axial force at the other tightening points. As a result, variation in the axial force that acts on the entire flanges 10-1 and 10-2 can be reduced.

[0034] <Seal Handling Management Processing>

Fig. 4 illustrates an example of seal handling management processing. A processing procedure and processing contents illustrated in Fig. 4 are examples of a method for managing seal handling or a program for managing seal handling of the present invention, and the present invention is not limited to such contents.

[0035] As the seal handling management processing, the control means 16 uses the target axial force or set axial force and the first torque coefficient k1 to calculate or select the first tightening torque value T1 (S1), and sets the first tightening torque value T1 to the tightening tool 14 (S2). The target axial force is a target value of the axial force F that acts on the bolts 6 or the nuts 8 when tightening is completed. The set axial force is a value of the axial force F that is set at the time of calculating the tightening torque value T1 in a case where the tightening torque value T1 for the bolts 6 and the nuts 8 is changed stepwise in accordance with the number of rounds S, and for example, x [%] of the target axial force is set in accordance with the number of rounds S. Furthermore, as the tightening torque value T1, for example, a value stored in advance in a database or the like may be selected and set.

The control means 16 acquires detection results of the axial force from the axial force sensors 18-1, 18-2, ..., and 18-n (S3), and compares the detection results with the target axial force or the set axial force (S4). This comparison of the axial force is performed for each of the tightening points. Then, if there is a difference between the detection results and the target axial force or the set axial force (YES in S5), a corrected torque coefficient k2 that is a second torque

coefficient k2 for each of the bolts 6 (S16). Furthermore, the control means 16 associates the calculated corrected torque coefficient k2 with corresponding one of the bolts 6 (S17), and uses the associated bolt coefficient k2 in the next calculation of the tightening torque value T.

When the control means 16 determines that the number of rounds (S) is not the calculation step of the torque coefficient (NO in S15), returning to S12, the control means 16 counts up the number of rounds (S), and sets the axial force F or the tightening torque value according to the number of rounds (S), to perform the tightening processing.

[0047] <Effects of Second Embodiment>

According to such a configuration, the following effects can be obtained.

(1) By setting the tightening torque value according to the number of rounds (S), monitoring tightened states by the detected axial force F, and correcting the tightening torque value, it is possible to prevent the variation in the tightened states among the tightening points.

(2) It is possible to match the axial force F of the bolts 6 with the set axial force Fx by correcting the torque coefficient k for the tightening torque that changes continuously or stepwise in accordance with the number of rounds (S) and the tightening points, and thus it is possible to achieve reliable seal handling.

(3) With regard to the round of the tightening points, it is possible to perform tightening not only in order of a bolt number but in various forms in which the bolt number is skipped, and to quickly perform appropriate seal handling regardless of which round of tightening is used.

[0048] [Third Embodiment]

[0049] Fig. 11 illustrates a configuration example of a seal handling management system according to a third embodiment. The configuration illustrated in Fig. 11 is an

112, and is used for wireless connection and internet connection between the server 54 and external devices such as the tightening tool 14 and the controller 52.

The input operation unit 66 is used for an input operation of the input information, and also used, by input operation, for an extraction trigger of the output information, mode switching operation, and the like.

The monitor 68 is an example of an information presenting unit and a display unit, and is used, for example, for displaying the tightening instruction information table 40 and the tightening results. A screen display unit of the monitor 68 may be provided with a touch panel 120, with which an input of input information corresponding to display information may be performed, instead of the input operation unit 66.

[0059] <Tightening Results>

Fig. 15 illustrates an example of the tightening results.

For example, as illustrated in A of Fig. 15, a tightening result screen imitating the tightening points P1, P2, ..., and Pn of a seal handling unit 4 is displayed on the display unit 60 of the controller 52 or the monitor 68 of the server 54. This tightening result screen is generated in combination of information on the detection results (B of Fig. 15) acquired from the axial force sensors 18-1, 18-2, ..., and 18-n by one or both of the controller 52 and the server 54, information on the tightening points and the number of rounds (S) by the tightening tool 14, and the like.

On the tightening result screen, for example, tightening target axial force and tightening force for each number of rounds (S) are displayed for each of the tightening point. That is, on the tightening result screen, variation of the axial force among the tightening points and transition of the tightening force for each number of rounds (S) are displayed.

Furthermore, for example, as illustrated in B of Fig. 15, detection data including the axial force F of the bolts 6 for

each STEP, that is, for each number of rounds (S) is stored as the detection results in the temporary storage area 94-1 of the controller 52 or the storage unit 114 of the server 54.

The detection results show, for example, the tightening results up to STEPs 1 to 6, and the detection data increases as a tightening step further progresses. Furthermore, in this seal handling management, correction processing of the torque coefficient is executed based on the detection results in STEP 3, as in the second embodiment, for example. Then, when the number of rounds (S) of tightening progresses after the correction of the torque coefficient, the detection results of the axial force of the bolts at a stage of STEP 6 become substantially equivalent values. As a result, it is shown that the seal handling is performed on surfaces of the flanges 10-1 and 10-2 by the axial force without variation.

[0060] <Processing Sequence for Seal Handling Management>

Fig. 16 illustrates a processing sequence for seal handling management by the seal handling management system 50.

In seal handling processing, the tightening tool 14 performs initialization (S31), and the controller 52 performs initialization (S32). After the initial setting, the controller 52 and the server 54 are linked, and the controller 52 takes in tightening condition information including the torque coefficient k1 and the like provided from the server 54 (S33). The controller 52 takes in the tightening condition information by acquiring the tightening instruction information table 40.

The controller 52 that has acquired the tightening condition information sets tightening conditions corresponding to the flanges 10-1 and 10-2 and the gasket 12 that are selected in advance (S34). Furthermore, the controller 52 sets the number of rounds S and the tightening positions P (S35), and calculates the tightening torque value T1 using the torque coefficient k1 and set axial force Fx

in S43), the processing returns to S35 to continue the tightening work.

At this time, the controller 52 counts up the number of rounds (S), for example, and calculates the tightening torque value T corresponding to the next number of rounds. As a result, the output torque T is changed or set stepwise or continuously in accordance with the tightening points P and the number of rounds S.

[0064] If the controller 52 determines that the detected axial force and the set axial force are different (YES in S43), the controller 52 calculates the corrected torque coefficient k2 using the detection results of the axial force as the correction processing of the tightening torque value (S44). The controller 52 then sets new tightening conditions including the corrected torque coefficient k2 (S45) and returns to S35 to continue the tightening processing.

[0065] If the controller 52 determines that the tightening has been completed based on a count value of the number of rounds S (YES in S41), the tightening is completed (S46), and the controller 52 inputs a tightening completion instruction to the tightening tool 14 to complete the tightening. The completion of tightening may be presented by use of the monitor 68, for example. The controller 52 notifies the server 54 of the tightening result information. The tightening result information is then displayed on the server 54 (S47).

[0066] Note that the controller 52 determines a count number of the number of rounds (S) as determination as to whether the tightening has been completed, but the determination is not limited to this. If the controller 52 determines that the detection results acquired from the axial force sensors 18-1, 18-2, ..., and 18-n have the variation of the axial force, do not reach the target axial force, or are not within a predetermined range, for example, the controller 52 may repeat additional tightening processing.

torque coefficient, axial force information and the like received from axial force sensors 18-1, 18-2,... and 18-n (Fig. 1) installed at tightening points (not illustrated).

The information presenting unit 148 is an example of means for displaying tightening torque value information set to the tightening tool 132, torque coefficient information, corrected torque coefficient information, detected axial force information, and the like, and also for displaying tightening position instruction information and the like in a tightening step.

[0071] Detection processing of the axial force, the calculation processing of the torque coefficient, and correction processing of the tightening torque value in the tightening step are as described in the above-described embodiments, and the description thereof will be omitted.

[0072] <Effects of Fourth Embodiment>

According to such a configuration, the following effects can be expected.

(1) It is possible to perform tightening with the tightening torque value corresponding to each of the tightening points, and to easily manage the tightening points by using the identification information of the bolts 6 and the nuts 8.

(2) By managing the tightening points based on the identification information of the bolts 6 and the nuts 8, even if an error of a work procedure occurs, guide display is performed by the information presenting unit 148 to guide a worker to an appropriate work, and thus, it is possible to improve reliability of seal handling management.

[Comparative Example]

[0073] Fig. 18 illustrates a comparative example of seal handling management processing of flanges.

In the seal handling management processing illustrated in Fig. 18, for example, similarly to the second and third