Automatic Inclining Experiment System

FOREWORD

It has been noticed that for Container Vessels and similar units the uncertainty of the loaded weights and the position of the relevant centre of gravity was bringing, for safety reasons to overestimate the vertical position of the Centre of Gravity of the system Ship + load before departure

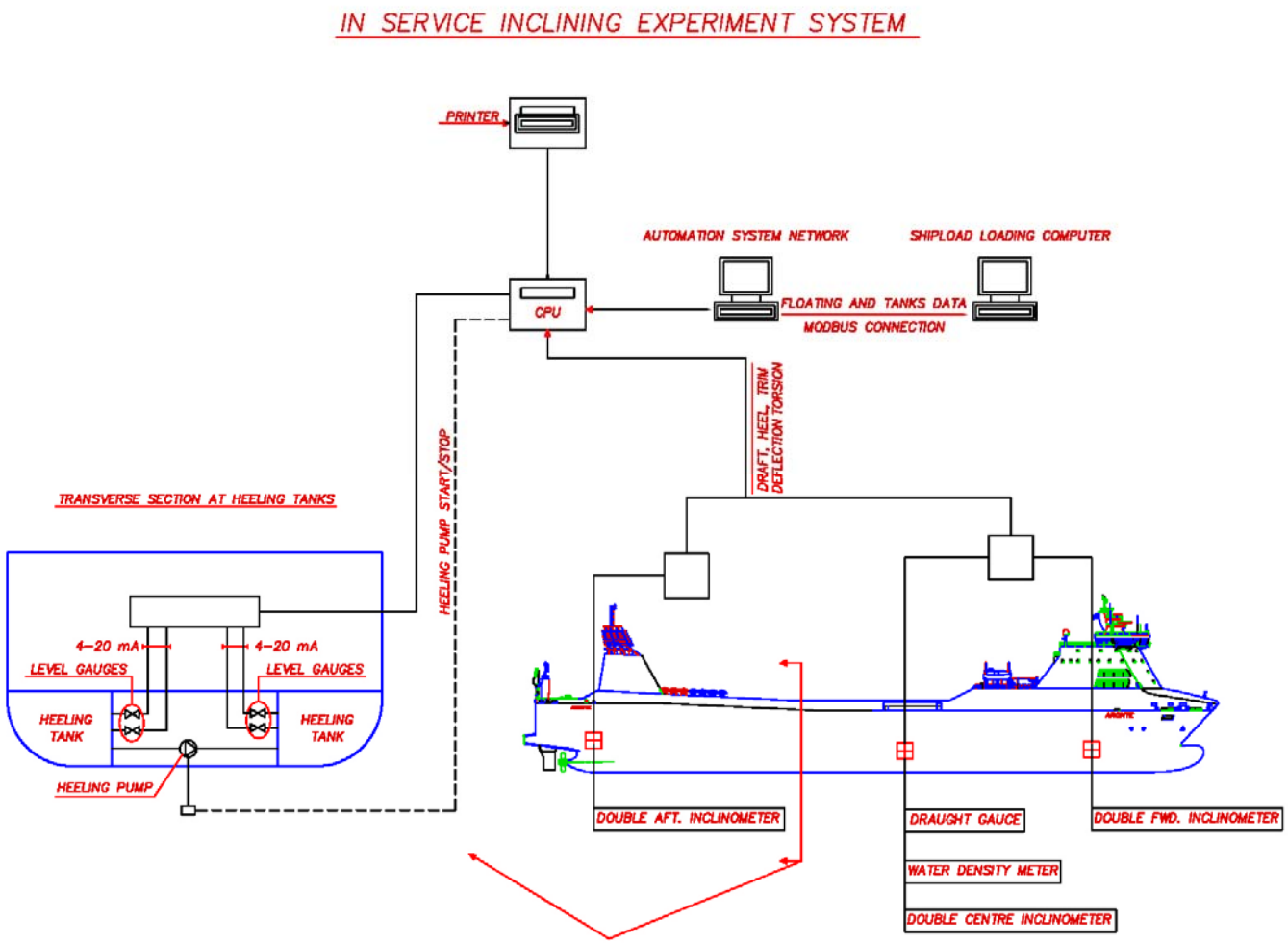
In several cases it can therefore happen that according to the results of the stability calculations the vertical position of the centre of gravity is so high that the master has to stop loading having reached the stability limits.

While the displacement can be updated after checking of the draft marks the only possibility to review the Centre of gravity position is the execution of an inclining experiments.

AIM OF THE SYSTEM

Aim of the proposed system is therefore, in case the forecasts at departure are not allowing to complete the loading, to carry out, in a completely automatic way an inclining experiment whose results can be used in way of those coming form manual or loading computer calculations.

DESCRIPTION OF THE SYSTEM



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The system shown on the above picture will allow the execution of an automatic sequence consisting in the following operations:

1. Definition of the floating conditions and relevant hydrostatic data (Displacement and KMT) at the test time.

2. Checking that the conditions to start the test are acceptable for the correct execution of the test itself.
   (maximum allowable trim = 1% LBP and max list = 0.5 °)

3. Setting up of the inclinometers and checking that the quantity of ballast and its distribution can allow the execution of the test with an inclination angle of 2°. In case such an angle is not reachable the system will provide information for the maximum obtainable angle

4. Starting of the heeling pump to transfer the calculated amount of ballast between the heeling tanks to obtain the first heeling angle of about 1°

5. Upon reaching this angle the heeling pump will be stopped and the system will collect data from the heeling tanks level transmitters and inclinometers then will calculate:

   - Heeling Moment
   - GM at the test conditions.

6. At completion of these calculation the system will restart the heeling pump to reach the next inclination angle of about 2° then repeating all the operations described at the previous step 5

7. When also these calculations are completed the system will revert the transferring of the ballast inside the heeling tank to reach again the starting position with an intermediate step at 1° of heeling where all the operations described at item 5 will be re-executed

8. From the starting position the system will then proceed to execute on the opposite side the procedure described at the item 4,5,6 and 7.

9. At completion of the whole sequence the ship will be in upright position as it was upon beginning of the test, after having calculated at every intermediate step both the Heeling Moment and the resulting GM.
   A report on the complete test sequence will be produced.

10. The system at this point will carry out a consistency check on all the obtained result and upon such a verification the GM value to be used on the stability calculations will be defined.
    This GM will be the minimum among all the obtained values.

11. Deducting such a value of GM from the originally calculated KMT will provide the maximum obtained vertical position of the Centre of Gravity of the ship in the actual condition.

What above described is controlled and carried out as follows:

1. The system defines the floating conditions by means of draft sensors and sea water density meter suitably located to provide an accurate indication of the floating position and relevant hydrostatic data The accuracy of such a measuring system is +/- 2 cm for drafts and +/- 0.0025t/m³ for the sea water specific gravity

2. The system checks that the starting list angle is less than 0.5 ° and that the trim is not higher than 1% of the length between the perpendiculars.

3. The heeling pump will be automatically stopped in case the ship is reaching a heeling angle equal to 4°

4. In order to check the consistency of the collected data the following instrumentation will be used:

    - Three electronic inclinometers will be provided with the measurements being taken by only two, and the spare third to be used as reference in case of discrepancies between the readings of the two used ones.

    - An additional level gauge for each of the heeling tank content measurement will be provided to exactly monitor the water ballast transfer and then the heeling moment calculation

ADDITIONAL FEATURES

The high degree of automation of the proposed system can allow the integration with the different systems allowable on board such as:

- Automation system
- Loading Computer

In order to fully integrate the cargo planning and control

The proposed system is furthermore incorporating a complete dynamic draft, trim an heel system having the main characteristic of being fully independent from pressure peaks influencing the standard draft measurements systems based on pressure transmitters type level sensors with the additional capability of providing a trim dynamic indication that could among others be used to define the optimum trim related to fuel consumption.