FIG. 1] FIG. 1 is a view illustrating the configuration of a steam turbine power generation facility according to Example 1 of the invention.

[FIG. 2] FIG. 2 is a view illustrating the configuration of a steam turbine power generation facility formed by partially changing the configuration of the steam turbine power generation facility according to Example 1 of the invention.

[FIG. 3] FIG. 3 is a view illustrating the configuration of a steam turbine power generation facility formed by partially changing the configuration of the steam turbine power generation facility according to Example 1 of the invention.

[FIG. 4] FIG. 4 is a view illustrating the configuration of a steam turbine power generation facility formed by partially changing the configuration of the steam turbine power generation facility according to Example 1 of the invention.

[FIG. 5] FIG. 5 is a view illustrating the configuration of a steam turbine power generation facility according to Example 2 of the invention.

[FIG. 6] FIG. 6 is a view illustrating the configuration of a steam turbine power generation facility formed by partially changing the configuration of the steam turbine power generation facility according to Example 2 of the invention.

[FIG. 7] FIG. 7 is a view illustrating the configuration of a steam turbine power generation facility according to Example 3 of the invention.

[FIG. 8] FIG. 8 is a view illustrating the configuration of a steam turbine power generation facility formed by partially changing the configuration of the steam turbine power generation facility according to Example 3 of the invention.

[FIG. 9] FIG. 9 is a view illustrating the configuration of a steam turbine power generation facility according to Example 4 of the invention.

[FIG. 10] FIG. 10 is a view illustrating the configuration of a steam turbine power generation facility formed by partially changing the configuration of the steam turbine power generation facility according to Example 4 of the invention.

[FIG. 11] FIG. 11 is a view illustrating the configuration of a steam turbine power generation facility according to Example 5 of the invention.

[FIG. 12] FIG. 12 is a view illustrating the configuration of a steam turbine power generation facility according to Example 6 of the invention.

[FIG. 13] FIG. 13 is a view illustrating the configuration of a steam turbine power generation facility according to Example 7 of the invention.

[FIG. 14] FIG. 14 is a view illustrating the configuration of a conventional steam turbine facility.

[FIG. 15] FIG. 15 is a view illustrating the configuration of another conventional steam turbine facility.

Detailed Description of the Preferred Embodiment

[0035] Preferred examples of the invention will be illustratively described below in detail with reference to the drawings. Here, the dimensions, materials, shapes, relative arrangements, etc. of component parts described in this example are not meant to limit the scope of the invention, but are merely simple explanatory examples, as long as there is no specific description of limitations.

[Example 1]

[0036] FIG. 1 is a view illustrating the configuration of a steam turbine power generation facility according to Example 1 of the invention.

[0037] As illustrated in FIG. 1, the steam turbine power generation facility according to Example 1 of the invention will be described.

[0038] The steam turbine power generation facility 10 illustrated in FIG. 1 includes a high-pressure turbine separated into two as will be described later, an intermediate-pressure turbine separated into two as will be described later, a low-pressure turbine 24, a generator 26, a condenser 28, and a boiler 32 as main components. The high-pressure turbine is separated into a first high-pressure turbine 16 on a high-temperature and high-pressure side and a second high-pressure turbine 18 on a low-temperature and low-pressure side, and the intermediate-pressure turbine is separated into a first intermediate-pressure turbine 12 on the high-temperature and high-pressure side and a second intermediate-pressure turbine 14 on the low-temperature and low-pressure side. The first high-pressure turbine 16 and the first intermediate-pressure turbine 12 are integrated to form an integrated structure 20, and the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 are integrated to form an integrated structure 22.

[0039] Additionally, the integrated structure 20, the integrated structure 22, the low-pressure turbine 24, and the generator 26 are connected together on the same axis.

[0040] At least any one of the rotors and casings of the first high-pressure turbine 16 and the first intermediate-pressure turbine 12 are formed from a Ni-based alloy. At least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0041] Main steam superheated to a temperature of 650°C or higher by the boiler 32 is introduced into the first high-pressure turbine 16 through a main steam pipe 34. The steam introduced into the first high-pressure turbine 16 performs expansion work and is then exhausted. The exhausted steam is introduced into the second high-pressure turbine 18 through a high-pressure part connection pipe 36 in a state where the temperature thereof decreased to less than 650°C. The introduced heat performs expansion work in the second high-pressure turbine and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 38. The steam returned to the boiler 32 is reheated to 650°C or higher by the boiler 32, and sent to the first intermediate-pressure turbine 12 through a high-temperature reheat pipe 40. The sent steam performs expansion work in the first intermediate-pressure turbine 12 and is then exhausted in a state where the temperature thereof decreased to the class of 550°C. The exhausted steam is sent to the second intermediate-pressure turbine 14 through an intermediate-pressure pipe 42. The steam sent to the second intermediate-pressure turbine 14 performs expansion work and is then exhausted and sent to the low-pressure turbine 24 through a crossover pipe 44. The steam sent to the low-pressure turbine 24 performs expansion work and is then exhausted and sent to the condenser 28. The steam sent to the condenser 28 is condensed by the condenser 28 and is returned to the boiler 32 in a state where the pressure thereof is raised by a water feed pump 30. The generator 26 is rotationally driven by the expansion work of the respective turbines to generate power.

[0042] According to the above-described steam turbine power generation facility 10 of Example 1 of the invention, at least any one of the rotors and the casings of the turbines (the first high-pressure turbine 16 and the first intermediate-pressure turbine 12), into which steam with a temperature of 650°C or higher is introduced, is constructed by joining the plurality of members formed from Ni-based alloy through welding. Therefore, it is possible to increase the size of the facility without increasing the numbers of casings, rotors, and blade stages in both the first high-pressure turbine 16 and the intermediate-pressure turbine 12.

[0043] Additionally, in the steam turbine power generation facility, the steam with a temperature of 650°C or higher is introduced into the first high-pressure turbine 16 and the first intermediate-pressure turbine 12, and the steam with a temperature of less than 650°C is introduced into the second high-pressure turbine 18 and the second intermediate-pressure turbine 14.

[0044] In the steam turbine power generation facility, both the high-pressure turbine and the intermediate-pressure turbine are separated into two parts. Additionally, the first high-pressure turbine 16 and the first intermediate-pressure turbine 12, into which the steam with a temperature of 650°C or higher is introduced and in which at least any one of the rotors and the casings constructed by joining the plurality of members formed from Ni-based alloy through welding are used, are integrated to form the integrated structure 20, and the second high-pressure turbine 18 and the second intermediate-pressure turbine 14, into which the steam with a temperature of less than 650°C is introduced and which may be formed from a ferrite-based material as in the related art, are integrated to form the integrated structure. Therefore, the amount of high-grade Ni-based alloy materials used may be reduced, which makes it possible to suppress a drastic increase in facility cost. When the temperature of the steam introduced into the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 exceeds 650°C, welding structures formed from different materials (for example, 12Cr steel and 2.25Cr steel; 12Cr steel and CrMoV steel) may be adopted for the rotors and the casings. In this case, a high-grade material may be used only in portions requiring high-temperature strength, and a low-grade material may be used in portions which do not require high-temperature strength. Therefore, it is possible to minimize the amount of high-grade material used.

[0045] Additionally, as illustrated in FIG. 2, the second high-pressure turbine 18, the second intermediate-pressure turbine 14, and the low-pressure turbine 24 may be integrated to form an integrated structure 21. In this case, since the numbers of casings and rotors may be reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure 21, it is possible to minimize the amount of high-grade material used.

[0046] On the other hand, as illustrated in FIG. 3, the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 may not be integrated due to increased capacity.

[0047] Additionally, in contrast to the example illustrated in Fig. 3, as illustrated in FIG. 4, the second intermediate-pressure turbine 14 and the low-pressure turbine 24 may be integrated to form an integrated structure 23. In this case, since the numbers of casings and rotors may be reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure 23, it is possible to minimize the amount of high-grade material used.

[Example 2]

[0048] FIG. 5 is a view illustrating the configuration of a steam turbine power generation facility according to Example 2 of the invention.

[0049] The steam turbine power generation facility 10 illustrated in FIG. 5 is constructed by partially changing the configuration of the steam turbine power generation facility according to Example 1 of the invention, which is illustrated in FIG. 1. That is, the integrated structure 22, the low-pressure turbine 24, and the generator 26 are connected together on the same axis, and the integrated structure 20 and a generator 27 are connected together on the same axis so as to be arranged at positions close to the boiler 32. The closer to the boiler 32 the integrated structure 20 is, the better.

[0050] The other components are the same as those of the steam turbine power generation facility according to Example 1 of the invention.

[0051] In the above-described steam turbine power generation facility 10 according to Example 2 of the invention, in addition to the effects of Example 1, the first high-pressure turbine 16 and the first intermediate-pressure turbine 12, into which steam with a temperature of 650°C or higher is introduced, are arranged close to the boiler 32. Therefore, since a pipe connecting the boiler 32 to the first high-pressure turbine 16 and a pipe connecting the boiler 32 to the first intermediate-pressure turbine 12 may be shortened, it is possible to reduce the amount of material used for the pipes. Since the steam with a temperature of 650°C or higher passes through the pipe connecting the boiler 32 to the first high-pressure turbine 16 and the pipe connecting the boiler 32 to the first intermediate-pressure turbine 12, it is necessary to manufacture the pipes with Ni-based alloy that is a high-grade material. However, since the amount of material used is reduced by shortening the pipes, it is possible to reduce the manufacturing costs of the entire facility.

[0052] Additionally, similar to the example illustrated in FIG. 2, the second high-pressure turbine 18, the second intermediate-pressure turbine 14, and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure 21, it is possible to minimize the amount of high-grade material used.

[0053] On the other hand, as illustrated in FIG. 6, the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 may not be integrated due to increased capacity.

[0054] Additionally, in contrast to the example illustrated in Fig. 6, similar to the example illustrated in FIG. 4, the second intermediate-pressure turbine 14 and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure 23, it is possible to minimize the amount of high-grade material used.

[Example 3]

[0055] FIG. 7 is a view illustrating the configuration of a steam turbine power generation facility according to Example 3 of the invention.

[0056] As illustrated in FIG. 7, the steam turbine power generation facility according to Example 3 of the invention will be described.

[0057] The steam turbine power generation facility 10 illustrated in FIG. 7 mainly includes an very-high-pressure turbine 19, a high-pressure turbine separated into two as will be described later, an intermediate-pressure turbine separated into two as will be described later, a low-pressure turbine 24, a generator 26, a condenser 28, and a boiler 32. The high-pressure turbine is separated into a first high-pressure turbine 16 on a high-temperature and high-pressure side and a second high-pressure turbine 18 on a low-temperature and low-pressure side, and the intermediate-pressure turbine is separated into a first intermediate-pressure turbine 12 on the high-temperature and high-pressure side and a second intermediate-pressure turbine 14 on the low-temperature and low-pressure side. The first high-pressure turbine 16 and the first intermediate-pressure turbine 12 are integrated to form an integrated structure 20, and the second high-pressure turbine 18 and the second intermediate-structure turbine 14 are integrated to form an integrated structure 22.

[0058] Additionally, the very-high-pressure turbine 19, the integrated structure 20, the integrated structure 22, the low-pressure turbine 24, and the generator 26 are connected together on the same axis.

[0059] Rotors of the very-high-pressure turbine 19, the first high-pressure turbine 16, and the first intermediate-pressure turbine 12 are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0060] Main steam superheated to a temperature of 650°C or higher by the boiler 32 is introduced into the very-high-pressure turbine 19 through a main steam pipe 33. The steam introduced into the very-high-pressure turbine 19 performs expansion work and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 35 in a state where the temperature thereof decreased to less than 650°C. The steam returned to the boiler 32 is reheated by the boiler 32 such that the temperature thereof increases to 650°C or higher. The reheated steam is introduced into the first high-pressure turbine 16 through a high-temperature reheat pipe 34. The steam introduced into the first high-pressure turbine 16 performs expansion work and is then exhausted. The exhausted steam is introduced into the second high-pressure turbine 18 through a high-pressure part connection pipe 36 in a state where the temperature thereof decreased to less than 650°C. The introduced steam performs expansion work in the second high-pressure turbine and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 38. The steam returned to the boiler 32 is reheated by the boiler 32 such that the temperature thereof increases to 650°C or higher. The reheated steam is sent to the first intermediate-pressure turbine 12 through a high-temperature reheat pipe 40. The sent steam performs expansion work in the first intermediate-pressure turbine 12 and is then exhausted and sent to the second intermediate-pressure turbine 14 through an intermediate-pressure part connection pipe 42 in a state where the temperature thereof decreased to 550°C. The steam sent to the second intermediate-pressure turbine 14 performs expansion work and is then exhausted and sent to the low-pressure turbine 24 through a crossover pipe 44. The steam introduced into the low-pressure turbine 24 performs expansion work and is then exhausted and sent to the condenser 28. The steam sent to the condenser 28 is condensed by the condenser 28 and is then returned to the boiler 32 in a state where the pressure thereof is raised by a water feed pump 30. The generator 26 is rotationally driven by the expansion work of the respective turbines to generate power.

[0061] According to the above-described steam turbine power generation facility 10 of Example 3 of the invention, at least any one of the rotors and the casings of the turbines (the very-high-pressure turbine 19, the first high-pressure turbine 16, and the first intermediate-pressure turbine 12), into which the steam with a temperature of 650°C or higher is introduced, are constructed by joining together a plurality of members formed from Ni-based alloy through welding. Therefore, it is possible to increase the size of the facility without increasing the numbers of casings, rotors, and blade stages in any one of the very-high-pressure turbine, the first high-pressure turbine 16, and the intermediate-pressure turbine 12. Additionally, as the very-high-pressure turbine 19 is provided, it is possible to use further high-pressure steam.

[0062] Additionally, in the steam turbine power generation facility, the steam with a temperature of 650°C or higher is introduced into the very-high-pressure turbine 19, the first high-pressure turbine 16, and the first intermediate-pressure turbine 12, and the steam with a temperature of less than 650°C is introduced into the second high-pressure turbine 18 and the second intermediate-pressure turbine 14.

[0063] Accordingly, both the high-pressure turbine and the intermediate-pressure turbine are separated into two parts. Additionally, the first high-pressure turbine 16 and the first intermediate-pressure turbine 12, into which the steam with a temperature of 650°C or higher is introduced and in which at least any one of the rotors and the casings constructed by joining together a plurality of members formed from Ni-based alloy through welding are used, are integrated to form the integrated structure 20 to connect the very-high-pressure turbine 19, and the second high-pressure turbine 18 and the second intermediate-pressure turbine 14, into which the steam with a temperature of less than 650°C is introduced and which may be formed from a ferrite-based material as in the related art, are integrated to form the integrated structure 22. Therefore, since the amount of high-grade Ni-based alloy materials used is reduced, it is possible to suppress a drastic increase in facility cost. Additionally, when the temperature of the steam introduced into the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 exceeds 650°C, welding structures formed from different materials (for example, 12Cr steel and 2.25 Cr; 12 Cr and CrMoV steel) may be adopted for the rotors and the casings. Therefore, it is possible to minimize the amount of high-grade material used.

[0064] Additionally, similar to the example illustrated in FIG. 2, the second high-pressure turbine 18, the second intermediate-pressure turbine 14, and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors may be reduced, it is possible to reduce the facility costs. Additionally, since welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure, it is possible to minimize the amount of high-grade material used.

[0065] On the other hand, as illustrated in FIG. 8, the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 may not be integrated due to increased capacity.

[0066] Additionally, in contrast to the example illustrated in FIG. 8, similar to the example illustrated in FIG. 4, the second intermediate-pressure turbine 14 and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure, it is possible to minimize the amount of high-grade material used.

[Example 4]

[0067] FIG. 9 is a view illustrating the configuration of a steam turbine power generation facility according to Example 4 of the invention.

[0068] The steam turbine power generation facility 10 illustrated in FIG. 9 is constructed by partially changing the configuration of the steam turbine power generation facility according to Example 3 of the invention, which is illustrated in FIG. 7. The integrated structure 22, the low-pressure turbine 24, and the generator 26 are connected together on the same axis, and the very-high-pressure turbine 19, the integrated structure 20, and the generator 27 are connected together on the same axis so as to be arranged at positions close to the boiler 32. The closer to the boiler 32 the very-high-pressure turbine 19 and the integrated structure 20 are, the better.

[0069] The other components are the same as those of the steam turbine power generation facility according to Example 3 of the invention.

[0070] According to the steam turbine power generation facility 10 of Example 4 of the invention, in addition to the effects of Example 3, the very-high pressure turbine 19, the first high-pressure turbine 16, and the first intermediate-pressure turbine 12, into which the steam with a temperature of 650°C or higher is introduced, are arranged close to the boiler 32. Therefore, since a pipe connecting the boiler 32 to the very-high-pressure turbine 19, a pipe connecting the boiler 32 to the first high-pressure turbine 16, and a pipe connecting the boiler 32 to the first intermediate-pressure turbine 12 may be shortened, it is possible to reduce the amount of material used in the pipes. Since the steam with a temperature of 650°C or higher passes through the pipe connecting the boiler 32 to the very-high-pressure turbine 19, the pipe connecting the boiler 32 to the first high-pressure turbine 16, and the pipe connecting the boiler 32 to the first intermediate-pressure turbine 12, it is necessary to manufacture the pipes with Ni-based alloy that is a high-grade material. However, since the amount of material used is reduced by shortening the pipes, it is possible to reduce the manufacturing costs of the entire facility.

[0071] Additionally, similar to the example illustrated in FIG. 2, the second high-pressure turbine 18, the second intermediate-pressure turbine 14, and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure, it is possible to minimize the amount of high-grade material used.

[0072] On the other hand, as illustrated in FIG. 10, the second high-pressure turbine 18 and the second intermediate-pressure turbine 14 may not be integrated due to increased capacity.

[0073] Additionally, in contrast to the example illustrated in FIG. 10, similar to the example illustrated in FIG. 4, the second intermediate-pressure turbine 14 and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors may be reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure, it is possible to minimize the amount of high-grade material used.

[Example 5]

[0074] FIG. 11 is a view illustrating the configuration of a steam turbine power generation facility according to Example 5 of the invention.

[0075] As illustrated in FIG. 11, the steam turbine power generation facility according to Example 5 of the invention will be described.

[0076] The steam turbine power generation facility 10 illustrated in FIG. 11 includes a high-pressure turbine 16, an intermediate-pressure turbine 12, a low-pressure turbine 24, generators 26 and 27, a condenser 28, and a boiler 32 as main components.

[0077] Additionally, the high-pressure turbine 16, the low-pressure turbine 24, and the generator 26 are connected together on the same axis, and the intermediate-pressure turbine 12 and the generator 27 are connected together on the same axis so as to be arranged at positions close to the boiler 32. The closer to the boiler 32 the intermediate-pressure turbine 12 is, the better.

[0078] Additionally, at least any one of a rotor and a casing of the intermediate-pressure turbine 12 is formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0079] Main steam superheated to a temperature of less than 650°C by the boiler 32 is introduced into the high-pressure turbine 16 through a main steam pipe 34. The steam introduced into the high-pressure turbine 16 performs expansion work and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 38. The steam returned to the boiler 32 is reheated by the boiler 32 such that the temperature thereof increases to 650°C or higher. The reheated steam is sent to the intermediate-pressure turbine 12 through a high-temperature reheat pipe 40. The sent steam performs expansion work in the intermediate-pressure turbine 12 and is then exhausted and sent to the low-pressure turbine 24 through a crossover pipe 44. The steam sent to the low-pressure turbine 24 performs expansion work and is then exhausted and sent to the condenser 28. The steam sent to the condenser 28 is condensed by the condenser 28 and is then returned to the boiler 32 in a state where the pressure thereof is raised by a water feed pump 30. The generators 26 and 27 are rotationally driven by the expansion work of the respective turbines to generate power.

[0080] According to the above-described steam turbine power generation facility 10 of Example 5 of the invention, at least any one of the rotor and the casing of the intermediate-pressure turbine 12 into which the steam with a temperature of 650°C or higher is introduced is constructed by joining together a plurality of members formed from Ni-based alloy through welding. Therefore, it is possible to increase the size of the facility, without increasing the numbers of casings, rotors, blade stages in the intermediate-pressure turbine 12.

[0081] Moreover, since the intermediate-pressure turbine 12 into which the steam with a temperature of 650°C or higher is introduced is arranged close to the boiler 32, the pipe connecting the boiler 32 to the intermediate-pressure turbine 12 may be shortened, which makes it possible to reduce the amount of material used in the pipe. Since the steam with a temperature of 650°C or higher passes through the pipe connecting the boiler 32 to the intermediate-pressure turbine 12, it is necessary to manufacture the pipe with Ni-based alloy that is a high-grade material. However, since the amount of material used is reduced by shortening the pipe, it is possible to reduce the manufacturing costs of the entire facility.

[Example 6]

[0082] FIG. 12 is a view illustrating the configuration of a steam turbine power generation facility according to Example 6 of the invention.

[0083] As illustrated in FIG. 12, the steam turbine power generation facility according to Example 6 of the invention will be described.

[0084] The steam turbine power generation facility 10 illustrated in FIG. 12 includes a high-pressure turbine 16, an intermediate-pressure turbine 12, a low-pressure turbine 24, a generator 26, a condenser 28, and a boiler 32 as main components.

[0085] Additionally, the high-pressure turbine 16, the intermediate-pressure turbine 12, the low-pressure turbine 24, and the generator 26 are connected together on the same axis, and the high-pressure turbine 16 and the intermediate-pressure turbine are integrated to form an integrated structure 25.

[0086] Additionally, at least any one of the rotors and casings of the high-pressure turbine 16 and the intermediate-pressure turbine 12 are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0087] Main steam superheated to a temperature of 650°C or higher by the boiler 32 is introduced into the high-pressure turbine 16 through a main steam pipe 34. The steam introduced into the high-pressure turbine 16 performs expansion work and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 48 in a state where the temperature thereof decreased to less than 650°C. The steam returned to the boiler 32 is reheated by the boiler 32 such that the temperature thereof increases to 650°C or higher. The reheated steam is introduced into the intermediate-pressure turbine 12 through a high-temperature reheat pipe 40. The introduced steam performs expansion work in the intermediate-pressure turbine 12 and is then exhausted and sent to the low-pressure turbine 24 through a crossover pipe 44. The steam sent to the low-pressure turbine 24 performs expansion work and is then exhausted and sent to the condenser 28. The steam sent to the condenser 28 is condensed by the condenser 28 and is then returned to the boiler 32 in a state where the pressure thereof is raised by a water feed pump 30. The generator 26 is rotationally driven by the expansion work of the respective turbines to generate power.

[0088] According to the above-described steam turbine power generation facility 10 of Example 6 of the invention, at least any one of the rotors and the casings of the turbines (the high-pressure turbine 16 and the intermediate-pressure turbine 12), into which the steam with a temperature of 650°C or higher is introduced, are constructed by joining together a plurality of members formed from Ni-based alloy through welding, and the high-pressure turbine 16 and the intermediate-pressure turbine 12 are integrated to form the integrated structure 25. Therefore, it is possible to increase the size of the facility, without increasing the numbers of casings, rotors, and blade stages.

[0089] Additionally, the high-pressure turbine 16, the intermediate-pressure turbine 12, and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, 12Cr steel, 2.25Cr steel, and 3.5Ni steel; 9Cr steel, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure, it is possible to minimize the amount of high-grade material used.

[Example 7]

[0090] FIG. 13 is a view illustrating the configuration of a steam turbine power generation facility according to Example 7 of the invention.

[0091] As illustrated in FIG. 13, the steam turbine power generation facility according to Example 7 of the invention will be described.

[0092] The steam turbine power generation facility 10 illustrated in FIG. 13 includes an very-high-pressure turbine 19, a high-pressure turbine 16, an intermediate-pressure turbine 12, a low-pressure turbine 24, a generator 26, a condenser 28, and a boiler 32 as main components.

[0093] Additionally, the very-high-pressure turbine 19, the high-pressure turbine 16, the intermediate-pressure turbine 12, the low-pressure turbine 24, and the generator 26 are connected together on the same axis.

[0094] At least any one of the rotors and casings of the very-high-pressure turbine 19, the high-pressure turbine 16, and the intermediate-pressure turbine 12 are formed from Ni-based alloy, and at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

[0095] Main steam superheated to a temperature of 650°C or higher by the boiler 32 is introduced into the very-high-pressure turbine 19 through a main steam pipe 33. The steam introduced into the very-high-pressure turbine 19 performs expansion work and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 35 in a state where the temperature thereof decreased to less than 650°C. The steam returned to the boiler 32 is reheated by the boiler 32 such that the temperature thereof increases to 650°C or higher. The reheated steam is introduced into the high-pressure turbine 16 through a high-temperature reheat pipe 34. The steam introduced into the high-pressure turbine 16 performs expansion work and is then exhausted and returned to the boiler 32 through a low-temperature reheat pipe 38 in a state where the temperature thereof decreased to less than 650°C. The steam returned to the boiler 32 is reheated by the boiler 32 such that the temperature increases to 650°C or higher. The reheated steam is sent to the intermediate-pressure turbine 12 through a high-temperature reheat pipe 40. The steam sent to the intermediate-pressure turbine 12 performs expansion work and is then exhausted to the low-pressure turbine 24 through a crossover pipe 44. The steam introduced into the low-pressure turbine 24 performs expansion work and is then exhausted and sent to the condenser 28. The steam sent to the condenser 28 is condensed by the condenser 28 and is then returned to the boiler 32 in a state where the pressure thereof is raised by a water feed pump 30. The generator 26 is rotationally driven by the expansion work of the respective turbines to generate power.

[0096] According to the steam turbine power generation facility 10 of Example 7 of the invention, at least any one of the rotors and the casings of the turbines (the very-high-pressure turbine 19, the high-pressure turbine 16, and the intermediate-pressure turbine 12), into which the steam with a temperature of 650°C or higher is introduced, are constructed by joining together a plurality of members formed from Ni-based alloy through welding. Therefore, it is possible to increase the size of the facility, without increasing the numbers of casings, rotors, and blade stages in any one of the very-high-pressure turbine 19, the high-pressure turbine 16, and the intermediate-pressure turbine 12. Additionally, as the very-high-pressure turbine 19 is provided, it is possible to use further high-pressure steam.

[0097] Meanwhile, the high-pressure turbine 16, the intermediate-pressure turbine 12, and the low-pressure turbine 24 may be integrated to form an integrated structure (not shown). In this case, since the numbers of casings and rotors are reduced, it is possible to reduce the facility costs. In addition, as welding structures formed from different materials (for example, Ni-based alloy, 12Cr steel, and 2.25Cr steel, 3.5Ni steel; Ni-based alloy, 9Cr steel, 2.25Cr steel, 3.5Ni steel; Ni-based alloy, 2.25Cr steel, and 3.5Ni steel) are adopted for the rotor and the casing of the integrated structure, it is possible to minimize the amount of high-grade material used.

Industrial Applicability

[0098] According to the examples of the invention, even if steam conditions in the 650°C class or 700°C class are adopted, it is possible to utilize the invention as a steam turbine facility capable of suppressing the possibility of vibration occurrence and a drastic increase in facility cost, thereby realizing an increase in size of the steam turbine facility.

Claims

1. A steam turbine facility comprising a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine,
wherein the high-pressure turbine is separated into a first high-pressure turbine part on a high-temperature and high-pressure side and a second high-pressure turbine part on a low-temperature and low-pressure side,
the intermediate-pressure turbine is separated into a first intermediate-pressure turbine part on a high-temperature and high-pressure side and a second intermediate-pressure turbine part on a low-temperature and low-temperature side,
the first high-pressure turbine part and the first intermediate-pressure turbine part are integrated to form a first integrated part,
at least the second high-pressure turbine part and the second intermediate-pressure turbine part are integrated to form a second integrated part,
at least any one of the rotors and casings of steam-introduction-side turbines of the first high-pressure turbine part and the first intermediate-pressure turbine part, into which steam with a temperature of 650°C or higher is introduced, are formed from Ni-based alloy, and
at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

2. The steam turbine facility according to claim 1, wherein the first integrated part, the second integrated part, and the low-pressure turbine are connected together on the same axis.

3. The steam turbine facility according to claim 1, further comprising an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced, wherein the very-high-pressure turbine, the first integrated part, the second integrated part, and the low-pressure turbine are connected together on the same axis.

4. The steam turbine facility according to claim 1, wherein steam with a temperature of 650°C or higher is introduced into the first high-pressure turbine part and the first intermediate-pressure turbine part forming the first integrated part,
steam with a temperature of less than 650° is introduced into the second high-pressure turbine part and the second intermediate-pressure turbine part forming the second integrated part,
the second integrated part and the low-pressure turbine are connected on a different axis from the first integrated part, and
the first integrated part is arranged at a position closer to a boiler than the connection structure of the second integrated part and the low-pressure turbine, the boiler superheating the steam introduced into the high-pressure turbine and the intermediate-pressure turbine.

5. The steam turbine facility according to claim 4, further comprising an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced,
wherein the first integrated part and the very-high-pressure turbine are connected together on the same axis.

6. The steam turbine facility according to any one of claims 1 to 5, wherein the second integrated part is further integrated with the low-pressure turbine.

7. A steam turbine facility comprising a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine,
wherein the high-pressure turbine is separated into a first high-pressure turbine part on a high-temperature and high-pressure side and a second high-pressure turbine part on a low-temperature and low-pressure side,
the intermediate-pressure turbine is separated into a first intermediate-pressure turbine part on the high-temperature and high-pressure side and a second intermediate-pressure turbine part on the low-temperature and low-temperature side,
the first high-pressure turbine part and the first intermediate-pressure turbine part are integrated to form a first integrated part,
at least any one of the rotors and casings of steam-introduction-side turbines of the first high-pressure turbine part and the first intermediate-pressure turbine part, into which steam with a temperature of 650°C or higher is introduced, are formed from Ni-based alloy, and
at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

8. The steam turbine facility according to claim 7, wherein the first integrated part, the second high-pressure turbine, the second intermediate-pressure turbine, and the low-pressure turbine are connected together on the same axis.

9. The steam turbine facility according to claim 7, wherein the second high-pressure turbine, the second intermediate-pressure turbine, and the low-pressure turbine are connected to form a connection structure,
the connection structure is connected on a different axis from the first integrated part, and
the first integrated part is arranged at a position closer to a boiler than the connection structure, the boiler superheating the steam introduced into the high-pressure turbine and the intermediate-pressure turbine.

10. The steam turbine facility according to claim 7, further comprising an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced,
wherein the very-high-pressure turbine, the first integrated part, the second intermediate-pressure turbine, and the low-pressure turbine are connected together on the same axis.

11. The steam turbine facility according to claim 9, further comprising an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced,
wherein the first integrated part and the very-high-pressure turbine are connected together on the same axis.

12. The steam turbine facility according to any one of claims 7 to 11, wherein the second intermediate-pressure turbine part and the low-pressure turbine are integrated.

13. A steam turbine facility comprising a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine,
wherein the turbines into which steam with a temperature of 650°C or higher is introduced are connected together on the same axis,
the turbines into which steam with a temperature of less than 650°C are connected together on the same axis different from that of the turbines into which the

steam with a temperature of 650°C or higher is introduced,
the turbines into which the steam with a temperature of 650°C or higher is introduced are arranged at positions closer to the boiler than the turbines into which the steam with a temperature of less than 650°C is introduced, the boiler superheating the steam introduced into the high-pressure turbine and the intermediate-pressure turbine,
at least any one of the rotors and casings of the turbines into which the steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, and
at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

14. A steam turbine facility comprising a high-pressure turbine, an intermediate-pressure turbine, and a low-pressure turbine,
wherein at least the high-pressure turbine and the intermediate-pressure turbine are integrated to form an integrated structure,
the integrated structure and the low-pressure turbine are connected together on the same axis,
at least any one of the rotors and casings of the turbines into which steam with a temperature of 650°C or higher is introduced are formed from Ni-based alloy, and
at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

15. The steam turbine facility according to claim 14, further comprising an very-high-pressure turbine into which steam having a higher pressure than the steam introduced into the high-pressure turbine is introduced,
wherein an integrated structure formed by integrating the very-high-pressure turbine with the high-pressure turbine and the intermediate-pressure turbine is connected to the low-pressure turbine on the same axis,
at least any one of the rotors and casings of the very-high-pressure turbine and the high-pressure turbine are formed from Ni-based alloy, and
at least any one of the overall rotors and the overall casings of the turbines are constructed by joining together a plurality of materials of rotor members or casing members by welding.

16. The steam turbine facility according to claim 14 or 15, wherein the integrated structure is further integrated with the low-pressure turbine.

FIG. 1

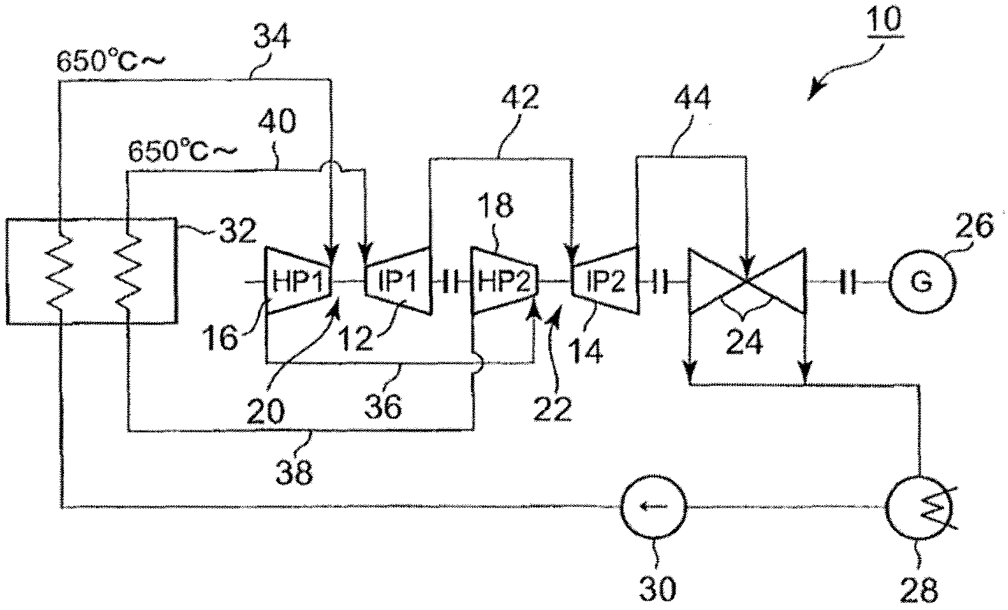
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FIG. 2

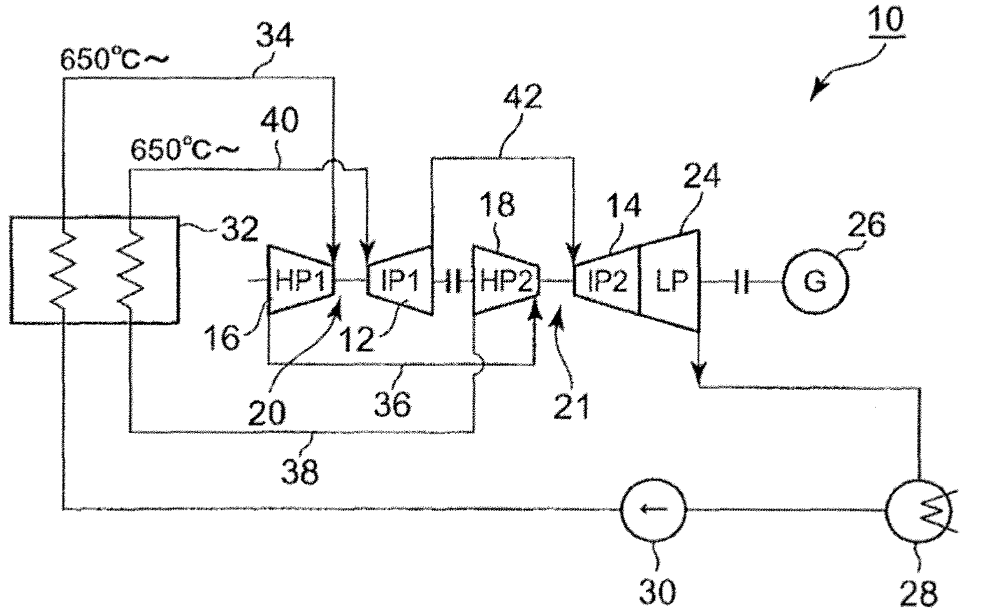
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FIG. 3

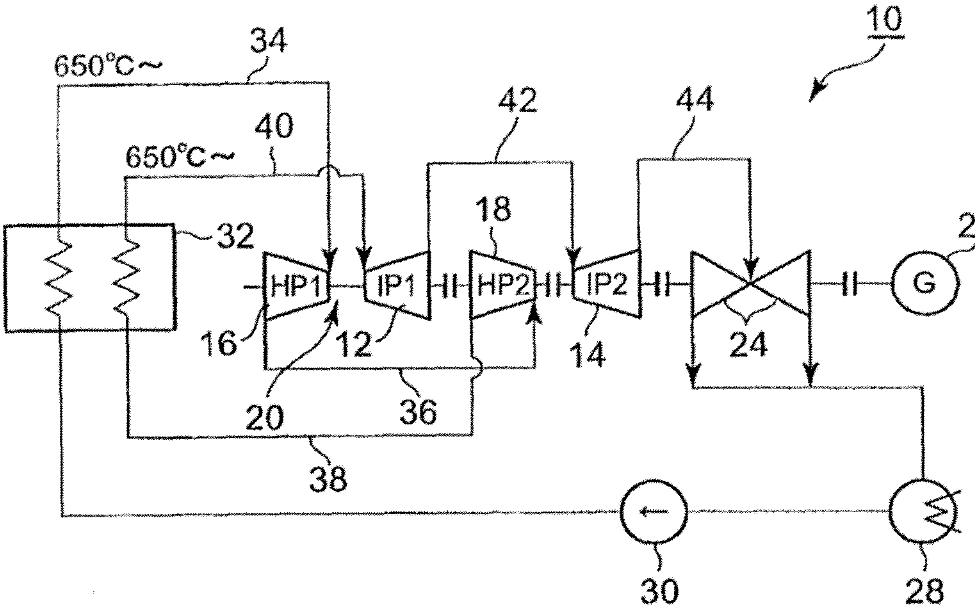
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FIG. 4

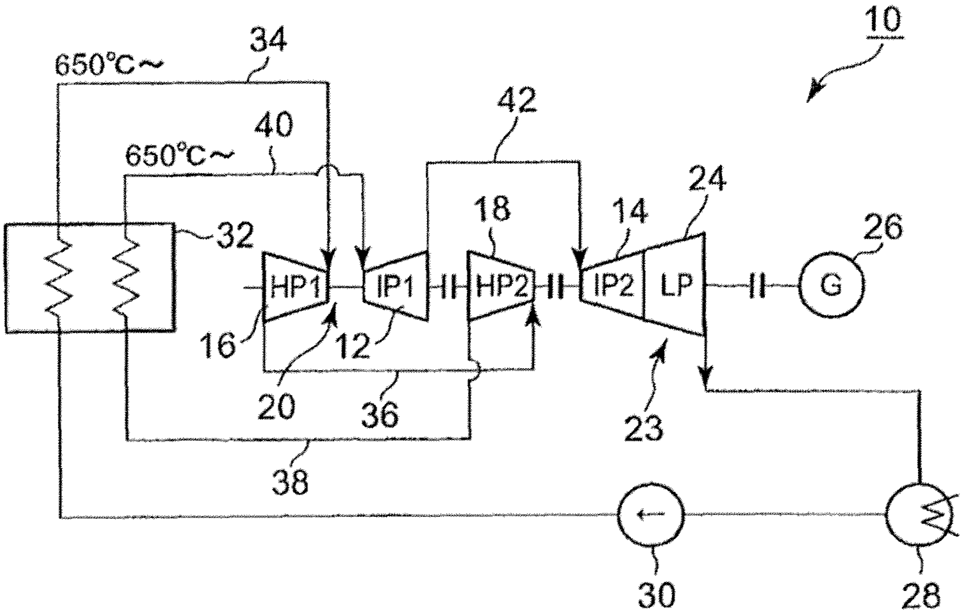
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FIG. 5

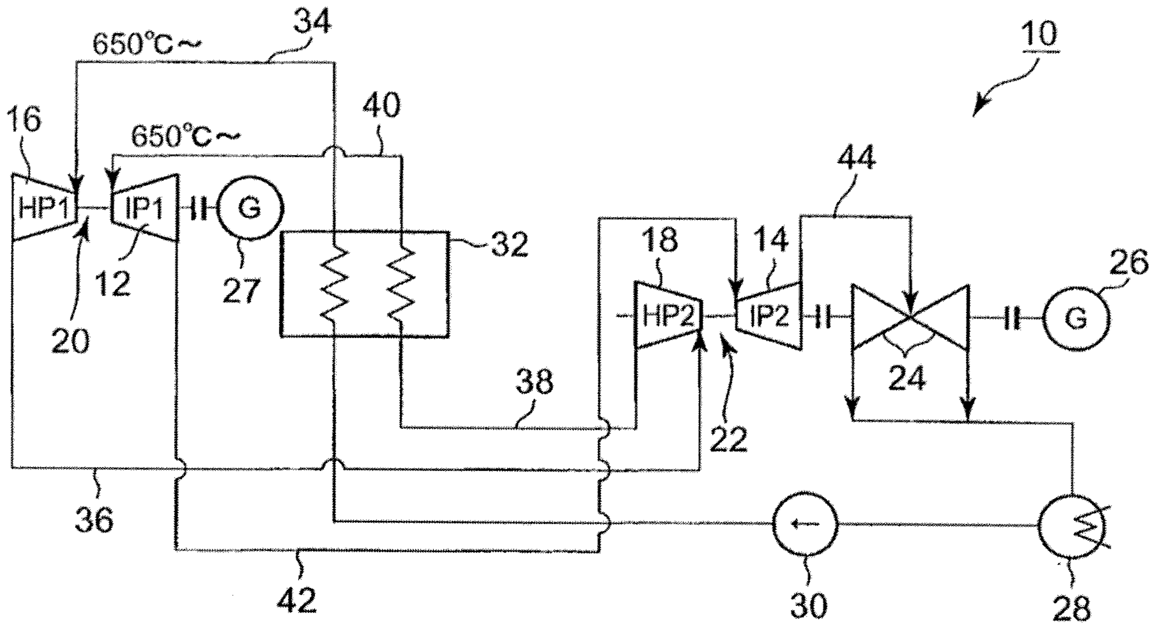
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FIG. 6

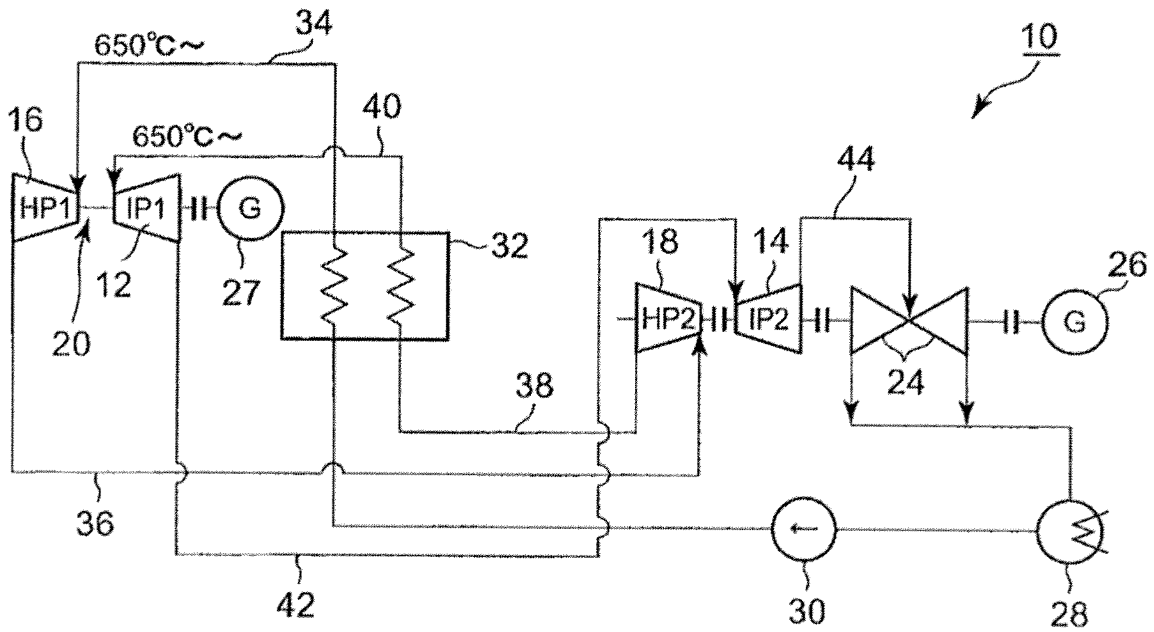
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FIG. 7

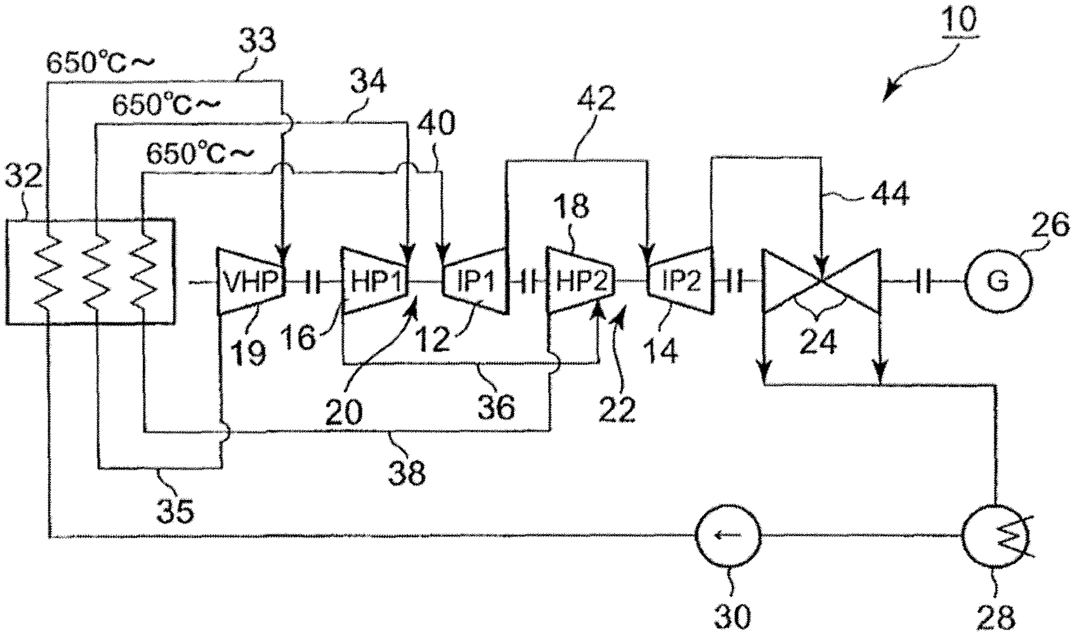
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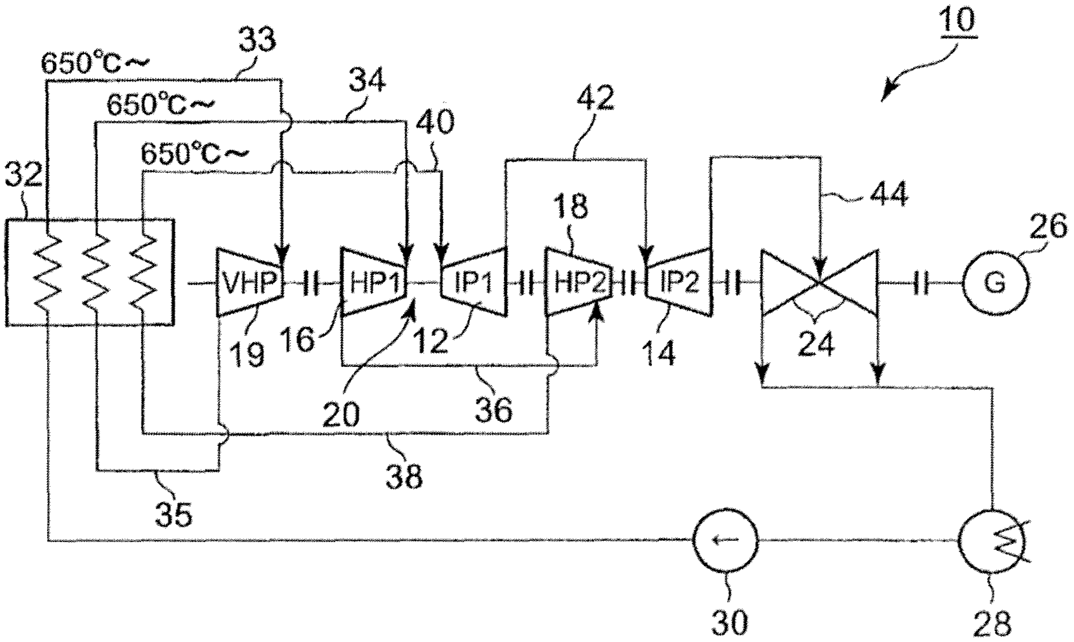
FIG. 8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650℃～
34
650℃～
40
42
650℃～
32
44
18
26
VHP
HP1
IP1
HP2
IP2
G
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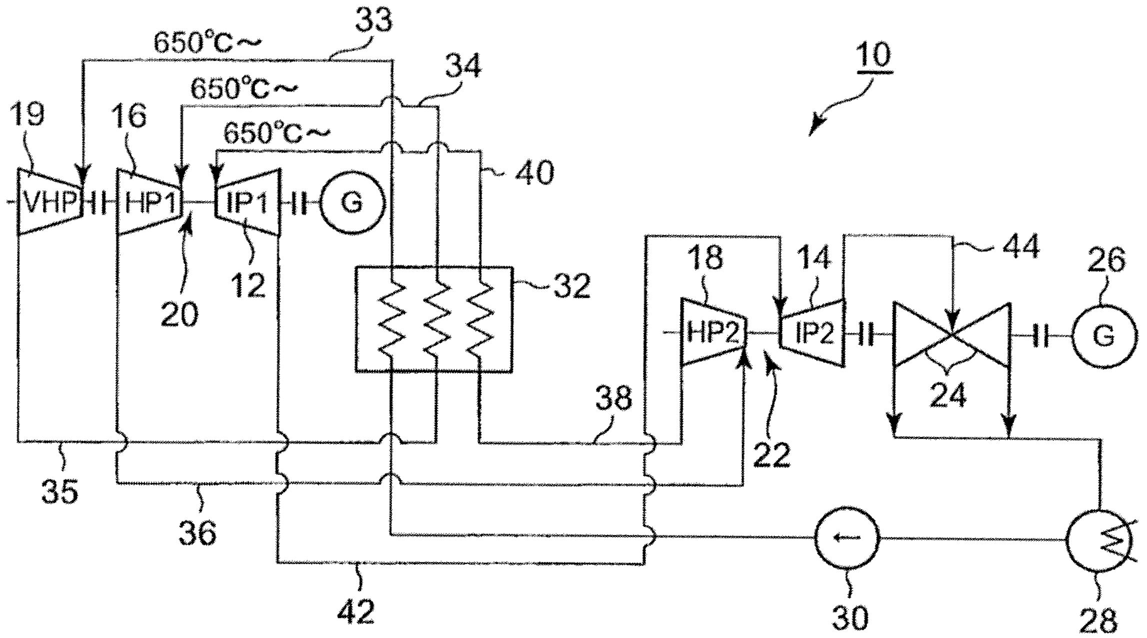
FIG. 9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IP1
G
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IP2
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22
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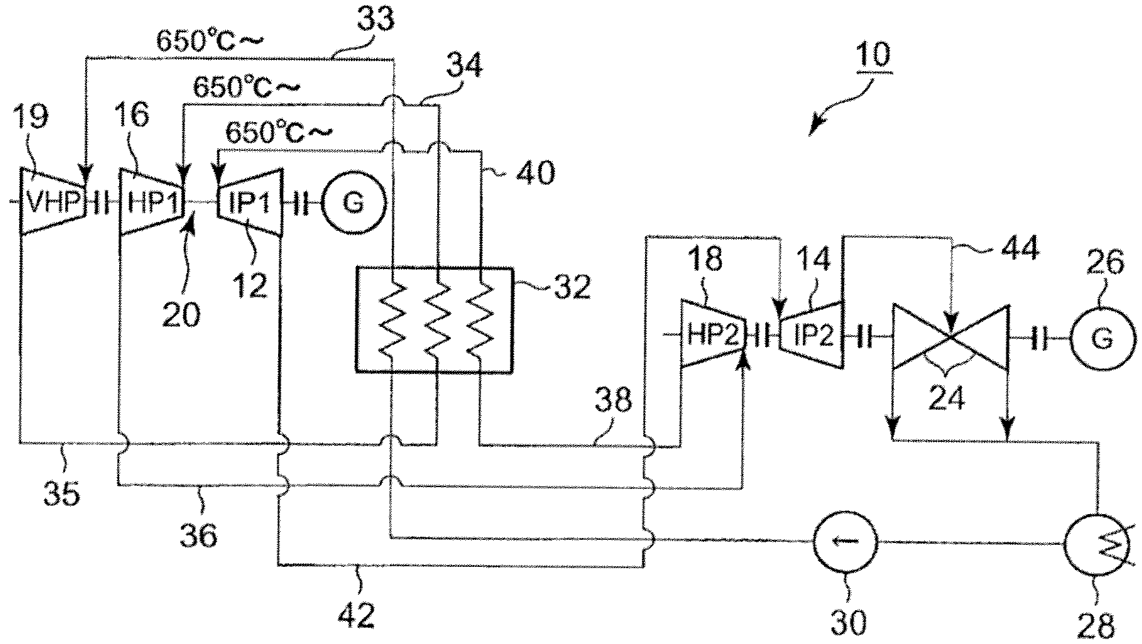
28
42

FIG. 10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42

FIG. 11

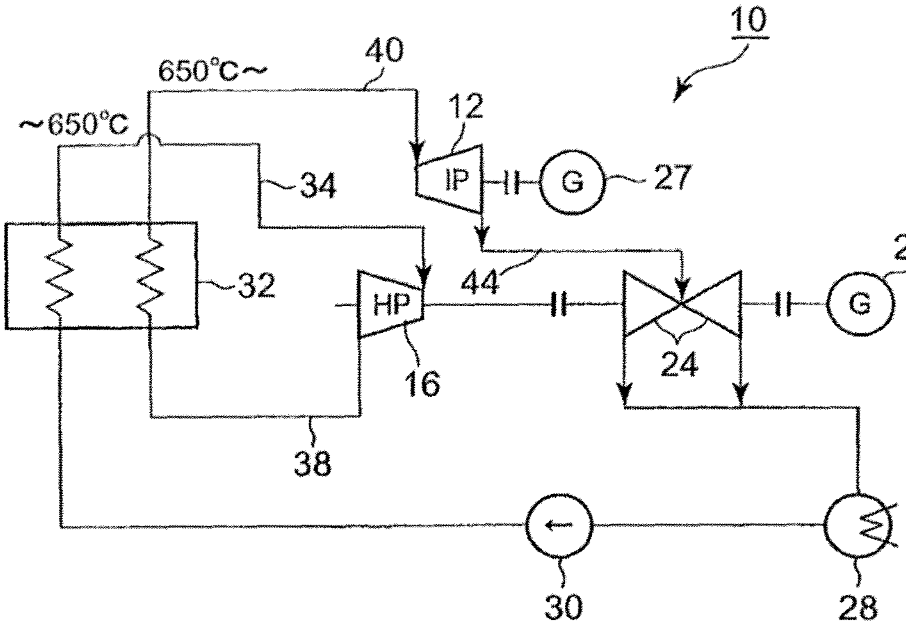
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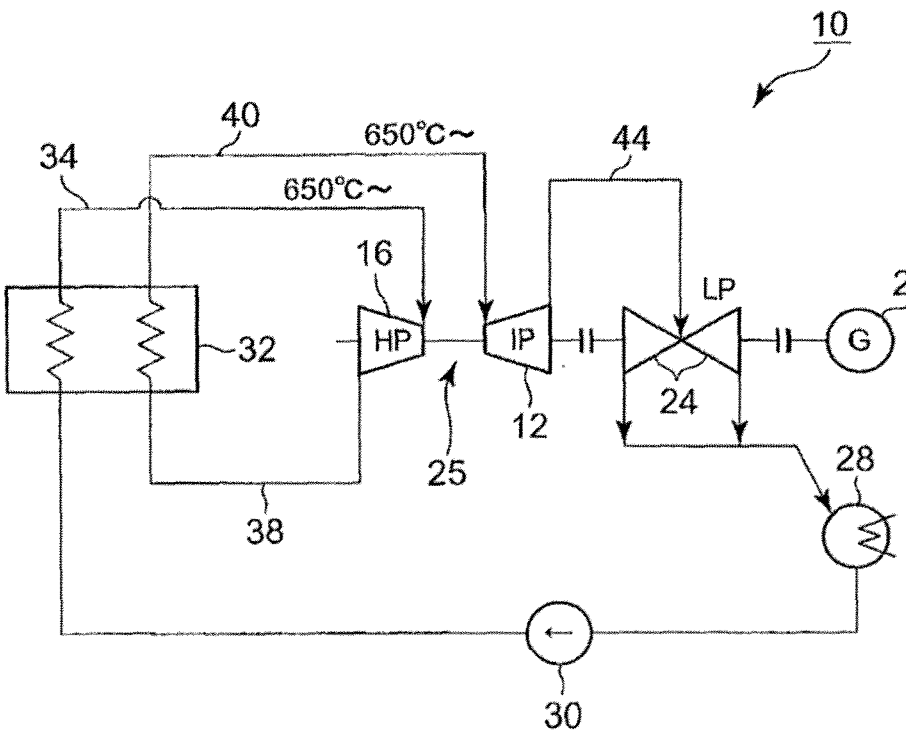
FIG. 12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G
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38
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FIG. 13

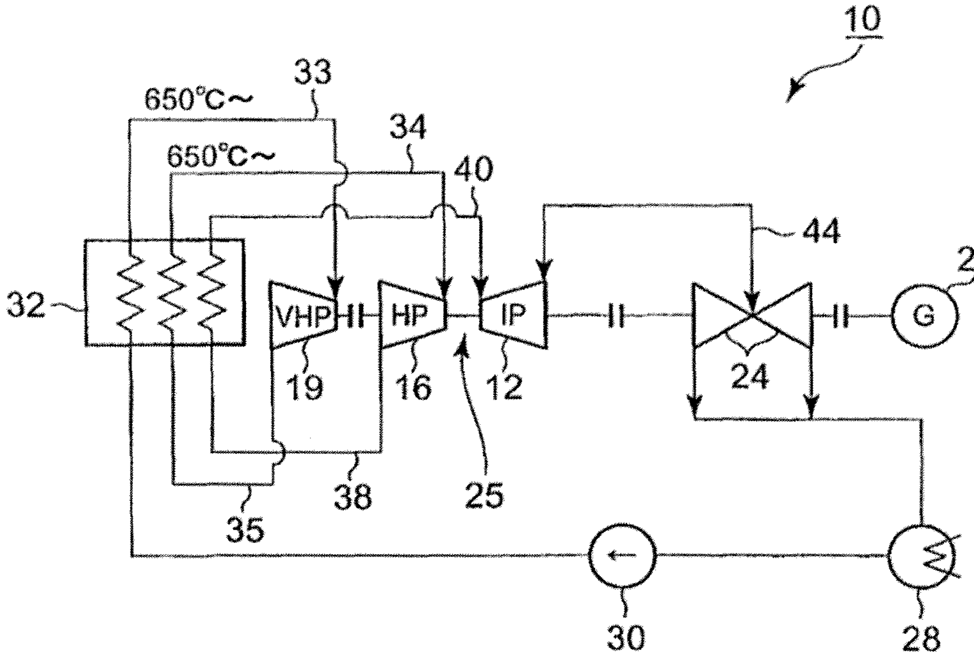
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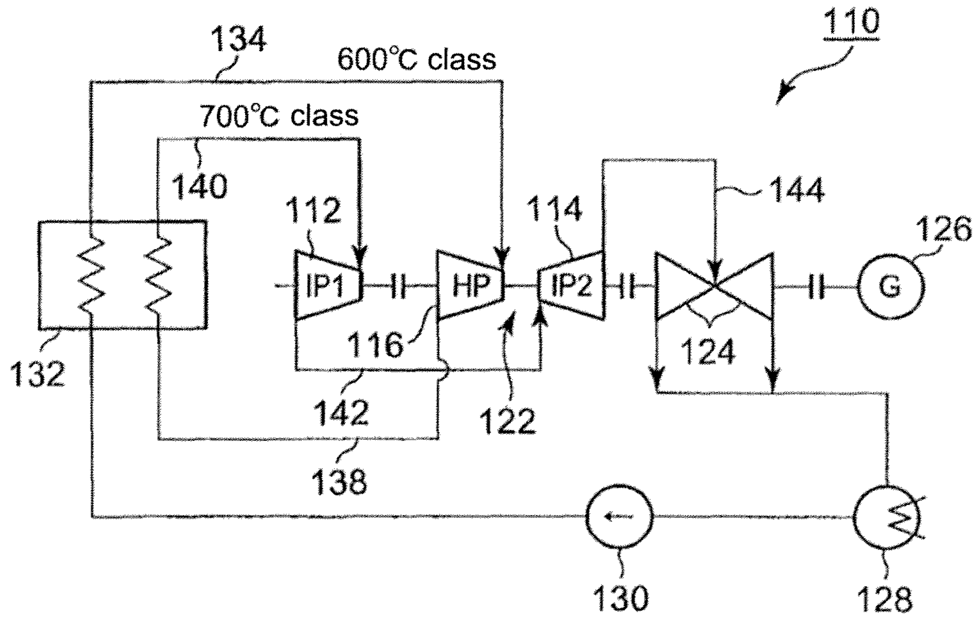
FIG. 14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IP2
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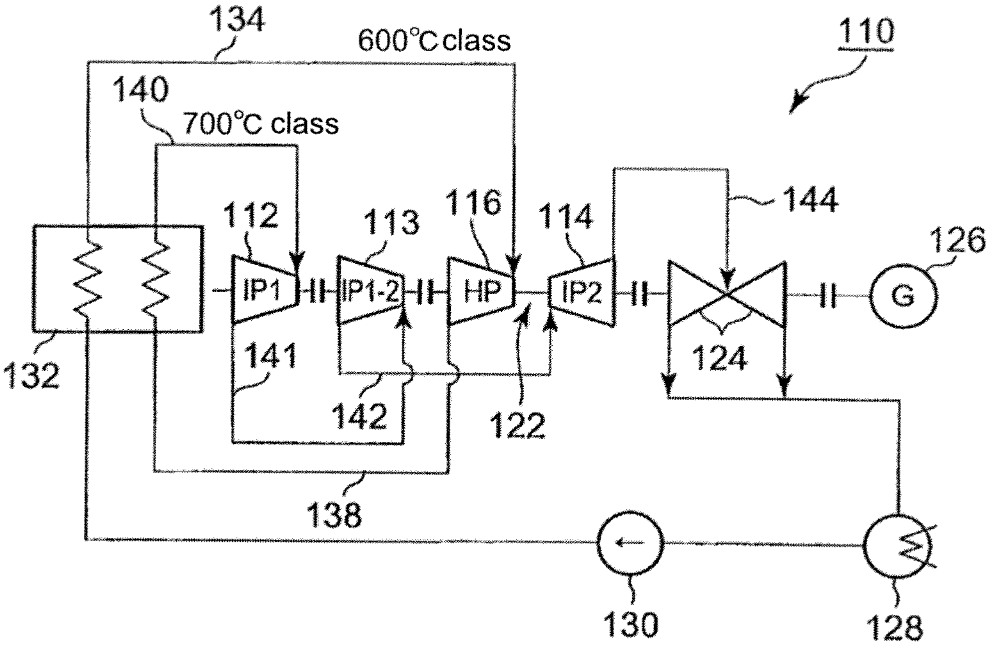
FIG. 15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122
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130
128

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/063909

A. CLASSIFICATION OF SUBJECT MATTER
F01D25/24(2006.01)i, F01D5/06(2006.01)i, F01D25/00(2006.01)i, F01K13/00 (2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01D25/24, F01D5/06, F01D25/00, F01K13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922–1996	Jitsuyo Shinan Toroku Koho	1996–2009
Kokai Jitsuyo Shinan Koho	1971–2009	Toroku Jitsuyo Shinan Koho	1994–2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 7-247806 A (Toshiba Corp.), 26 September 1995 (26.09.1995), paragraph [0019]; fig. 1 (Family: none)	1-3,7,8,10 4-6,9,11-16
Y A	JP 2008-88525 A (Toshiba Corp.), 17 April 2008 (17.04.2008), paragraphs [0003] to [0005] & US 2008/0085192 A1 & EP 1911932 A2	1-3,7,8,10, 14,15 4-6,9,11-13, 16
Y	JP 2007-85294 A (The Chugoku Electric Power Co., Inc.), 05 April 2007 (05.04.2007), paragraph [0024] (Family: none)	3,10,15

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search 27 October, 2009 (27.10.09)	Date of mailing of the international search report 02 November, 2009 (02.11.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2009/063909

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 4-209903 A (Toshiba Corp.), 31 July 1992 (31.07.1992), paragraph [0026]; fig. 1 (Family: none)	14-15
A	JP 2006-307280 A (Toshiba Corp.), 09 November 2006 (09.11.2006), fig. 1 & US 2006/0245911 A1 & EP 1752614 A2	3,5,10,11,15
A	JP 2000-274208 A (Toshiba Corp.), 03 October 2000 (03.10.2000), fig. 4, 8 (Family: none)	4,9
A	JP 2000-282808 A (Toshiba Corp.), 10 October 2000 (10.10.2000), paragraphs [0014] to [0021], [0031]; fig. 1 to 3, 6, 7 (Family: none)	1-16
A	JP 2004-278432 A (Toshiba Corp.), 07 October 2004 (07.10.2004), entire text; all drawings (Family: none)	1-16

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Patent documents cited in the description

- JP 4074208 B **[0012]**