Due to the extension in the length direction on the gasket contact portion 88, the flaw 146-3 does not affect the sealing function of the gasket 94-1. Due to the presence outside the gasket contact portion 88, the flaws 146-4 and 146-5 do not affect the sealing function of the gasket 94-1, not causing any problem.

[0052]

Provided that W represents the width of the gasket contact portion 88 and rd represents the width of the corrosion/dint 144 and the flaw 146-1 within the width W in the same direction as the width W, the ratio (rd/W) of the width rd of the corrosion/dint 144 or the flaw 146-1 to the width W of a gasket abutment surface 148 of the gasket contact portion 88, and the depth v thereof become problematic.

[0053]

Although the surface state of the gasket contact portion 88 of the shell flange 82 is shown in this embodiment, the same applies to the gasket contact portions 108 and 128 of the fixing tube plate 44 and of the channel flanges 114 and 116 of the channel unit 46, respectively.

[0054]

B of Fig. 7 shows the allowances of the rd/W and the depth v and the necessity of repair, for each of gaskets. k1, k2, k3, and k4 are criterion values of the depth v, with the magnitude thereof being k1>k2>k3>k4. For example, according to this table, if rd/W=1/4 or below, the soft gasket does not need the repair when v=k1 or below and the semimetallic or metal gasket does not need the repair when v=k2 or below. If rd/W=1/2 to 3/4, the soft gasket does not need the repair with v=k4 or below but the semimetallic or metal gasket needs the repair.

[0055]

B) Marking Step (S12)

[0056]

In the marking step (S12), to position the members, marking is performed for the shell flange 82, the fixing tube plate 44,

not enter the fitted groove 104 of the fixing tube plate 44 as shown in B of Fig. 11 but hits the fixing tube plate 44 outside the fitted groove 104, resulting in an abnormal assembling status. In this status, the functions of the gaskets 94-1 and 94-2 do not work.

[0073]

If the channel unit 46 is misaligned with the shell flange 82 in spite of the normal alignment of the fixing tube plate 44 with the shell flange 82, the partition plate 98 does not enter the fitted groove 104 of the fixing tube plate 44 as shown in C of Fig. 11 but hits the fixing tube plate 44 outside the fitted groove 104, resulting in an abnormal assembling status. In this status, the function of the gasket 94-2 does not work.

[0074]

In order to modify such hitting of the fixing tube plate 44, as shown in A of Fig. 12, the alignment may be performed by pushing up the fixing tube plate 44 from below by a lifting device 152. With the fixing tube plate 44 resting on a plunger 154 of the lifting device 152, the extent of a gap occurring between the shell flange 82 and the fixing tube plate 44 is visually checked so that the height of the fixing tube plate 44 is adjusted with the plunger 154 of the lifting device 152. Next, as shown in B of Fig. 12, the lifting device 152 is disposed under the channel flange 114 and, with the channel flange 114 resting on the plunger 154, the extent of the gap occurring between the shell flange 82 and the fixing tube plate 44 is visually checked so that the height of the channel flange 114 is adjusted by advancing or retracting the plunger 154 of the lifting device 152.

[0075]

Such a height adjustment enables the shell flange 82, the fixing tube plate 44, and the channel flange 114 to be aligned.

[0076]

H) Bolt Fastening Step (S18)

[0077]

This bolt fastening step includes trainings of

respective sensors 164.

[0108]

<PC 168>

[0109]

The PC 168 includes, as shown in Fig. 16, a processor 174, a storing unit 176, an input/output unit (I/O) 178, a communicating unit 180, and an operation input unit 182.

[0110]

The processor 174 executes information processing of various computer programs such as an operating system (OS) and a work monitoring program in the storing unit 176. This information processing includes various processes executable by the computer, such as calculation of the fastening force, recording of work history, control of the monitor 170, work monitoring, and work management, in addition to the processes including the above processes a) to d).

[0111]

The storing unit 176 includes, for example, as storage devices, a read-only memory (ROM) and a random-access memory (RAM), the ROM storing the OS and the monitoring program. This storing unit 176 has a database (DB) 184 disposed to store detection information, drawing information, etc., the DB 184 storing detection information imported from the data logger 166. The detection information includes sensor outputs obtained from the sensor group 164.

[0112]

The I/O 178 is used for transmission/reception of image data to/from the monitor 170. The data logger 166 is connected via a cable 186 to the communicating unit 180.

[0113]

The operation input unit 182 is configured from e.g. input equipment such as a keyboard and a mouse and is used for operation of the screen and input of information.

[0114]

<Monitoring Process>

axial forces F1, F2, ..., and F16 of the bolts 54 and joining adjacent plot points by a straight line. The distribution graph 194 is formed by plotting recommended axial forces Fref1, Fref2, ..., and Fref16 as the comparative axial forces and joining adjacent plot points by a straight line. These recommended axial forces Fref1, Fref2, ..., and Fref16 are axial force values through 4 rounds of true fastening of the bolts 54.

[0125]

By comparison between the distribution graphs 192 and 194, excess and deficiency in the value of the detected axial force with respect to the comparative axial force can easily be visually recognized. In this case, at the bolt No. [16], the detected axial force F16 is substantially coincident with the recommended axial force Fref16 and then reaches the recommended value. The other detected axial forces F1, ..., and F15 do not reach the recommended axial forces Fref1, ..., Fref15, so that it can be seen that the axial force needs to be increased thereat.

[0126]

A of Fig. 19 shows a display of a distribution graph in the case without fastening management. In the case of absence of the fastening management, fastening is left to the trainee's discretion, so that the distribution graph 192-1 of the detected axial force has a large deviation from the distribution graph 194-1 of the comparative axial force.

[0127]

B of Fig. 19 shows a display of a distribution graph in the case of presence of fastening management. In the case of presence of the fastening management, fastening is managed at a proper value, with the result that the distribution graph 192-2 of the detected axial force does not have a large deviation from the distribution graph 194-2 of the comparative axial force, rendering it possible to visually recognize the acquisition of the substantially uniform work status. Shown in this case are the distribution graphs 192-2 and 194-2 of the detected axial force and the comparative axial

true fastening. The temporary fastening is a process executed before the true fastening and includes attaching the nuts 56 to the bolts 54, adjusting the alignment, and fastening the nuts 56 before true fastening. The alignment adjustment includes position setting of the gaskets 94-1 and 94-2 and the bolts 54. The true fastening imparts the torque T to the bolts 54 with the fastening tool, to allow a stepwise arrival at the comparative fastening force (target fastening force).

[0163]

In this work monitoring process, the processor 174 runs a program to import detected axial forces from the sensor group 164 (S401), performing graphic processing of the detected axial force F and the comparative axial force Fref (S402).

[0164]

Under control of the processor 174, the monitor 170 dynamically displays the distribution graph 192 of the detected axial force F and the distribution graph 194 of the comparative axial force Fref on the coordinates (S403).

[0165]

During the graphic processing of the detected axial force etc. and fastening work, it is monitored whether the fastening process has reached a predetermined round number-of-times (S404). If the predetermined round number-of-times, e.g. the round number-of-times of 4 to 6 has not been reached (NO of S404), S401 to S404 are continuously executed. Then, if the fastening process has reached the predetermined round number-of-times (YES of S404), the sealing work comes to completion (S405), and this process is terminated.

[0166]

<Effect of Second Embodiment>

[0167]

(1) The trainee can master fastening of bolts and nuts, occurrence of a change or bias of the axial force, its disadvantages, and its avoidance technology.

real machine can be done using the structure similar to the heat exchanger as the real machine, and the training can be done assuming the situations hard to be trained with the real machine, thereby enhancing the trainee's skill and accuracy of the sealing work, to consequently contribute to the improvement in the reliability.

REFERENCE SIGNS LIST

[0191]

2-1, 2-2, 2-3 sealing work training device
4 frame
6 device body
8-1 first transport support mechanism
8-2 second transport support mechanism
10, 12 post member
14, 16, 18, 20 support member
22 space part
24 caster
26 stopper
28 rail part
30 hanger part
32 lifting part
34 sliding part
36-1, 36-2 lifting part
38 roller
40 support member
42 shell unit
44 fixing tube plate
46 channel unit
48 support leg
50 bolt
52 nut
54 bolt
56 nut
58 channel cover
60 bolt
62 nut