

Test of Welded Plate Quadrant.

On the 13th April, 1938 I attended at the works of Messrs. Deutsche Werke Kiel to witness the test of a welded plate quadrant. Representatives of Messrs. Deutsche Werke, Messrs. A. E. G. (the designers of the quadrant), Messrs. Deutsche Werft, Hamburg, and of the Norske Veritas were also present.

This quadrant is of the type, which was recently fitted in Messrs. Bremer Vulkan's Yard Nos. 748 and 749, and others have been already constructed intended for vessels classed with this and other Societies.

In the cases of vessels classed with Lloyd's Register the quadrants already fitted, have been strengthened by arranging double plates and additional supporting brackets to the vertical plate flanges. (see correspondence and drawing for Messrs. Bremer Vulkan's Yard No.748)

The designers contend however, that these quadrants were sufficiently strong without reinforcement, and it was because of this opinion, that the test in question was arranged. A sketch of the quadrant now tested and also a drawing showing the arrangements of the test are enclosed and are self-explanatory. It was found, however,, that the plates, of which this quadrant was constructed, were of a thickness of $11\frac{1}{4}$ mm and not 10 mm as shown on the plan, and it may be stated, that this was also the case in the quadrants fitted in Messrs. Bremer Vulkan's Yard Nos. 748 and 749 and in others, which are already manufactured.

Before the test started the mm scale reading (see plan) was 50 and initial pressure was slowly applied at A to take up a slip in the fixings and keys of the quadrant, after which the zero reading on the scale was 59.

A pressure of 165 atmos. was then gradually applied and the scale reading increased to 70, on release of the pressure the scale reading returned to 53, pressure was again applied being increased this time to 220 atmos., when the scale reading was

84 and on release of the pressure became 60. The pressure was then very rapidly forced up to 260 atmos. giving scale reading of 100 and on release of the pressure the reading was 63. It was then decided to force up the pressure to find a limit and this was rapidly raised until 360 atmos. were recorded on the manometer gauge, the scale reading then being 114 and the bolts numbered 1 - 4 (see sketch) holding the quadrant to the lathe bed, on which the test was made, snapped and the lathe bed itself, which was of cast steel, fractured in way of bolt №.5, a piece of the bed being detached, whilst the bolt itself remained intact. The angle bars attaching the side plates to the lathe bed buckled at bolt №.5 and were lifted clear of the lathe bed 10 mm.

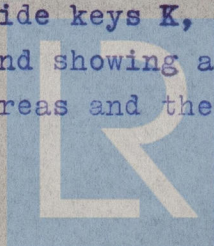
The pressures applied had values as follows:

for a gauge reading of

165	atmos.	the pressure at A	=	36300 kg.	35.76m
220	"	"	"	"	47.5"
260	"	"	"	"	51.2"
360	"	"	"	"	77.8

It is not considered, that much value can be attached to the records made from the scale readings, as these were undoubtedly effected considerably by the stretching of the bolts at each test, and there was also some torsion in the rudder head itself.

So far as the quadrant itself was concerned, a careful examination made after the final test disclosed no signs of distortion, bending, nor indication of weakness, and the welding work remained in good condition and showed no signs of fracture. At the beginning of the experiment it was noted, that the 3 keys marked K and K 1 on the sketch were exactly in line, but after the final test there was a difference of 4 mm in the relative positions of the boss key K 1 and the two outside keys K, and as on examination the keys themselves were found showing a depression of less than $\frac{1}{4}$ of a mm over the faying areas and the key ways themselves



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were intact, it would appear, that the difference in the relative positions of the keys, above referred to, was an indication, that there had been some twisting of the rudder head itself and would tend to indicate, that when ^{AG}normal forces are brought to bear against the rudder itself, the rudder head will twist before there is failure in the quadrant.

Large forces, such as those now applied, are only likely to be transmitted through the rudder and in the type of gear in question the force might be sufficiently severe to throw the quadrant against the deck stopper and in such case it would probably be the rudder head, which would be twisted, whilst the quadrant itself would remain undamaged. Further in this steering gear so soon as the quadrant departs from a position in agreement with the helm indicator, the "Rudder Watcher" gear operates and the motor comes into action correcting this difference.

It is considered, that the designers have some support for their opinion, that the quadrants are sufficiently strong for their purpose and that their submission, that these quadrants might now be accepted without reinforcement is worthy of further consideration.

Drawings of rudder quadrants of the type, above referred to, are being forwarded to London today under separate cover for approval, these quadrants being intended for Messrs. Deutsche Werft's Yard Nos. 201, 2, 3, and 4.

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R. M. M. M. M.
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