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LONDON
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E.I.D. Report No. 2323

"FRISTON DOWN"

Class: A1 Tug (Class Contemplated).
Built: R. Dunston Ltd., Thorne.
Dimensions: 31' 10" x 20' 8".
Engine: Oil Engine 4SA 4Cy. 340 x 570 mm.
British Polar Engines Ltd., Glasgow.

Lateral Vibration of Main Engine.

REASON FOR INVESTIGATION

At the request of the Builders, Messrs. Richard Dunston and Co. Ltd., the undersigned attended on board the above vessel at Hull on 18th June, 1964, in order to investigate lateral vibration of the main engine.

PROCEDURE AND RESULTS

With the vessel running free the speed of the engine was slowly increased from 185 R.P.M. to 220 R.P.M. Records of the amplitude of lateral vibration were taken with an Askania hand vibrograph from the top of No. 4 cylinder at the front of the engine. The resonance curve is plotted in FIG. 1.

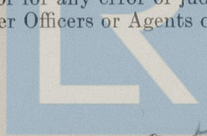
The instrument incorporated an electrical timing marker from which the vibration frequency was determined. Engine speeds were obtained from the engine tachometer.

Since it was evident that the maximum amplitude occurred at 210 R.P.M., the speed of the engine was maintained at this value while records were taken from points in a vertical line from the holding down bolts to the top of No. 4 cylinder. Records were also taken from the engine seating and ship's structure. The results are tabulated overleaf.

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<u>Position of Measurement.</u>	<u>Amplitude mm.</u>
Top of No. 4 Cylinder.	1.3
Between No. 4 cylinder and crankcase door.	0.85
Crankcase door.	0.50
Bedplate flange.	0.25
Engine chock.	0.20

The above amplitudes are horizontal. Measurements taken from the engine seating adjacent to the chocks showed the vertical amplitude to be zero. However, three feet outboard from the chocks a vertical amplitude of 0.17 mm. was measured.

On the deep frame opposite No. 4 cylinder a horizontal amplitude of 0.2 mm. was recorded.

It is relevant to note that while the amplitudes at the top of the cylinder are large, the amplitudes in the ship's structure and engine seating are relatively insignificant.

CONCLUSIONS

The mass and stiffness of the engine and its seating have a transverse natural frequency of approximately 840 c.p.m. At 210 R.P.M. the engine firing frequency is 840 c.p.m. and the resultant torque reaction on the engine frame results in an excessive transverse vibration.

DISCUSSION

Although it would be possible to place the critical outside the running range by reducing the service speed from 220 R.P.M. to 205 R.P.M., an overload would be placed on the engine and this solution cannot therefore be recommended.

The possibility of stiffening the engine seating has also been considered and rejected, as a considerable amount of material would be required to raise the critical speed significantly. It would be necessary to fit material under the engine and this could not be done without removing the engine. Further, if the resultant stiffness were insufficient, the vibration amplitudes could be worse as at higher speeds the exciting forces are greater.

In many cases of engine lateral vibration successful stiffening has been introduced by fitting stays between the engine cylinders and the ship's structure. Such stays are usually fitted to one side only so that they are in compression when the engine is operating in the ahead direction. Shear pins are also incorporated in the stay attachments to prevent damage to the engine should the side of the vessel strike the quay or some similar object. It is understood that the Engine Builders are reluctant to agree to such stays because of external forces which might be transmitted to the engine.

RECOMMENDATIONS

It is recommended that a finer pitched propeller be fitted to enable the engine service speed to be increased from 220 R.P.M. to 250 R.P.M. The speed range 205 R.P.M.-215 R.P.M. should then be barred.

Calculations indicate that the increase in speed would be acceptable from the aspect of torsional stresses. However, details of the new propeller should be forwarded to the Society in order that the calculations may be confirmed.

A. R. Linsen -

ENGINEERING INVESTIGATION DEPARTMENT. *sk*



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