



(11) **EP 2 175 104 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
08.06.2016 Bulletin 2016/23

(51) Int Cl.:
F01D 19/00 ^(2006.01) **F01D 21/00** ^(2006.01)
F01K 7/22 ^(2006.01) **F01K 13/02** ^(2006.01)
F22B 37/52 ^(2006.01)

(21) Application number: **07845793.4**

(86) International application number:
PCT/CN2007/003431

(22) Date of filing: **03.12.2007**

(87) International publication number:
WO 2008/151484 (18.12.2008 Gazette 2008/51)

(54) **A SMALL BYPASS SYSTEM OF A GENERATOR SET AND A CONTROLLING METHOD THEREOF**
KLEINES BYPASSSYSTEM FÜR EINEN GENERATORSATZ UND STEUERVERFAHREN DAFÜR
SYSTÈME DE PETITE DÉRIVATION D'UN ENSEMBLE GÉNÉRATEUR ET PROCÉDÉ DE
COMMANDE ASSOCIÉ

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE
SI SK TR**

(30) Priority: **11.06.2007 CN 200710041839**

(43) Date of publication of application:
14.04.2010 Bulletin 2010/15

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Description

Field of the Invention

[0001] The present invention relates to the field of electric power heat engine and thermal automation, and more particularly, to a small bypass system and a control method thereof.

Background of the invention

[0002] Document US 4598 551 discloses an apparatus and method for controlling steam turbine operating conditions during starting and loading.

[0003] A coal-fired generating unit mainly comprises three main machines: a boiler, a turbine and a generator. In the control strategies, since the boiler with a huge volume has a relatively big inertia to change its state, the change is relatively slow. However, as compared to the state change of the boiler, the change of the rotation speed and the output state of a turbine is much faster. The bypass system is an indispensable part in the process of coordinating the operation of the two machines.

[0004] At present, the high-capacity bypass systems for coal-fired generating units both at home and abroad, including 100% capacity bypass systems, are always directly led out from the outlet pipes of the boiler superheater header at the side close to the boiler and then connected into the cold section of the reheater, resulting in that only little live steam passes through each of the main steam pipe extending from the big bypass valves to the steam turbine. As a result, on the one hand, the temperature of this pipe section is relatively low, however, in the operating mode, this pipe section endures the highest temperature in the whole steam-water circulation. Therefore, in general, oxidation in this pipe section is rather serious. In the cold starting mode, due to thermal impact, the fallen oxide skins in the pipe will directly enter the HP cylinder of the steam turbine, thus causing tremendous damage to the turbine blades.

[0005] Secondly, when starting the unit, a large quantity of foreign matters such as oxide skins and solid particles will pass through the big bypass valves along with a high speed steam flow, while in the conventional starting process, because the gaps between the valve spools and the valve seats are very small when the big bypass valves have a relatively small opening, the flow speed at this position is very high, and the solid foreign matters carried by the high-speed steam will scour the spools of the bypass valves at a high speed, easily causing wounds on the spools of the bypass valves. When a valve spool has returned to the valve base, the leak tightness between the valve spool with the wounds and the valve body is considerably reduced, and the high-speed steam flow will continuously scour the wounds, causing the wounds to become increasingly large, and in serious cases it will directly result in discarding of expensive spools. During the operation, a great amount of steam will leak

from the wounds, affecting the economical efficiency of unit operation.

[0006] Thirdly, under usual conditions, the starting of a unit always involves a process of starting with a bypass system. The main steam passes the big bypass valves and enters the cold section of the boiler reheater, and then returns to the boiler reheater. During this process, when the steam is passing through the big bypass valves, all the pipes from the big bypass valves to the turbine only allow a small amount of steam flow to pass through a drain valve, causing a considerable lag between the temperature of this section of the main steam line and the actual main steam temperature. Furthermore, the steam quality sampled from this pipe section is not authentic, and it is not easy to meet the conditions for turbine impulse start, thus resulting in a delay of the starting of the turbine and a waste of lots of fuel, station-service power and time.

Summary of the Invention

[0007] In view of the deficiencies in the prior art as described above, a technical issue to be addressed by the present invention is to provide a control method of a small by pass system, which is to be used at the starting stage of a generating unit to protect a high-capacity bypass valve and to solve the problem that the steam flow in the main steam pipe is too small in quantity.

[0008] To achieve the above objects, the present invention provides a small bypass system, wherein said generating unit comprises at least a boiler and a turbine as well as a main steam pipe, and a big bypass system which is connected with said boiler and said turbine. A small bypass system is provided on said main steam pipe close to said turbine. Said small bypass system comprises a small bypass steam pipe and at least one group of small bypass adjusting valves.

[0009] Preferably, said small bypass adjusting valves are small capacity adjusting valves for reducing temperature and pressure, and in said small bypass steam pipe, stop valves are also provided in front of and/or behind said small bypass adjusting valves.

[0010] Preferably, the flow of said small bypass system is 1% - 50% of the flow of said main steam pipe.

[0011] Preferably, the flow of said small bypass system is 5% - 30% of the flow of said main steam pipe.

[0012] The present invention provides a control method of a small bypass system, comprising the following steps:

Step 1: prior to opening said big bypass system of said generating unit, firstly opening the small bypass stop valves, and gradually opening said small bypass adjusting valves, so that the main steam from said boiler is discharged to the reheat system of said generating unit via said bypass system, until said bypass system reaches the maximum flow;
Step 2: immediately after said small bypass system

has reached the maximum flow, adjusting said big bypass system to an opening that corresponds to the maximum flow of said small bypass, and at the same time closing said small bypass adjusting valves, so that the flow of said small bypass system is quickly shifted to said big bypass system;

Step 3: when said big bypass system has gradually reached a relatively larger opening, gradually opening said small bypass adjusting valves to the maximum flow.

[0013] Preferably, it further includes a Step 4 after said Step 3: after the load on said generating unit has gradually increased, firstly gradually closing said small bypass adjusting valves, then gradually closing said big bypass system until the steam flow in said big bypass system is slightly less than the maximum flow of said small bypass system, quickly closing said big bypass system; and at the same time quickly opening said small bypass system, so as to shift all the steam flow in said big bypass system to said small bypass system, and then closing said small bypass adjusting valves, until the steam flow of the whole bypass system becomes zero. In the whole process of Step 4, the main steam pressure of said generating unit remains substantially stable.

[0014] Preferably, in the process of shutdown operation of the unit, when the load of turbogenerator gradually decreases until parallel off and the load of boiler gradually decreases until shutdown of the boiler, the operation steps of the small bypass can be the reverse of the unit starting process, in a sequence from Step 4 to Step 1.

[0015] Preferably, the opening/closing operations of said small bypass system as well as its coordination with said big bypass system are controlled by way of a programmed control.

[0016] Preferably, said small bypass adjusting valves and the valves of said big bypass system jointly constitute a first bypass valve group and a second bypass valve group, which are respectively located on two steam inlet sides of said turbine. Before said turbine is prepared for impulse start, it is feasible to firstly enter the alternate opening and closing operations of the bypass valve group, firstly opening said the first bypass valve group and then closing said second valve group, so that said steam in said boiler outlet header is unilaterally discharged only via said first bypass valve group in an open state. Then, after maintaining said first bypass valve group in the open state for a predetermined time period, closing said first bypass valve group, and at the same time opening said second bypass valve group, so that said steam in said header is discharged only from said second bypass valve group in an open state. Subsequently, after maintaining said second bypass valve group in the open state for a predetermined time period, terminating the alternate opening/closing operations and shifting to the normal control mode. In the process of said alternate opening/closing operations, the main steam pressure of said generating unit maintains substantially

stable.

[0017] Only by adding a small bypass system in an existing generating unit, the present invention avoids the big bypass valves from operating at a smaller opening, and significantly reduces the erosion of the spools of the big bypass valves by foreign matters such as fallen oxide skins in the boiler. On the other hand, the steam of a certain flow rate can enter the cold section of the reheater via the small bypass system, thus improving the pipe warming efficiency of this section of the main steam pipe. Moreover, the fallen oxide skins in the main steam pipe at the starting stage can be discharged via the small bypass system, thus reducing the erosion of the turbine by solid particles, and thus improving the safety of the unit. At the same time, the steam in this section and the steam generated in the boiler can be substantially synchronized in terms of quality, and the starting time of the unit is thus reduced. In this way, the technical object of protecting the spools of the big bypass valves is achieved. This small bypass system is easy for installation and setting, low in cost and wide in applications.

[0018] According to the control method of a small bypass system of the present invention, with a small bypass system added in the existing unit, the steam of a certain flow rate can enter the cooling section via the small bypass system and the main steam pipe can obtain a great amount of steam to warm up this pipe section. At the starting stage of the unit, a large amount of foreign matters such as solid particles causes serious erosion to the spools of the big bypass valves. With the small bypass system added, at the starting stage, the small bypass adjusting valves are firstly opened without an action of the big bypass valves, thus properly avoiding the damage to the spools of the big bypass valves caused by the oxide skins and solid particles in the pipe. Although the solid particles of foreign matters in the pipe can also cause damage to the body of the small bypass valves, the body of the small bypass adjusting valves is of smaller size and thus the price is much lower than that of the big bypass valves. At the same time, it is also feasible to install stop valves in front of or behind the small bypass adjusting valves. After the starting process is complete, the stop valves installed in front of or behind the small bypass adjusting valves can bring an excellent sealing effect, causing no leakage even if the small bypass adjusting valves have cracks or wounds, and the economical efficiency of the unit operation will not be affected.

[0019] In the meantime, with the adoption of the control method of the small bypass system according to the present invention, since the steam that enters the cold section of the reheater via the whole main steam pipe and the steam that enters the cold section of the reheater via the big bypass valves have substantially the same quality, the quality of the steam in the pipe extending from the big bypass valves to the front of the turbine is more close to the authentic value of the main steam, and therefore the time of waiting for the steam in the pipe section extending from the big bypass valves to the front of the

turbine to become acceptable is significantly reduced, and at the same time the starting time is also reduced.

[0020] In addition, regarding the oxide skins in the pipe extending from the big bypass valves to the front of the turbine, since in the conventional starting process, the steam in this pipe section has a very small impulse, it is very difficult to completely sweep out the oxide skins in this pipe section. However, after a small bypass system has been installed, the small bypass can be opened at the starting time and thus integrated into the existing control of the starting process of the big bypass, so that the steam firstly passes through the small bypass. In this way, the impulse of the steam in this pipe section can be greatly increased, removing the solid particles accumulated in this pipe section, reducing the erosion of the turbine by solid particles, and improving the safety of the unit.

[0021] If in combination with the existing big bypass, the small bypass adjusting valves can act together with the big bypass valves, firstly performing unilateral opening/closing actions, and protecting the big bypass valves in this continuous opening/closing process. Meanwhile, at the early stage of starting, if it is in a cold state, the small bypass adjusting valves need to be opened to avoid the throttled steam from scouring the big bypass valves. If in a hot state or in an extremely hot state, it is necessary to firstly open the big bypass valves to avoid supercooled steam and water from entering the high-temperature pipes and thus resulting in the falling of a large quantity of oxide skins in the pipes. The above described steps are adopted to reduce the generation of oxide skins in the header, with a good effect of sweeping the pipes.

[0022] The concept, the specific configuration and the resulted technological effects of the present invention will be further described hereinafter in conjunction with the attached drawings, in order to fully understand the objects, features and effects of the present invention.

Brief Description of the Drawings

[0023]

Figure 1 is a schematic diagram showing an arrangement of a unit to which a small bypass system of the present invention is applied;

Figure 2 is a simplified block diagram of the starting process of the unit as shown in Figure 1 ("small bypass valves" in this figure refers to the small bypass adjusting valves).

Detailed Description of the Preferred Embodiments

[0024] Figure 1 is a schematic diagram showing an arrangement of a unit to which a small bypass system of the present invention is applied. At least two main machines are provided in one thermal power unit: a turbine 12 and a boiler 1, as well as a pipe system. The bypass system is a main component to adjust and coordinate

the two main machines. In the operation process of the unit, the steam from the boiler 1 passes through a superheater 2 and enters the superheater outlet header 5, then, after passing through the main steam pipe 13, enters an HP cylinder (not shown) of the turbine 12 via the turbine 12 to do work. The discharged steam enters the reheater 3 in the boiler after passing the cold section 4. The big bypass is located between the boiler outlet header 5 and the cold section 4 of the reheater. In this embodiment, the big bypass comprises big bypass valves 6, 7, 8 and 9, which are respectively located on both sides of the superheater outlet header of the boiler 1, as well as communicating pipes connected with the cold section of the reheater. The specialty of the present invention lies in the fact that: a small bypass system is installed on the main steam pipe, between the side close to the turbine 12 and the cold section 4 of the reheater. In this embodiment, this small bypass system comprises two small bypass adjusting valves 10 and 11 which are respectively located on both sides of the HP cylinder of the turbine 12, as well as communicating pipes. The adjusting valves of the small bypass system are not required to have a quick opening/closing function. These adjusting valves are only used at the starting/stop stages of the unit, and are not required to endure the full pressure of the unit.

[0025] The present invention provides a control method for a bypass system described above.

[0026] Under normal operating conditions, the steam enters the HP cylinder of turbine 12 via the main steam pipe 13 to do work. At the starting stage of the unit, the big bypass valves are firstly opened. Different from the prior art, in the small bypass system of the present invention, prior to opening the big bypass valves 6, 7, 8 and 9, firstly the small bypass adjusting valve system are gradually opened, i.e., the small bypass adjusting valves 10 and 11 are slowly opened, so that the steam from the boiler 1 passes through the superheater outlet header and enters the cold section pipe of the reheater via the small bypass adjusting valves 10 and 11, until the small bypass system is fully opened. In this embodiment, the flow of the small bypass system is 20% of the steam flow in the unit, therefore this small bypass system is called for short as a 20% small bypass system.

[0027] After the small bypass system has been fully opened, the big bypass valves 6, 7, 8 and 9 need to be quickly opened, and at the same time the small bypass adjusting valves 10 and 11 are closed, so that the steam is transferred from the small bypass adjusting valves 10 and 11 to the big bypass valves 6, 7, 8 and 9 and then enters the cold section 4 of the reheater.

[0028] In performing the bypass closing operations, firstly the big bypass valves 6, 7, 8 and 9 need to be closed gradually until the steam flow in the pipe is less than or equal to 20% of the total amount of steam. The big bypass valves 6, 7, 8 and 9 need to be quickly closed completely, and at the same time the small bypass adjusting valves 10 and 11 need to be opened to keep the pressure of the main steam to decrease steadily. Sub-

sequently, the small bypass adjusting valves 10 and 11 need to be closed gradually, until the steam flow in the pipe becomes zero.

[0029] By this time, the unit continues to carry out the following starting procedures in a conventional starting mode.

[0030] According to the control method of the small bypass system of the present invention, at the starting stage of the unit, the main steam pipe in the section from the big bypass valves to the small bypass adjusting valves is pre-warmed, and the solid particles and oxide skins in this pipe section are removed. At the same time, a large quantity of solid particles accumulated at the early stage of starting are firstly discharged via the small bypass adjusting valves, reducing the impact of foreign matters of solid particles on the spools of the big bypass valves, and thus protecting the spools of the big bypass valves from being damaged.

[0031] As a further improvement, the control method of the present invention can also realize the control on the opening/closing of the small bypass system in a program-controlled mode. Preferably, the small bypass control system can be included in the control system of the whole unit, so as to realize a full automatic management.

[0032] In this embodiment, by adding the front or rear stop valves (not shown) in front of or behind the small bypass adjusting valves, the safety of the small bypass adjusting valves is improved, and the small bypass adjusting valves are prevented from being scoured or wounded, which may result in steam leakage in the normal operating modes.

[0033] It is obvious that, in other embodiments of the present invention, the flow of the small bypass system is not limited to 20% of the steam flow in the unit. Theoretically, any bypass with a flow less than 50% of the steam flow in the unit can be called as a small bypass. In practical applications, as considered in combination with the effects in various aspects, it is preferred that the flow of the small bypass system is selected at 5%- 30% of the steam flow in the unit.

[0034] Figure 2 is the simplified block diagram of the starting process of the unit as shown in Figure 1 ("small bypass valves" in this figure refers to the small bypass adjusting valves).

[0035] The starting procedures of the unit with a bypass system can be basically divided into the following stages: the stage of the minimum opening, the stage of the minimum pressure, the stage of increasing pressure, the stage of fixed pressure, and the stage of following mode.

[0036] As shown in Figure 2, in conjunction with Figure 1, at the early stage of starting, it is necessary to firstly judge whether the unit is started in a cold state. If it is to start in cold state, firstly the small bypass adjusting valves 10 and 11 need to be opened. At several stages described above, the pressure is to be kept in accordance with the preset procedures, until the small bypass adjusting valves have been fully opened. Then, the big bypass

valves 6, 7, 8 and 9 are quickly opened, and at the same time the small bypass adjusting valves 10 and 11 need to be closed. By this time, the main steam pipe 13 extending from the big bypass valves 6, 7, 8 and 9 to the small bypass adjusting valves 10 and 11 is also pre-warmed and scoured, and a large quantity of solid particles have been discharged via the small bypass adjusting valves 10 and 11. Furthermore, since the big bypass valves 6, 7, 8 and 9 are quickly opened, their working time under throttle operating mode is also reduced, and the spools of the big bypass valves are also protected.

[0037] When the starting operation has proceeded to a certain stage (set as the stage of fixed pressure in this embodiment), it is started to take the unilaterally alternate opening/closing actions on the bypass and scour the superheater outlet header 5. Since this stage is transited from the stage of increasing pressure, by this time the big bypass valves 6, 7, 8 and 9 are in the open state, it is required to firstly close the first group of the big bypass valves located on the same side with the superheater header, and then slowly close the big bypass valves 6 and 7. At this moment, in order to maintain a stable pressure, the second group of the big bypass valves 8 and 9, which are located on the other side of the HP cylinder 12, remain a open state. When the first group of the big bypass valves 6 and 7 have been closed to correspond to the capacity of the small bypass, the small bypass adjusting valves need to be quickly opened, and at the same time the closing of the second group of the big bypass valves 6 and 7 need to be speeded up. The big bypass valves act together with the small bypass adjusting valves to keep the pressure to change according to the preset curve. After all the small bypass adjusting valves have been closed, the steam generated from the superheater 3 of the boiler 1 passes through the superheater outlet header 5 and unilaterally enters the cold section 4 of the reheater via the first group of the big bypass valves 8 and 9, and at the same time partial steam passes through the main steam pipe 13 on the same side with the first group of the big bypass valves 8 and 9 and also enters the cold section 4 of the reheater via the small bypass adjusting valve 11, and returns to the reheater 2. The main steam pipe 13 and the outlet header 3 on this side are scoured, and the foreign matters of solid particles therein are discharged from the outlet header 5.

[0038] Subsequently, it enters the stage of the alternate opening/closing of the unilateral valves. Firstly the small bypass adjusting valves are to be slowly opened, and at this time the first group of the big bypass valves 8 and 9 need to be slowly closed. After the small bypass adjusting valve 10 has been fully opened, the second group of the big bypass valves 6 and 7 located on the same side need to be opened, and at the same time the small bypass adjusting valve 10 are quickly closed, resulting in that the second group of big bypass valves 6 and 7 are quickly opened. The specifics of the process here are similar to those of the process described above.

[0039] After the completion of opening unilateral

valves, it enters the impulse stage. By this time, firstly the small bypass adjusting valves 10 and 11 need to be closed, and then the big bypass valves 6, 7, 8 and 9 are closed, and are quickly closed when the flow of the small bypass adjusting valves has been reached. At the same time the small bypass adjusting valves are opened to keep the pressure stable. Then, the small bypass adjusting valves are used to maintain a stable pressure until these small bypass adjusting valves are closed, so as to avoid the throttled steam from scouring the spools of the big bypass valves.

[0040] If it is started in a hot state, the whole starting process will be performed in the original mode. Finally, at the fixed pressure stage, as the process as mentioned above, it is required to perform an unilateral valve opening action in combination with the small bypass adjusting valves.

Claims

1. A control method of the small bypass system for a steam-driven generating unit, wherein said generating unit comprises at least a boiler (1) and a turbine (12) as well as a main steam pipe (13) and a big bypass system that are connected with said boiler (1) and said turbine (12), wherein a small bypass system is provided on the main steam pipe (13) close to said turbine (12), and said small bypass system comprises a steam pipe of a small bypass and at least one group of small bypass adjusting valves (10, 11); said small bypass adjusting valves (10, 11) are small capacity adjusting valves for reducing temperature and pressure, and in said steam pipe of the small bypass, stop valves are also provided in front of and/or behind said small bypass adjusting valves (10, 11); and the flow of said bypass system is 5% - 30% of the flow of said main steam pipe (13), **characterized in that** the control method comprises the following steps:

step 1: prior to opening said big bypass system of said generating unit, firstly opening the small bypass stop valves, and gradually open said small bypass adjusting valves (10, 11), so that the main steam from said boiler (1) is discharged to a reheat system of said generating unit via said bypass system, until said bypass system reaches a maximum flow;

step 2: after said small bypass system has reached the maximum flow, immediately adjusting said big bypass system to an opening that corresponds to a maximum flow of said small bypass, and at the same time closing said small bypass adjusting valves (10, 11), so that the flow of said small bypass system is quickly shifted to said big bypass system;

step 3: when said big bypass system has grad-

ually reached a relatively bigger opening, gradually opening said small bypass adjusting valves (10, 11) to the maximum flow.

2. The control method of Claim 1, further includes a step 4 after said step 3; after the load on said generating unit has gradually increased, firstly gradually closing said small bypass adjusting valves (10, 11), then gradually closing said big bypass system; until the steam flow in said big bypass system is slightly less than the maximum flow of said small bypass system, immediately closing said big bypass system, and at the same time quickly opening said small bypass system, so as to shift all the steam flow in said big bypass system to said small bypass system; and then, closing said small bypass adjusting valves (10, 11), until the steam flow of the whole bypass system becomes zero; finally, closing the small bypass stop valves; in the whole process of step 4, a main steam pressure in said generating unit being kept substantially stable.
3. The control method of Claim 2, wherein in the process of shutdown operation of the unit when a load of the turbo generator gradually decreases until parallel off and a load of the boiler (1) gradually decreases until shutdown of the boiler (1), the operation steps of the small bypass are the reverse to the starting process of the unit, in a sequence from step 4 to step 1.
4. The control method of Claim 1, wherein the opening/closing operations of said small bypass system as well as its coordination with said big bypass system are controlled in a program-controlled mode.
5. The control method of the small bypass system of Claim 1, wherein said small bypass adjusting valves (10, 11) and the valves of said big bypass system jointly compose a first bypass valve group and a second bypass valve group, which are respectively located on two steam inlet sides of said turbine (12); before said turbine (12) is prepared for impulse start, it is feasible to firstly enter the alternate opening and closing operations of the bypass valve group; firstly opening said first bypass valve group, then closing said second valve group, so that said steam in said boiler (1) outlet header is unilaterally discharged only via said first bypass valves in an open state; then after keeping said first bypass valve group in the open state for a predetermined time period, closing said first bypass valve group, and at the same time opening said second bypass valve group, so that said steam in said header is discharged only from said second bypass valve group in said open state; subsequently, after keeping said second bypass valve group in the open state for a predetermined time period, terminating the alternate opening/clos-

ing operation and shifting to a normal control mode; in the process of said alternate opening/closing operations, the main steam pressure of said generating unit being kept substantially stable.

Patentansprüche

1. Steuerverfahren des Kleinbypasssystems für eine dampfgetriebene Erzeugungseinheit, wobei die Erzeugungseinheit zumindest einen Boiler (1) und eine Turbine (12) wie auch eine Hauptdampfleitung (13) und ein Großbypasssystem, die mit dem Boiler (1) und der Turbine (12) verbunden sind, aufweist, wobei ein Kleinbypasssystem auf der Hauptdampfleitung (13) in der Nähe der Turbine (12) angeordnet ist, und wobei das Kleinbypasssystem eine Dampfleitung eines Kleinbypasses und zumindest eine Gruppe von Kleinbypasseinstellventilen (10, 11) aufweist; wobei die Kleinbypasseinstellventile (10, 11) Kleinkapazitätseinstellventile sind, um die Temperatur und den Druck zu verringern, und wobei in der Dampfleitung des Kleinbypasses auch Stoppventile vor und/oder hinter den Kleinbypasseinstellventilen (10, 11) angeordnet sind; und wobei die Strömung des Bypasssystems zwischen 5% und 30% der Strömung der Hauptdampfleitung (13) beträgt, **dadurch gekennzeichnet, dass** das Steuerverfahren die folgenden Schritte aufweist:

Schritt 1: Vor dem Öffnen des Großbypasssystems der Erzeugungseinheit, zunächst Öffnen der Kleinbypasstoppventile, und schrittweises Öffnen der Kleinbypasseinstellventile (10, 11), so dass der Hauptdampf von dem Boiler (1) über das Bypasssystem zu einem Wiedererwärmungssystem der Erzeugungseinheit abgelassen wird, bis das Bypasssystem eine Maximalströmung erreicht;

Schritt 2: Nachdem das Kleinbypasssystem die Maximalströmung erreicht hat, unmittelbares Einstellen des Großbypasssystems auf eine Öffnung, die einer Maximalströmung des Kleinbypasses entspricht, und gleichzeitig Schließen der Kleinbypasseinstellventile (10, 11), so dass die Strömung des Kleinbypasssystems schnell auf das Großbypasssystem verschoben wird;

Schritt 3: Wenn das Großbypasssystem schrittweise eine verhältnismäßig größere Öffnung erreicht hat, schrittweises Öffnen der Kleinbypasseinstellventile (10, 11) auf die Maximalströmung.

2. Steuerverfahren nach Anspruch 1, das ferner einen Schritt 4 nach Schritt 3 beinhaltet; nachdem die Last, die auf die Erzeugungseinheit wirkt, schrittweise zugenommen hat, zunächst schrittweises Schließen der Kleinbypasseinstellventile (10, 11), dann schritt-

weises Schließen des Großbypasssystems; bis die Dampfströmung in dem Großbypasssystem geringfügig niedriger ist als die Maximalströmung des Kleinbypasssystems, unmittelbares Schließen des Großbypasssystems, und gleichzeitig schnelles Öffnen des Kleinbypasssystems, um die gesamte Dampfströmung in dem Großbypasssystem auf das Kleinbypasssystem zu verschieben; und dann, Schließen der Kleinbypasseinstellventile (10, 11) bis die Dampfströmung des gesamten Bypasssystems bei Null liegt; schließlich, Schließen der Kleinbypasstoppventile; bei dem gesamten Vorgang von Schritt 4 wird ein Hauptdampfdruck in der Erzeugungseinheit im Wesentlichen stabil gehalten.

3. Steuerverfahren nach Anspruch 2, wobei, während des Vorgangs des Herunterfahrens der Einheit, wenn eine Last des Turbogenerators schrittweise abnimmt, bis sie parallel aus ist, und während eine Last des Boilers (1) schrittweise abnimmt, bis der Boiler (1) abgeschaltet ist, die Betriebsschritte des Kleinbypasses zum Startvorgang der Einheit umgekehrt durchgeführt werden, und zwar in einer Folge von Schritt 4 bis Schritt 1.

4. Steuerverfahren nach Anspruch 1, wobei die Öffnungs-/Schließvorgänge des Kleinbypasssystems und seine Koordination mit dem Großbypasssystem in einem programmgesteuerten Modus gesteuert werden.

5. Steuerverfahren des Kleinbypasssystems nach Anspruch 1, wobei die Kleinbypasseinstellventile (10, 11) und die Ventile des Großbypasssystems gemeinsam eine erste Bypassventilgruppe und eine zweite Bypassventilgruppe bilden, die sich an zwei Dampfeinlassseiten der Turbine (12) befinden; wobei es, bevor die Turbine (12) für den Impulsstart vorbereitet wird, möglich ist, erst in die alternativen Öffnungs- und Schließvorgänge der Bypassventilgruppe einzutreten; wobei zunächst die erste Bypassventilgruppe geöffnet und dann die zweite Ventilgruppe geschlossen wird, so dass der Dampf in dem Austrittssammler des Boilers (1) nur über die ersten Bypassventile in einem geöffneten Zustand in einer Richtung abgelassen wird; und wobei dann, nachdem die erste Bypassventilgruppe für einen bestimmten Zeitraum in dem geöffneten Zustand gehalten wurde, die erste Bypassventilgruppe geschlossen wird und gleichzeitig die zweite Bypassventilgruppe geöffnet wird, so dass der Dampf in dem Sammler nur von der zweiten Bypassgruppe in dem geöffneten Zustand abgelassen wird; wobei im Folgenden, nachdem die zweite Bypassventilgruppe für einen bestimmten Zeitraum in dem geöffneten Zustand gehalten wurde, der alternative Öffnungs-/Schließvorgang beendet wird und auf einen normalen Steuermodus umgeschaltet wird; wobei in

dem Vorgang der alternativen Öffnungs-/Schließvorgänge der Hauptdampfdruck der Erzeugungseinheit im Wesentlichen stabil gehalten wird.

Revendications

1. Procédé de commande du système de petite dérivation pour une unité de génération à vapeur, dans lequel ladite unité de génération comprend au moins une chaudière (1) et une turbine (12) ainsi qu'une canalisation de vapeur principale (13) et un système de grande dérivation qui sont reliés à ladite chaudière (1) et à ladite turbine (12), dans lequel un système de petite dérivation est prévu sur la canalisation de vapeur principale (13) à proximité de ladite turbine (12), et ledit système de petite dérivation comprend une canalisation de vapeur d'une petite dérivation et au moins un groupe de vannes de réglage de petite dérivation (10, 11) ; lesdites vannes de réglage de petite dérivation (10, 11) sont des vannes de réglage de petite capacité permettant de réduire la température et la pression, et dans ladite canalisation de vapeur de la petite dérivation, des vannes d'arrêt sont également prévues devant et/ou derrière lesdites vannes de réglage de petite dérivation (10, 11) ; et le débit dudit système de dérivation est de 5 % à 30 % le débit de ladite canalisation de vapeur principale (13),
caractérisé en ce que le procédé de commande comprend les étapes suivantes :

étape 1 : avant l'ouverture dudit système de grande dérivation de ladite unité de génération, l'ouverture préalable des vannes d'arrêt de petite dérivation, et l'ouverture progressive desdites vannes de réglage de petite dérivation (10, 11), de sorte que la vapeur principale provenant de ladite chaudière (1) soit évacuée vers un système de réchauffe de ladite unité de génération par l'intermédiaire dudit système de dérivation, jusqu'à ce que ledit système de dérivation atteigne un débit maximal ;

étape 2 : après que ledit système de petite dérivation a atteint le débit maximal, le réglage immédiat dudit système de grande dérivation selon une ouverture qui correspond à un débit maximal de ladite petite dérivation, et dans le même temps la fermeture desdites vannes de réglage de petite dérivation (10, 11), de sorte que le débit dudit système de petite dérivation soit rapidement déplacé vers ledit système de grande dérivation ;

étape 3 : lorsque ledit système de grande dérivation a progressivement atteint une ouverture relativement plus grande, l'ouverture progressive desdites vannes de réglage de petite dériva-

tion (10, 11) au débit maximal.

2. Procédé de commande selon la revendication 1, qui comprend en outre une étape 4 après ladite étape 3 ; après que la charge sur ladite unité de génération a progressivement augmenté, la fermeture progressive préalable desdites vannes de réglage de petite dérivation (10, 11), puis la fermeture progressive dudit système de grande dérivation ; jusqu'à ce que le débit de vapeur dans ledit système de grande dérivation soit légèrement inférieur au débit maximal dudit système de petite dérivation, la fermeture immédiate dudit système de grande dérivation, et dans le même temps l'ouverture rapide dudit système de petite dérivation, de sorte à déplacer la totalité du débit de vapeur dans ledit système de grande dérivation vers ledit système de petite dérivation ; puis, la fermeture desdites vannes de réglage de petite dérivation (10, 11), jusqu'à ce que le débit de vapeur de tout le système de dérivation devienne nul ; enfin, la fermeture des vannes d'arrêt de petite dérivation ; dans le processus entier de l'étape 4, une pression de vapeur principale dans ladite unité de génération étant maintenue sensiblement stable.
3. Procédé de commande selon la revendication 2, dans lequel, dans le processus d'opération d'arrêt de l'unité, lorsqu'une charge du turbogénérateur diminue progressivement jusqu'à la mise hors parallèle et qu'une charge de la chaudière (1) diminue progressivement jusqu'à l'arrêt de la chaudière (1), les étapes d'opération de la petite dérivation sont l'inverse du processus de départ de l'unité, dans un ordre de l'étape 4 à l'étape 1.
4. Procédé de commande selon la revendication 1, dans lequel les opérations d'ouverture/de fermeture dudit système de petite dérivation ainsi que sa coordination avec ledit système de grande dérivation sont commandées dans un mode commandé par programme.
5. Procédé de commande du système de petite dérivation selon la revendication 1, dans lequel lesdites vannes de réglage de petite dérivation (10, 11) et les vannes dudit système de grande dérivation forment ensemble un premier groupe de vannes de dérivation et un second groupe de vannes de dérivation, qui sont respectivement situés sur deux côtés admission de vapeur de ladite turbine (12) ; avant que ladite turbine (12) soit préparée pour un démarrage par impulsion, il est possible d'entrer au préalable les opérations d'ouverture et de fermeture en alternance du groupe de vannes de dérivation ; l'ouverture préalable dudit premier groupe de vannes de dérivation, puis la fermeture dudit second groupe de vannes, de sorte que ladite vapeur dans le collecteur de refoulement de ladite chaudière (1)

soit évacuée unilatéralement uniquement par l'intermédiaire desdites premières vannes de dérivation à l'état ouvert ; puis, après avoir maintenu ledit premier groupe de vannes de dérivation à l'état ouvert pendant une période prédéterminée, la fermeture dudit premier groupe de vannes de dérivation, et dans le même temps l'ouverture dudit second groupe de vannes de dérivation, de sorte que ladite vapeur dans ledit collecteur soit évacuée uniquement dudit second groupe de vannes de dérivation audit état ouvert ; par la suite, après avoir maintenu ledit second groupe de vannes de dérivation à l'état ouvert pendant une période prédéterminée, la fin de l'opération d'ouverture/de fermeture en alternance et le passage à un mode de commande normal ; dans le processus desdites opérations d'ouverture/de fermeture en alternance, la pression de vapeur principale de ladite unité de génération étant maintenue sensiblement stable.

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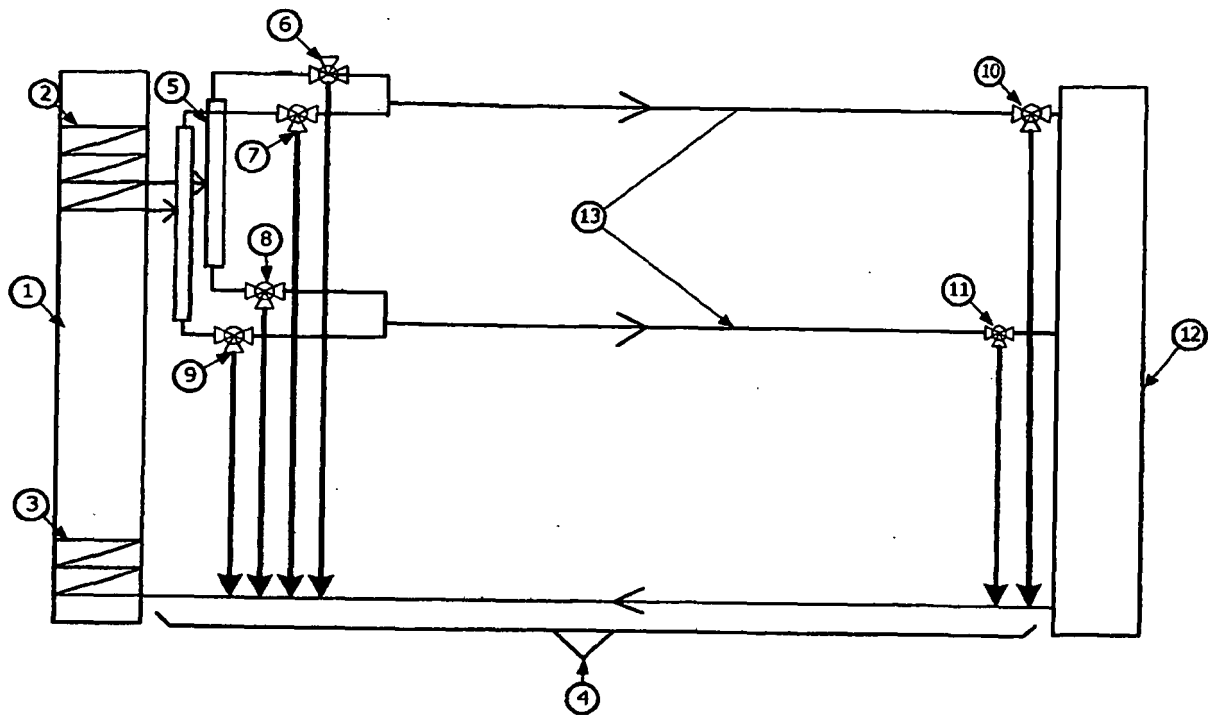


Figure 1

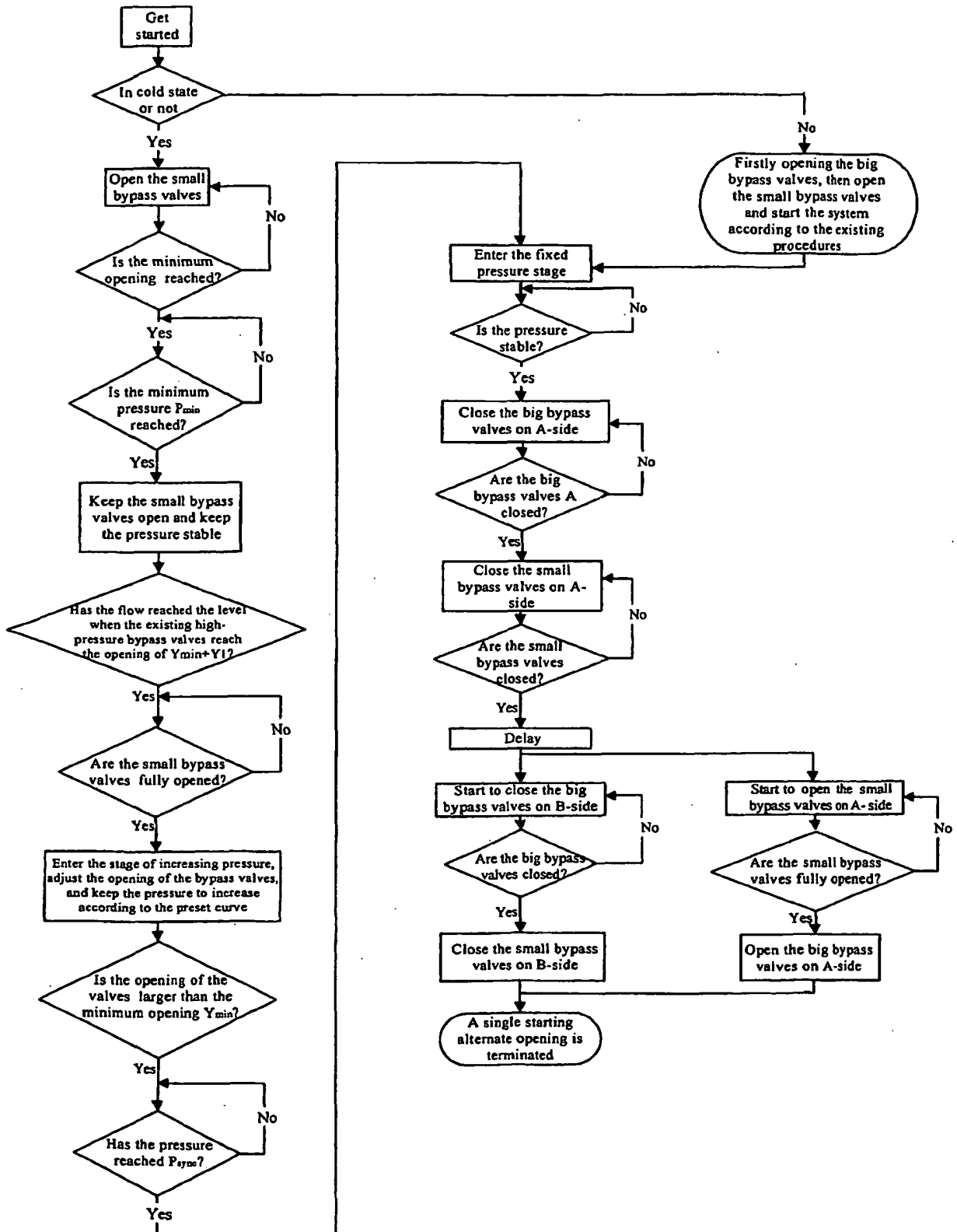


Figure 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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