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(54) **GENERALIZED FREQUENCY CONVERSION SYSTEM FOR STEAM TURBINE GENERATOR UNIT**

(71) Applicant: **Weizhong FENG**, Shanghai (CN)

(72) Inventor: **Weizhong FENG**, Shanghai (CN)

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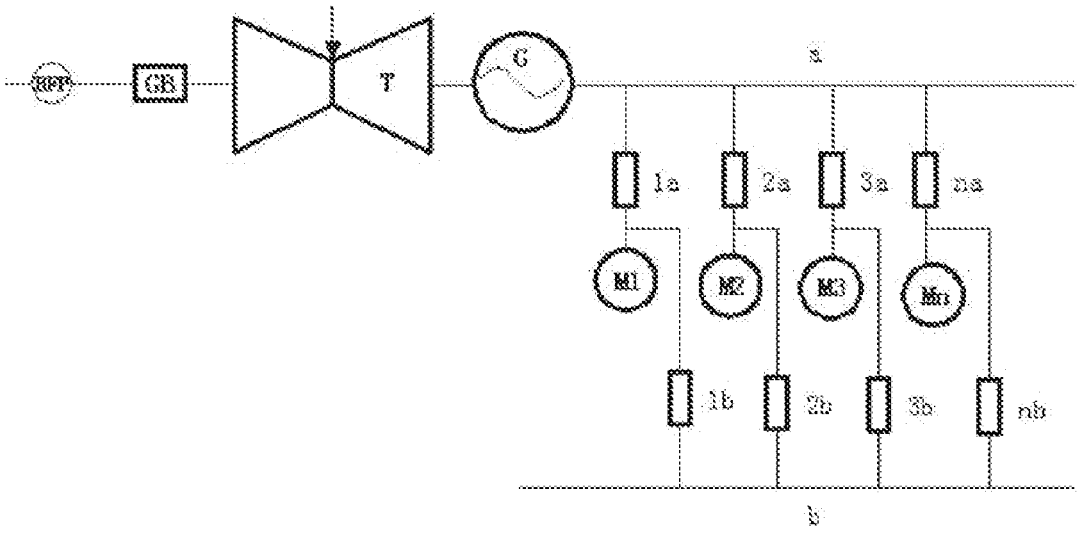
(57) **ABSTRACT**

The present invention provides a generalized frequency conversion system for a steam turbine generator unit. The system comprises at least a steam turbine (T) with an adjustable rotating speed, a water feeding pump (BFP), a generator (G), a speed increasing gearbox (GB), a variable frequency bus (a, c) and an auxiliary machine connected thereto. With a change in load of the unit, parameters of steam entering the steam turbine (T) and an extracted steam amount are correspondingly adjusted (changed), so that the rotating speed of the steam turbine (T) changes correspondingly; and thus the rotating speed of the water feeding pump (BFP) is changed through the speed increasing gearbox (GB) on the one hand, and the frequency of an alternating current outputted by the generator (G) is changed on the other hand. Other types of frequency converters do not need to be additionally provided. The system is simple, reliable, low in cost, and high in efficiency.



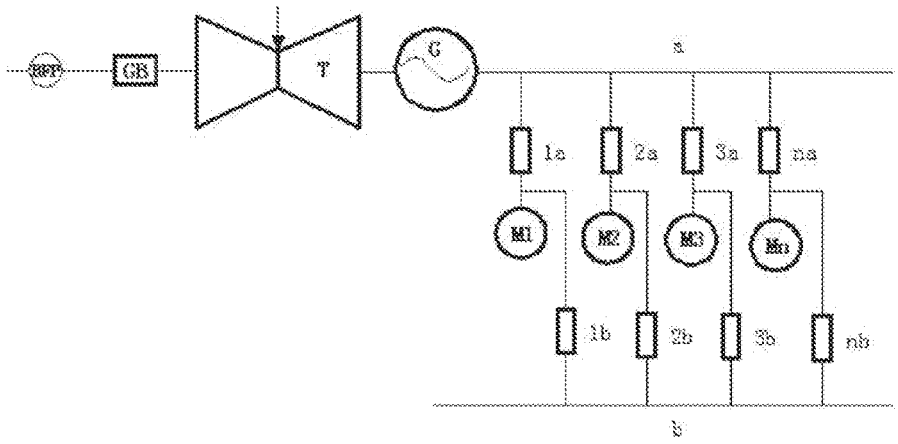



Fig.1

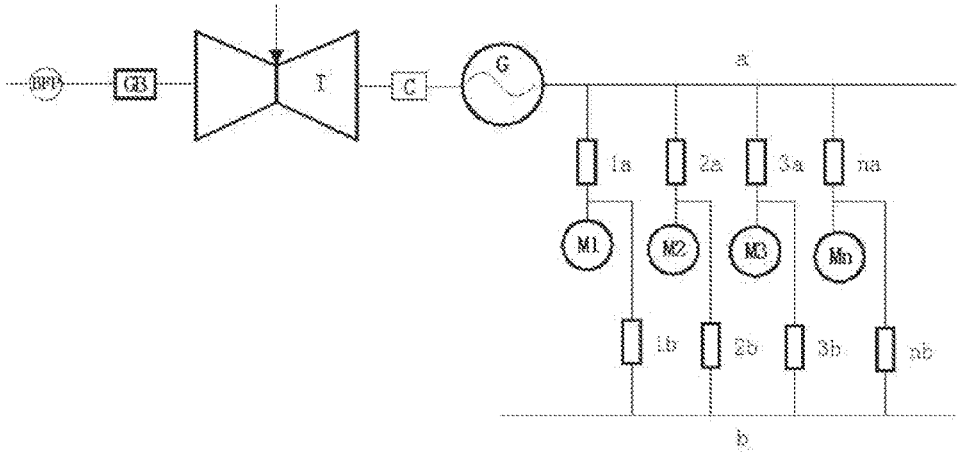



Fig.2

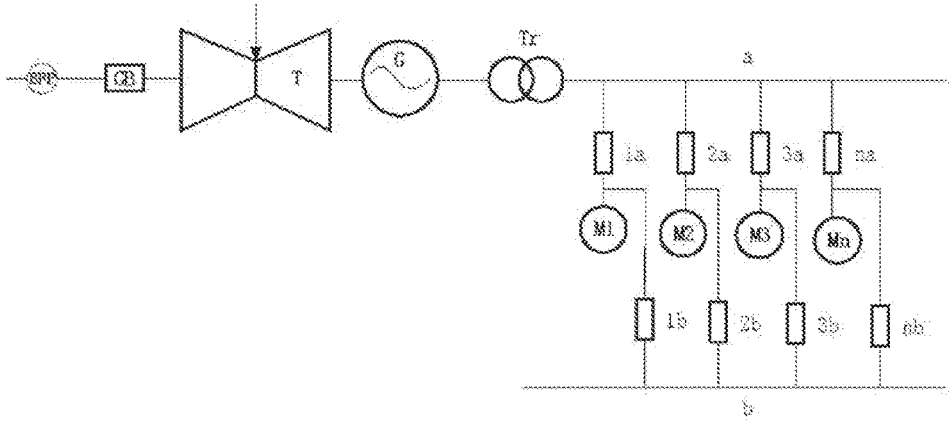



Fig.3

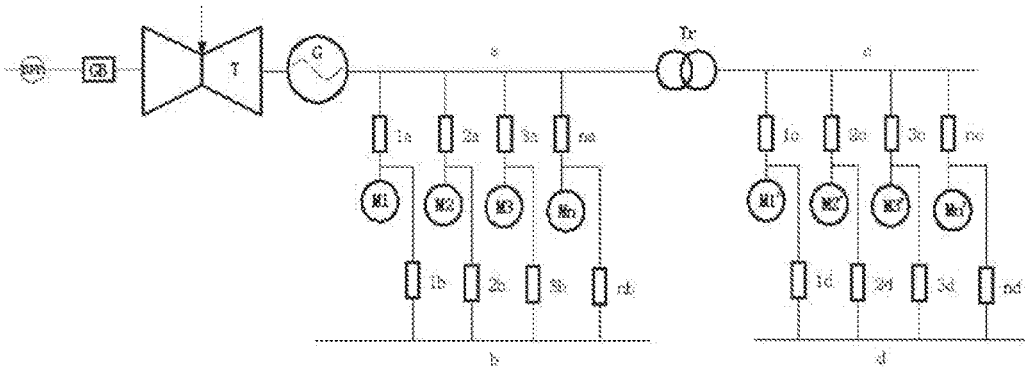


Fig.4

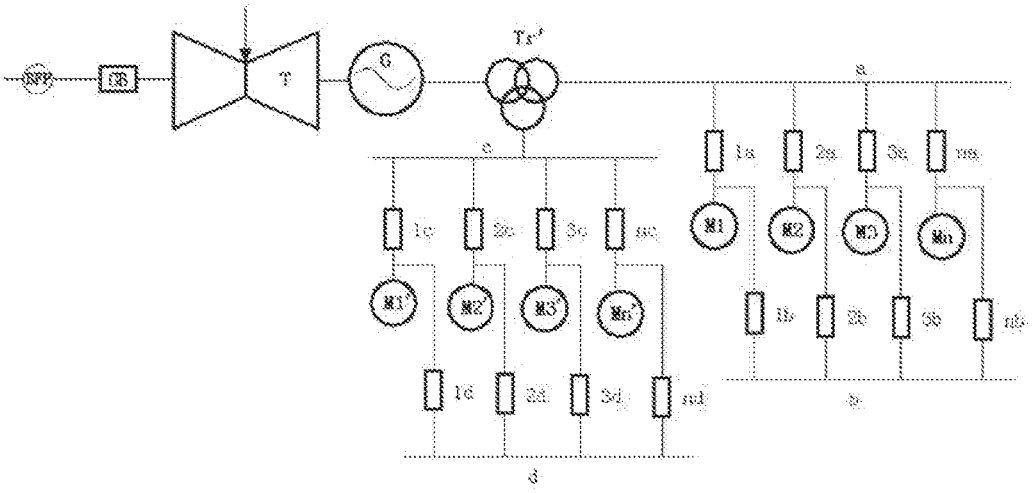


Fig.5

# GENERALIZED FREQUENCY CONVERSION SYSTEM FOR STEAM TURBINE GENERATOR UNIT

## FIELD OF THE INVENTION

**[0001]** The present invention relates to the field of steam turbine generator units, and in particular to a generalized frequency conversion system for a steam turbine generator unit.

## DESCRIPTION OF THE PRIOR ART

**[0002]** During production of power plants, water is heated into steam in the boiler; and then steam is used to drive the steam turbine to rotate, thereby driving the generator to rotate and finally converting the chemical energy of the fuel into electricity. In the process of power generation, a large number of rotating auxiliary machines such as pumps and fans provided in the power plants need to consume a large amount of electricity. At present, the general practice is to use a plant transformer to draw part of the generated electricity for the use of plant auxiliary machines.

**[0003]** In engineering design of power plants, the capacity of auxiliary machines is usually selected according to a maximum demand plus a certain allowance, so the auxiliary machines in actual operation have a relatively large margin. However, when the auxiliary machines running at a fixed speed do not operate at full load, especially at low load, their working efficiency will drop sharply, which causes a serious waste of electricity. If the frequency conversion technology is adopted, the working point of the auxiliary machines can be enabled to be as close to the high efficiency area as possible, and the throttling loss of the fan baffle and valve can be reduced to the maximum extent, the energy consumption of the equipment in operation can be greatly reduced, and the service life of the equipment can be prolonged. Taking centrifugal fans as an example, according to the principle of fluid mechanics, shaft power is directly proportional to the third power of rotating speed. When the required air volume is reduced and the fan speed decreases, the power falls by the third power of the speed. Therefore, the energy saving effect of variable-speed operation is very considerable.

**[0004]** Frequency conversion speed adjustment technology is an important means to save energy and reduce emission, improve process flow to improve product quality and improve the environment, and promote technological progress. Frequency conversion speed adjustment is recognized as the most promising speed adjustment mode at home and abroad because of its excellent speed adjustment and starting and braking performance, high efficiency, high power factor and power saving effect. At present, the frequency converter is mainly mounted in power plants to change the frequency of the pump or fan motor, thereby changing the rotating speed of the pump or fan, improving its operation efficiency, to achieve the purposes of energy saving and emission reduction.

**[0005]** Now the frequency conversion methods mainly include silicon controlled rectifier frequency conversion, hydraulic coupling frequency conversion and magnetic coupling frequency conversion. Among the three frequency conversion methods, the hydraulic coupling frequency conversion has the advantages of high power, low reliability and low cost, its efficiency is directly proportional to the first power of the rotating speed, and its adjustment precision is low. Magnetic coupling frequency conversion has high reliability and the highest cost, its efficiency is directly proportional to the square of the rotating speed, the efficiency is low when the rotating speed is low, and if a magnetic coupling device is additionally mounted, the mounting position of the motor or equipment needs to be changed and the original civil construction foundation needs to be removed. Silicon controlled rectifier frequency conversion has the advantage of the highest efficiency, its efficiency is not affected by load changes, the response is the fastest, and the adjustment accuracy is the highest. In these three frequency conversion methods, the cost of silicon controlled rectifier frequency conversion is in the middle. In terms of cost and efficiency, the silicon controlled rectifier frequency conversion technology is widely used in power plants.

**[0006]** Because of the high reliability of the equipment required in power plants, the used rotating equipment such as circulating water pump and blower have the advantages of high power and high voltage level, so the requirement on the frequency converter used in power plants is also extremely high. At present, the silicon controlled rectifier technology is mainly used in frequency conversion equipment in power plants. The biggest disadvantage of the silicon controlled rectifier technology is that the higher the voltage level is, the lower the reliability of the equipment is, the area occupied by the frequency conversion equipment is large, and its frequency conversion harmonic waves have influences on both the power grid and the motor. Therefore, in the power plants, the promotion and application of the silicon controlled rectifier frequency conversion technology is relatively slow. With the development of technology, some products have been able to better solve the above-mentioned problems at present, but the high price of these products hinders their further promotion.

**[0007]** For this, patent "ZL 2012 10006442.8" provides a frequency conversion main power supply system for a thermal power plant, which uses a separately arranged small steam turbine with adjustable operating speed to drive a generator. By changing the operating speed of the small steam turbine, the frequency of alternating current outputted from the generator is changed. This invention realizes that alternating current with required frequency can be obtained without using a frequency converter, thus achieving the purpose of energy saving. However, the shortcoming is that a small steam turbine and a generator need to be additionally configured; besides, corresponding auxiliary equipment such as condenser and oil system, and control systems, electrical systems and the like need to be supportively provided.

**[0008]** Therefore, patent "ZL 201420245755.3" further provides a novel frequency conversion system for a thermal power plant, that is, a water feeding pump steam turbine is directly connected to a water feeding pump, a generator is indirectly connected through a gearbox, the steam turbine also drives the generator through the water feeding pump while driving the water feeding pump steam turbine, this also realizes the same effect of obtaining alternating current of required frequency without using other types of frequency converters, and all auxiliary supporting systems are combined into one. However, the shortcoming is that with the increasing capacity of the unit at present, the capacity of the feed water pump itself is relatively large, if the generator is

further driven, the power will be relatively greater. Taking a 1000 MW unit as an example, the design power of the water feeding pump is about 38 MW and the rotating speed is generally 4500-5300 rpm, which together with the auxiliary power of the generator lead to at least 53 MW for the power of the water feeding pump steam turbine. Moreover, the manufacturing process ability of water feeding pump steam turbines is limited by factors such as cylinder structures and blade strength at present, especially by the high stress at the root of long blades caused by high centrifugal force under high-speed rotation, the length of the last-stage blades and the exhaust area of the steam turbine are limited, the exhaust pressure of the water feeding pump steam turbines under the rated working condition will be very high, and thus, not only the economy efficiency is poor, but also it is difficult to match the rotating speed of the water feeding pump.

**[0009]** Therefore, the present invention is devoted to developing a generalized frequency conversion system having the advantages of low cost, high reliability, high efficiency and simple operation.

## SUMMARY OF THE INVENTION

**[0010]** In view of the above-mentioned shortcomings of the prior art, the purpose of the present invention is to provide a generalized frequency conversion system having the advantages of low cost, high reliability, high efficiency and simple operation.

**[0011]** The present invention provides a generalized frequency conversion system for a steam turbine generator unit. The system at least comprises a steam turbine with an adjustable rotating speed, a water feeding pump, a generator, a speed increasing gearbox, a variable frequency bus and an auxiliary machine. The system is characterized in that the steam turbine is connected with the water feeding pump through the speed increasing gearbox to drive the water feeding pump; the steam turbine is connected with the generator to drive the generator to generate power; and the generator is connected with a motor of the auxiliary machine through the variable frequency bus.

**[0012]** Further, the generalized frequency conversion system is characterized in that the generalized frequency conversion system further comprises an industrial frequency bus and an industrial frequency power supply; and the motor of the auxiliary machine is connected with the industrial frequency power supply through the industrial frequency bus.

**[0013]** Further, the generalized frequency conversion system is characterized in that the generalized frequency conversion system further comprises a clutch system provided between the steam turbine and the generator.

**[0014]** Further, the generalized frequency conversion system is characterized in that the clutch system can be a separate safety coupling, or a separate clutch or a combination of a safety coupling and a clutch.

**[0015]** Alternatively, the generalized frequency conversion system is characterized in that the generalized frequency conversion system further comprises a corresponding voltage transformer provided at the rear of an output end of the generator.

**[0016]** Alternatively, the generalized frequency conversion system is characterized in that the generalized frequency conversion system further comprises a switch and an industrial frequency bus; the motor of the auxiliary machine is connected with the variable frequency bus through the switch; and the motor of the auxiliary machine is connected with the industrial frequency bus through the switch.

**[0017]** Alternatively, the generalized frequency conversion system is characterized in that the number of the auxiliary machines is at least one.

**[0018]** The basic principle of the generalized frequency conversion system provided by the present invention is as follows: the steam turbine with an adjustable rotating speed (called as "variable frequency steam turbine") is used to connect the speed increasing gearbox to drive the water feeding pump and to further drive the generator, so as to adjust (change) parameters and an amount of steam entering the variable frequency steam turbine according to a load variation of the unit, so that the rotating speed changes correspondingly, thus the frequency of alternating current outputted from the generator is changed, the power frequency of motors of all auxiliary machines connected to the variable frequency bus is changed through the variable frequency bus, and finally, the rotating speed of rotating machines of the auxiliary machines is changed.

**[0019]** The auxiliary machine connected to the variable frequency bus can also be connected to the industrial frequency bus. Industrial frequency and variable frequency are switched to each other as a backup. When the steam turbine or generator fails or is under other special working conditions, the auxiliary machine connected with the variable frequency bus can switch to the industrial frequency quickly, thus ensuring the safe operation of the unit.

**[0020]** It is also possible to further provide a clutch system between the variable frequency steam turbine and the generator. If a variable frequency generator or its electrical equipment fails and thus it is required that the generator must be shut down, the variable frequency generator can be disconnected directly through the clutch system to ensure the normal operation of the water feeding pump, thus ensuring the operation safety of the main steam turbine generator unit. The clutch system may be a separate safety coupling, or a separate clutch, or a combination of a safety coupling and a clutch.

**[0021]** In addition, a corresponding voltage transformer can be provided at the rear of the output end of the generator so that the output voltage of the generator, after voltage transformation, can meet the requirements of motors of all auxiliary machines at different voltage levels.

**[0022]** As the load of the unit changes, the frequency conversion system provides all auxiliary machines connected thereto with a frequency modulation power supply having an initially adjusted frequency. The adjustment structures on the auxiliary machines, such as valves, baffles, or movable blades of adjustable axial-flow fans, can be further fine-tuned to ensure that production requirements are met. For example, the power supply frequency at which the opening of the adjusting mechanism of the auxiliary machine is 95% of the largest adjustable opening is used as the frequency of the frequency modulation power supply.

**[0023]** The variable frequency steam turbine of the present invention takes the steam extracted from the main steam turbine as a working steam source. In addition, an inlet valve can be further provided at the front of the variable frequency steam turbine of the present invention, so that the rotating speed of the variable frequency steam turbine can be accurately controlled through the valve while the load of the unit changes.

**[0024]** The generalized frequency conversion system provided by the present invention has the following advantages:

**[0025]** 1. The generalized frequency conversion system of the present invention can obtain alternating current of a required frequency without using other types of frequency converters, thus greatly reducing the power consumption of the auxiliary machine connected to the variable frequency bus.

**[0026]** 2. According to the feature that the rotating speed of the water feeding pump and variable frequency steam turbine synchronously varies with the load of the unit, the variable frequency steam turbine used in the present invention drives both the water feeding pump and the generator. Therefore, compared with the solution of patent "ZL 201210006442.8", the water feeding pump steam turbine is combined with the separately arranged variable frequency steam turbine, and the correspondingly arranged auxiliary machine systems are combined into one, the system is greatly simplified and the investment is reduced. In addition, the capacity of the combined steam turbine is relatively increased, and the internal efficiency is improved accordingly.

**[0027]** 3. Since the variable-frequency steam turbine of the present invention is connected with the water feeding pump through the speed increasing gearbox, compared with the solution of the patent "ZL 201420245755.3", on the one hand, the rotating speed of the water feeding pump can be designed higher, the diameter of the pump becomes smaller, and thus the manufacturing cost of the water feeding pump can be reduced; the pump shell becomes thinner, and the start-up and load-changing adaptability is strong; on the other hand, the rotating speed of the variable frequency steam turbine is relatively low, the variable frequency steam turbine can be compatible with the existing industrial frequency steam turbine to a certain extent, and it overcomes the problem that it is difficult to match the rotating speeds of the variable frequency steam turbine and of the water feeding pump; at the same time, the exhaust residual velocity loss of the variable frequency steam turbine at low speed is also relatively low, so a higher internal efficiency can be obtained relatively; and besides, since longer last-stage blades can be used for the variable frequency steam turbine at low speed, the exhaust area is larger, and thus the exhaust pressure can be relatively lower, that is, the actual total enthalpy drop during the operation of the steam turbine is relatively large, and the economic benefit will be better.

**[0028]** In order to fully understand the purpose, features and effects of the present invention, the concept, specific structure and produced technical effects of the present invention will be further described below with reference to the drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0029]** FIG. **1**, FIG. **2**, FIG. **3**, FIG. **4** and FIG. **5** are schematic diagrams of systems according to specific embodiments of the present invention.

## DESCRIPTION OF REFERENCE SIGNS IN THE DRAWINGS

**[0030]** T: steam turbine; G: generator; BFP: water feeding pump; GB: gearbox; C: clutch system; Tr: double-winding voltage transformer; Tr': three-winding voltage transformer;

**[0031]** a: variable frequency bus; b: industrial frequency bus;

**[0032]** c: variable frequency bus; d: industrial frequency bus;

**[0033]** **1***a*, **2***a*, **3***a*, . . . , na: switch between auxiliary machine and variable frequency bus;

**[0034]** **1***b*, **2***b*, **3***b*, . . . , nb: switch between auxiliary machine and industrial frequency bus;

**[0035]** **1***c*, **2***c*, **3***c*, . . . , nc: switch between auxiliary machine and variable frequency bus;

**[0036]** **1***d*, **2***d*, **3***d*, . . . , nd: switch between auxiliary machine and industrial frequency bus;

**[0037]** M**1**, M**2**, M**3**, . . . , Mn: motor of auxiliary machine;

**[0038]** M**1'**, M**2'**, M**3'**, . . . , Mn': motor of auxiliary machine.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

### Embodiment 1

**[0039]** As illustrated in FIG. **1**, it illustrates a specific embodiment of a generalized frequency conversion system for a steam turbine generator unit, comprising a steam turbine T, a water feeding pump BFP, a generator G, a speed increasing gearbox GB, a variable frequency bus a and an industrial frequency bus b. Auxiliary machines M**1**, M**2**, M**3**, . . . , Mn are connected with the variable frequency bus a through switches **1***a*, **2***a*, **3***a*, . . . , na, and are connected with the industrial frequency bus b through switches **1***b*, **2***b*, **3***b*, . . . , nb. With a change in load of the unit, parameters of steam entering the steam turbine and an extracted steam amount are adjusted (changed) accordingly, so that the rotating speed of the steam turbine changes accordingly. In this way, on the one hand, the rotating speed of the water feeding pump is changed indirectly through the gearbox; and on the other hand, the frequency of alternating current outputted by the generator is changed directly. The generator provides a variable frequency power supply for all auxiliary machines connected to the variable frequency bus a. The industrial frequency bus b and the variable frequency bus a may be switched to each other for a standby use. When the variable frequency steam turbine or generator fails or is under other special working conditions, all auxiliary machines on the variable frequency bus a can switch to the industrial frequency bus b quickly, thus ensuring the safe operation of the main steam turbine generator unit.

**[0040]** In this solution, the variable frequency steam turbine can choose longer last-stage blades because of its low rotating speed relative to the high speed water feeding pump steam turbine, so as to obtain a more adequate exhaust area and thus obtain a lower exhaust pressure. Taking a 53 MW variable frequency steam turbine as an example, the exhaust pressure is relatively reduced by 2.4 KPa, and the variable frequency steam turbine can therefore do more work by 3360 KW.

### Embodiment 2

**[0041]** As illustrated in FIG. **2**, it illustrates another specific embodiment of a generalized frequency conversion system for a steam turbine generator unit, comprising a steam turbine T, a water feeding pump BFP, a generator G, a speed increasing gearbox GB, a clutch system C, a variable frequency bus a and an industrial frequency bus b. Auxiliary

machines M1, M2, M3, . . . , Mn are connected with the variable frequency bus a through switches 1*a*, 2*a*, 3*a*, . . . , na and are connected with the industrial frequency bus b through switches 1*b*, 2*b*, 3*b*, . . . , nb. With a change in load of the unit, the parameters of steam entering the steam turbine and the extracted steam amount are adjusted (changed) accordingly, so that the rotating speed of the steam turbine changes accordingly. In this way, on the one hand, the rotating speed of the water feeding pump is changed indirectly through the gearbox; and on the other hand, the frequency of alternating current outputted by the generator is changed directly. The generator provides a variable frequency power supply for all auxiliary machines connected to the variable frequency bus a. The industrial frequency bus b and the variable frequency bus a may be switched to each other for a standby use. When the variable frequency steam turbine or generator fails or is under other special working conditions, auxiliary machines on the variable frequency bus a can switch to the industrial frequency bus b quickly, thus ensuring the safe operation of the main steam turbine generator unit.

**[0042]** Compared with embodiment 1, in this embodiment, the clutch system C is additionally provided. If an abnormal working condition (such as when the variable frequency generator or its electrical equipment fails and thus it is required that the generator must be shut down) occurs, the variable frequency generator can be disconnected directly through the clutch system, and instead, the steam turbine operates and drives the water feeding pump only. The reliability of the entire generalized frequency conversion system and the main steam turbine generator unit is improved.

Embodiment 3

**[0043]** As illustrated in FIG. **3**, it illustrates another specific embodiment of a generalized frequency conversion system for a steam turbine generator unit, comprising a steam turbine T, a water feeding pump BFP, a generator G, a speed increasing gearbox GB, a double-winding voltage transformer Tr, a variable frequency bus a and an industrial frequency bus b. Auxiliary machines M1, M2, M3, . . . , Mn are connected with the variable frequency bus a through switches 1*a*, 2*a*, 3*a*, . . . , na and are connected with the industrial frequency bus b through switches 1*b*, 2*b*, 3*b*, . . . , nb. With a change in load of the unit, the parameters of steam entering the steam turbine and the extracted steam amount are adjusted (changed) accordingly, so that the rotating speed of the steam turbine changes accordingly. In this way, on the one hand, the rotating speed of the water feeding pump is changed indirectly through the gearbox; and on the other hand, the frequency of alternating current outputted by the generator is changed directly. The generator provides a variable frequency power supply for all auxiliary machines connected to the variable frequency bus a. The industrial frequency bus b and the variable frequency bus a may be switched to each other for a standby use. When the variable frequency steam turbine or generator fails or is under other special working conditions, auxiliary machines on the variable frequency bus a can switch to the industrial frequency bus b quickly, thus ensuring the safety.

**[0044]** Compared with embodiment 1, in this embodiment, the double-winding voltage transformer Tr is additionally provided, so the output voltage of the generator, after voltage transformation, can meet the requirements of motors of all auxiliary machines at the same voltage level.

Embodiment 4

**[0045]** As illustrated in FIG. **4**, it illustrates another specific embodiment of a generalized frequency conversion system for a steam turbine generator unit, comprising a steam turbine T, a water feeding pump BFP, a generator G, a speed increasing gearbox GB, a double-winding voltage transformer Tr, a variable frequency bus a, an industrial frequency bus b, a variable frequency bus c and an industrial frequency bus d. Auxiliary machines M1, M2, M3, . . . , Mn are connected with the variable frequency bus a through switches 1*a*, 2*a*, 3*a*, . . . , na and are connected with the industrial frequency bus b through switches 1*b*, 2*b*, 3*b*, . . . , nb. Auxiliary machines M1', M2', M3', . . . , Mn' are connected with the variable frequency bus c through switches 1*c*, 2*c*, 3*c*, . . . , nc and are connected with the industrial frequency bus d through switches 1*d*, 2*d*, 3*d*, . . . , nd. With a change in load of the unit, the parameters of steam entering the steam turbine and the extracted steam amount are adjusted (changed) accordingly, so that the rotating speed of the steam turbine changes accordingly. In this way, on the one hand, the rotating speed of the water feeding pump is changed indirectly through the gearbox; and on the other hand, the frequency of alternating current outputted by the generator is changed directly. The generator provides a variable frequency power supply for all auxiliary machines connected to the variable frequency bus a. The industrial frequency bus b and the variable frequency bus a may be switched to each other for a standby use. At the same time, through the double-winding voltage transformer Tr, a variable frequency power supply is provided for all auxiliary machines on the variable frequency bus c at different voltage levels. The industrial frequency bus d and the variable frequency bus c may be switched to each other for a standby use.

**[0046]** When the variable frequency steam turbine or generator fails or is under other special working conditions, auxiliary machines on the variable frequency bus a can switch to the industrial frequency bus b quickly; and at the same time, auxiliary machines on the variable frequency bus c can switch to the industrial frequency bus d quickly, thus ensuring the safe operation of the main steam turbine generator unit.

**[0047]** Compared with embodiment **1**, in this embodiment, the output voltage of the generator can not only meet the voltage requirements of part of motors of auxiliary machines directly, but also meet the requirements of motors of auxiliary machines at other voltage levels after the voltage is transformed by the double-winding voltage transformer Tr.

Embodiment 5

**[0048]** As illustrated in FIG. **5**, it illustrates another specific embodiment of a generalized frequency conversion system for a steam turbine generator unit, comprising a steam turbine T, a water feeding pump BFP, a generator G, a speed increasing gearbox GB, a three-winding voltage transformer Tr', a variable frequency bus a, an industrial frequency bus b, a variable frequency bus c and an industrial frequency bus d. Auxiliary machines M1, M2, M3, . . . , Mn are connected with the variable frequency bus a through

switches **1***a*, **2***a*, **3***a*, . . . , na and are connected with the industrial frequency bus b through switches **1***b*, **2***b*, **3***b*, . . . , nb. Auxiliary machines M**1'**, M**2'**, M**3'**, . . . , Mn' are connected with the variable frequency bus c through switches **1***c*, **2***c*, **3***c*, . . . , nc and are connected with the industrial frequency bus d through switches **1***d*, **2***d*, **3***d*, . . . , nd. With a change in load of the unit, the parameters of steam entering the steam turbine and the extracted steam amount are adjusted (changed) accordingly, so that the rotating speed of the steam turbine changes accordingly. In this way, on the one hand, the rotating speed of the water feeding pump is changed indirectly through the gearbox; and on the other hand, the frequency of alternating current outputted by the generator is changed directly. The generator provides a variable frequency power supply for all auxiliary machines connected to the variable frequency bus a. The industrial frequency bus b and the variable frequency bus a may be switched to each other for a standby use. At the same time, through the double-winding voltage transformer Tr, a variable frequency power supply is provided for all auxiliary machines on the variable frequency bus c at different voltage levels. The industrial frequency bus d and the variable frequency bus c may be switched to each other for a standby use.

**[0049]** When the variable frequency steam turbine or generator fails or is under other special working conditions, auxiliary machines on the variable frequency bus a can switch to the industrial frequency bus b quickly; and auxiliary machines on the variable frequency bus c can switch to the industrial frequency bus d quickly, thus ensuring the safe operation of the main steam turbine generator unit.

**[0050]** Compared with embodiment 1, in this embodiment, the output voltage of the generator is transformed by the three-winding transformer Tr'; and then a variable frequency power supply is provided for motors of auxiliary machines at two different voltage levels through the variable frequency buses a and c respectively.

**[0051]** It should be noted that in the above-mentioned embodiments of the present invention, the double-winding voltage transformer Tr, three-winding voltage transformer Tr' and clutch system C can be combined into a variety of embodiments, but all of them should fall within the protective scope of the present invention patent.

**[0052]** Specific embodiments of the present invention are described in detail above. It should be understood that one skilled in the art could make various modifications and variations according to the concept of the present invention without contributing any inventive labor. Therefore, all technical solutions which could be obtained by one skilled in the art through logical analysis, reasoning or limited experiments on the basis of the prior art according to the concept of the present invention shall fall within the protective scope determined by the claims.

**1**. A generalized frequency conversion system for a steam turbine generator unit, comprising a steam turbine with an adjustable rotating speed, a water feeding pump, a generator, a speed increasing gearbox, a variable frequency bus and an auxiliary machine, characterized in that the steam turbine is connected with the water feeding pump through the speed increasing gearbox to drive the water feeding pump; the steam turbine is connected with the generator to drive the generator to generate power; and the generator is connected with a motor of the auxiliary machine through the variable frequency bus.

**2**. The generalized frequency conversion system according to claim **1**, characterized in that the generalized frequency conversion system further comprises an industrial frequency bus and an industrial frequency power supply; and the motor of the auxiliary machine is connected with the industrial frequency power supply through the industrial frequency bus.

**3**. The generalized frequency conversion system according to claim **1**, characterized in that the generalized frequency conversion system further comprises a clutch system provided between the steam turbine and the generator.

**4**. The generalized frequency conversion system according to claim **3**, characterized in that the clutch system can be a separate safety coupling, or a separate clutch or a combination of a safety coupling and a clutch.

**5**. The generalized frequency conversion system according to claim **1**, characterized in that the generalized frequency conversion system further comprises a voltage transformer; and the voltage transformer is provided at the rear of an output end of the generator and is connected with the motor of the auxiliary machine through the variable frequency bus.

**6**. The generalized frequency conversion system according to claim **1**, characterized in that the generalized frequency conversion system further comprises a switch and an industrial frequency bus; the motor of the auxiliary machine is connected with the variable frequency bus through the switch; and the motor of the auxiliary machine is connected with the industrial frequency bus through the switch.

**7**. The generalized frequency conversion system according to claim **1**, characterized in that the number of the auxiliary machines is at least one.

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