security and reliability of the connecting portions of detachable pipes, handling of the seal material is very important and careful handling is needed.

[0008] Such seal material handling by proficient operators is desirable, and practice and experience are required to attain proficiency. However, even for experts, confirming and enhancing skills is of great importance in order to secure handling reliability.

[0009] Thus, in view of the foregoing problems, an object of the present invention is to facilitate confirmation of a seal material handling state and improve handling reliability and handling capabilities.

[0010] In addition, a further object of the present invention is not only to make the axial forces on the bolts that tighten a seal material uniform, but also, based on a finding by the present inventor that seal performance is also affected by parallelism between flanges, the tightening force on each seal material, and bolt tightening procedures, to monitor parallelism between flanges, the tightening force on each seal material, and the tightening procedure, thereby contributing to improving handling skills and further increasing seal handling reliability.

~~Solution to Problem~~Summary

[0010a] According to an aspect, the present disclosure refers to a seal material handling monitoring device, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring device comprising: a plurality of first sensors that detect an axial force of each bolt; an information generation unit that generates distribution information of a target axial force by

means of the target axial force and position information for the axial force, and generates distribution information of the axial force by means of the axial force and position information; and a monitor that presents a first distribution map representing the target axial force and presents a second distribution map representing the axial force, via coordinates, and a second sensor that detects parallelism between flanges of the flange joint, wherein the information generation unit generates parallelism information by means of a sensor output from the second sensor, and the monitor presents a third distribution map representing parallelism between the flanges.

[0010b] According to another aspect, the present disclosure refers to a seal material handling monitoring program for causing a computer to implement functions to: receive a sensor output from a plurality of first sensors that detect an axial force of each bolt, generate distribution information of a target axial force by means of the target axial force and position information for the axial force, and generate distribution information of the axial force by means of the axial force and position information; and present a first distribution map representing the target axial force and present a second distribution map representing the axial force, via coordinates; receive a sensor output from a second sensor that detects parallelism between flanges of a flange joint, generate parallelism information by means of the sensor output from the second sensor, and present a third distribution map representing the parallelism between the flanges.

[0010c] According to another aspect, the present disclosure refers to a seal material handling monitoring method, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring method comprising: a step of detecting an axial force of each bolt; a step of generating distribution information of a

target axial force by means of the target axial force and position information for the axial force, and generating distribution information of the axial force by means of the axial force and position information; a step of presenting a first distribution map representing the target axial force and presenting a second distribution map representing the axial force, via coordinates; a step of detecting parallelism between flanges of the flange joint; a step of generating parallelism information by means of the parallelism; and a step of presenting a third distribution map representing the parallelism between the flanges.

[0010d] According to another aspect, the present disclosure refers to a seal material handling monitoring system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring system comprising: a seal handling unit including a sensor that detects parallelism between flanges of the flange joint; an information generation unit which is connected to the sensor by means of a wired or wireless connection, and which generates parallelism information by means of the parallelism; and a monitor which is connected to the information generation unit by means of a wired or wireless connection, and which presents a distribution map representing the parallelism.

[0010e] According to another aspect, the present disclosure refers to a seal material handling training system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling training system comprising: a seal handling unit including a sensor that detects parallelism between flanges of the flange joint; an information generation unit which is connected to the sensor by means of a wired or wireless connection, and which generates parallelism information by means of the parallelism;

and a monitor which is connected to the information generation unit by means of a wired or wireless connection, and which presents a distribution map representing the parallelism.

[0011] To achieve the foregoing object, one ~~aspect of a seal material handling monitoring device~~example of the present ~~invention~~ disclosure is a seal material handling monitoring device, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring device including graphical information generation means which generates a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the

coordinates, as the distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.

In the seal material handling monitoring device, the graphical information generation means displays the first distribution map and the second distribution map such that the first and second distribution maps are superposed via common coordinates.

To achieve the foregoing object, one ~~aspect of the seal material handling monitoring device~~example of the present ~~invention~~ disclosure is a seal material handling monitoring device, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring device including a plurality of first sensors that detect an axial force of each bolt; an information generation unit that generates distribution information of a target axial force by means of the target axial force and position information for the axial force, and generates distribution information of the axial force by means of the axial force and position information; and a monitor that presents a first distribution map representing the target axial force and presents a second distribution map representing the axial force, via coordinates.

[0012] The seal material handling monitoring device further includes a second sensor that detects parallelism between flanges of the flange joint, wherein the information generation unit generates parallelism information by means of a sensor output from the second sensor, and wherein the monitor presents a third distribution map representing parallelism between the flanges.

[0013] In the seal material handling monitoring device,

the information generation unit also refers to a tightening torque which is calculated by means of dimension information for the flanges of the flange joint and the bolts, determines, for each bolt, whether a tightening force for the seal material has reached a target tightening force configured for each seal material, and presents determination results to the monitor.

[0014] In the seal material handling monitoring device, by changing the position or angle of a seal handling unit that includes the flange joint or by changing the position or angle of the flange joint, the work environment can also be simulated.

[0015] To achieve the foregoing object, one ~~aspect of a seal material handling monitoring program~~example of the present ~~invention~~ disclosure is a seal material handling monitoring program for causing a computer to implement a function to generate a plurality of coordinates that extend radially from a center point, display target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as the distance from the center point, and generate a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.

In the seal material handling monitoring program, further, the computer implements a function to display the first distribution map and the second distribution map such that the first and second distribution maps are superposed via common coordinates.

To achieve the foregoing object, one example~~aspect of the seal material handling monitoring program~~ of the present ~~invention~~ disclosure is a seal material handling monitoring program for causing a computer to implement a function to receive a sensor output from a plurality of first sensors that detect an axial force

of each bolt, generate distribution information of a target axial force by means of the target axial force and position information for the axial force, and generate distribution information of the axial force by means of the axial force and position information, and present a first distribution map representing the target axial force and present a second distribution map representing the axial force, via coordinates.

[0016] In the seal material handling monitoring program, further, the computer implements a function to receive a sensor output from a second sensor that detects parallelism between flanges of a flange joint, generate parallelism information by means of the sensor output, and present a third distribution map representing the parallelism between the flanges.

[0017] In the seal material handling monitoring program, further, the computer implements a function to configure a target tightening force for each seal material, determine, for each bolt, whether a tightening force for the seal material has reached the target tightening force, and present the determination results via the monitor.

[0018] In the seal material handling monitoring program, further, the computer implements a function to determine a tightening procedure for each bolt, and present the determination results to the monitor.

[0019] To achieve the foregoing object, one example~~aspect of a seal material handling monitoring method~~ of the present ~~invention~~ disclosure is a seal material handling monitoring method, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts,

the seal material handling monitoring method including a step of generating, by graphical information generation means, a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected

axial forces of the bolts, via each of the coordinates, as the distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.

To achieve the foregoing object, one example~~aspect of the seal material handling monitoring method~~ of the present ~~invention~~ disclosure is a seal material handling monitoring method, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring method including a step of detecting an axial force of each bolt; a step of generating distribution information of a target axial force by means of the target axial force and position information for the axial force, and generating distribution information of the axial force by means of the axial force and position information; and a step of presenting a first distribution map representing the target axial force and presenting a second distribution map representing the axial force, via coordinates.

[0020] The seal material handling monitoring method further includes a step of detecting parallelism between flanges of the flange joint; a step of generating parallelism information by means of the parallelism; and a step of presenting a third distribution map representing the parallelism between the flanges.

[0021] To achieve the foregoing object, one example~~aspect of a seal material handling monitoring system~~ of the present ~~invention~~ disclosure is a seal material handling monitoring system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring system including a seal handling unit including a first sensor that detects axial forces of a plurality of bolts which

tighten a seal sandwiched in a flange joint, or a second sensor that detects parallelism between flanges of the flange joint; and graphical information generation means which generates a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as the distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.

To achieve the foregoing object, one example~~aspect of the seal material handling monitoring system~~ of the present ~~invention~~ disclosure is a seal material handling monitoring system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring system including a seal handling unit including a first sensor that detects axial forces of a plurality of bolts which tighten a seal material sandwiched in a flange joint, or a second sensor that detects parallelism between flanges of the flange joint; an information generation unit which is connected to the first sensor or the second sensor by means of a wired or wireless connection, and which generates distribution information of a target axial force by means of the target axial force and position information for the axial force, generates distribution information of the axial force by means of the axial force and position information, or generates parallelism information by means of the parallelism; and a monitor which is connected to the information generation unit by means of a wired or wireless connection, and which presents a first distribution map representing the target axial force, presents a second distribution map representing the axial force, via

coordinates, or presents a third distribution map representing the parallelism.

[0022] To achieve the foregoing object, one example~~aspect of a seal material handling training system~~ of the present ~~invention~~ disclosure is a seal material handling training system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling training system including: a seal handling unit including a first sensor that detects axial forces of a plurality of bolts which tighten a seal material sandwiched in a flange joint, or a second sensor that detects parallelism between flanges of the flange joint; and graphical information generation means which generates a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as the distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.

To achieve the foregoing object, one example~~aspect of the seal material handling training system~~ of the present ~~invention~~ disclosure is a seal material handling training system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling training system including a seal handling unit including a first sensor that detects axial forces of a plurality of bolts which tighten a seal material sandwiched in a flange joint, or a second sensor that detects parallelism between flanges of the flange joint; an information generation unit which is connected to the first sensor or the second sensor by means of a wired or wireless connection, and which generates distribution information of a

CLAIMS

1. ~~A seal material handling monitoring device, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring device comprising:~~

~~graphical information generation means which generates a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as a distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.~~

~~2. The seal material handling monitoring device according to claim 1, wherein the graphical information generation means displays the first distribution map and the second distribution map such that the first and second distribution maps are superposed via common coordinates.~~

~~3.~~ A seal material handling monitoring device, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring device comprising:

a plurality of first sensors that detect an axial force of each bolt;

an information generation unit that generates distribution information of a target axial force by means of the target axial force and position information for the axial force, and generates distribution information of the axial force by means of the axial force and position information; and

a monitor that presents a first distribution map representing the target axial force and presents a second distribution map representing the axial force, via coordinates,

and~~.~~

~~4. The seal material handling monitoring device according to claim 3, further comprising:~~

a second sensor that detects parallelism between flanges of the flange joint,

wherein the information generation unit generates parallelism information by means of a sensor output from the second sensor, and the monitor presents a third distribution map representing parallelism between the flanges.

~~5~~2. The seal material handling monitoring device according to claim ~~3~~1, wherein the information generation unit also refers to a tightening torque which is calculated by means of dimension information for the flanges of the flange joint and the bolts, determines, for each bolt, whether a tightening force for the seal material has reached a target tightening force configured for each seal material, and presents determination results to the monitor.

~~6~~3. The seal material handling monitoring device according to claim ~~3~~1, wherein, by changing a position or an angle of a seal handling unit that includes the flange joint or by changing a position or an angle of the flange joint, a work environment can be simulated.

~~7. A seal material handling monitoring program for causing a computer to implement a function to:~~

~~generate a plurality of coordinates that extend radially from a center point, display target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as a distance from the center point, and generate a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.~~

~~8. The seal material handling monitoring program according to claim 7, for further causing the computer to implement a~~

~~function to display the first distribution map and the second distribution map such that the first and second distribution maps are superposed via common coordinates.~~

~~9~~4. A seal material handling monitoring program for causing a computer to implement ~~a~~ function~~s~~ to:

receive a sensor output from a plurality of first sensors that detect an axial force of each bolt,

generate distribution information of a target axial force by means of the target axial force and position information for the axial force, and generate distribution information of the axial force by means of the axial force and position information; and

present a first distribution map representing the target axial force and present a second distribution map representing the axial force, via coordinates~~;~~.

~~10. The seal material handling monitoring program according to claim 9, for further causing the computer to implement a function to:~~

receive a sensor output from a second sensor that detects parallelism between flanges of a flange joint,

generate parallelism information by means of the sensor output from the second sensor, and

present a third distribution map representing the parallelism between the flanges.

~~11~~5. The seal material handling monitoring program according to claim ~~9~~4, for further causing the computer to implement ~~a~~ function~~s~~ to:

configure a target tightening force for each seal material, determine, for each bolt, whether a tightening force for the seal material has reached the target tightening force, and

present the determination results via ~~the~~ a monitor.

~~12. The seal material handling monitoring program according to claim 9, for further causing the computer to implement a~~

~~function to: determine a tightening procedure for each bolt, and present the determination results to the monitor.~~

~~13. A seal material handling monitoring method, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring method comprising:~~

~~a step of generating, by graphical information generation means, a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as a distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.~~

~~14~~6. A seal material handling monitoring method, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring method comprising:

a step of detecting an axial force of each bolt;

a step of generating distribution information of a target axial force by means of the target axial force and position information for the axial force, and generating distribution information of the axial force by means of the axial force and position information; and

a step of presenting a first distribution map representing the target axial force and presenting a second distribution map representing the axial force, via coordinates;~~.~~

~~15. The seal material handling monitoring method according to claim 14, further comprising:~~

a step of detecting parallelism between flanges of the flange joint;

a step of generating parallelism information by means of the parallelism; and

a step of presenting a third distribution map representing the parallelism between the flanges.

~~16. A seal material handling monitoring system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring system comprising:~~

~~a seal handling unit including a first sensor that detects axial forces of a plurality of bolts which tighten a seal material sandwiched in a flange joint, or a second sensor that detects parallelism between flanges of the flange joint; and~~

~~graphical information generation means which generates a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as a distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.~~

~~1~~7. A seal material handling monitoring system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling monitoring system comprising:

a seal handling unit including a ~~first sensor that detects axial forces of a plurality of bolts which tighten a seal material sandwiched in a flange joint, or a second~~ sensor that detects parallelism between flanges of the flange joint;

an information generation unit which is connected to the ~~first sensor or the second~~ sensor by means of a wired or wireless connection, and which generates ~~distribution information of a target axial force by means of the target~~

~~axial force and position information for the axial force, generates distribution information of the axial force by means of the axial force and position information, or generates~~ parallelism information by means of the parallelism; and

a monitor which is connected to the information generation unit by means of a wired or wireless connection, and which presents a ~~first distribution map representing the target axial force, presents a second distribution map representing the axial force, via coordinates, or presents a third~~ distribution map representing the parallelism.

~~18. A seal material handling training system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling training system comprising:~~

~~a seal handling unit including a first sensor that detects axial forces of a plurality of bolts which tighten a seal material sandwiched in a flange joint, or a second sensor that detects parallelism between flanges of the flange joint; and~~

~~graphical information generation means which generates a plurality of coordinates that extend radially from a center point, displays target axial forces of the bolts or detected axial forces of the bolts, via each of the coordinates, as a distance from the center point, and generates a first distribution map from the target axial forces or a second distribution map from the detected axial forces, at the coordinates, by linking between the target axial forces or the detected axial forces at adjacent coordinates.~~

~~19~~8. A seal material handling training system, sealing being performed by sandwiching a seal material in a flange joint and tightening the seal material by means of a plurality of bolts, the seal material handling training system comprising:

a seal handling unit including a ~~first sensor that detects axial forces of a plurality of bolts which tighten a~~

~~seal material sandwiched in a flange joint, or a second~~ sensor that detects parallelism between flanges of the flange joint;

an information generation unit which is connected to the ~~first sensor or the second~~ sensor by means of a wired or wireless connection, and which generates ~~distribution information of a target axial force by means of the target axial force and position information for the axial force, generates distribution information of the axial force by means of the axial force and position information, or generates~~ parallelism information by means of the parallelism; and

a monitor which is connected to the information generation unit by means of a wired or wireless connection, and which presents a ~~first distribution map representing the target axial force, presents a second distribution map representing the axial force, via coordinates, or presents a third~~ distribution map representing the parallelism.