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DIESEL ENGINE SUMP NOISE

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INTRODUCTION

As engine and vehicle noise levels fall, sump noise becomes more important and the need arises for increased sump damping. This can be achieved by applying damping patches or lead covers, constructing the sump from visco-elastic laminated steel, and by using castings. However none of these methods have been considered particularly successful in reducing sump vibration and noise, partly because high operating temperatures reduce their effectiveness and partly because of weight and cost penalties.

An alternative technique utilises the frictional damping which occurs when contacting surfaces are subjected to relative interfacial slip. This requires additional panels to be fastened to the sump, so that when the sump vibrates, relative motion between the sump and panels dissipates vibrational energy. Furthermore, fastening the panels inside the sump gives rise to additional viscous damping. The heat dissipated by the sump is little affected. This method has been shown to be capable of introducing high damping into flat plates where Q factors have been reduced from 1300 to 20. However an optimum contact force has been shown to exist when the energy dissipated by frictional damping is a maximum.

EXPERIMENT AND RESULTS

The sump tested, which was from a 2.5ℓ 4 cylinder diesel engine, measured 0.5m x 0.3m x 0.2m deep, and was made from 1.6mm sheet steel. It was clamped to a seismic table with normal gasket in place, and vibrated by an electric shaker driven by narrow band white noise. / Fig 1. The troublesome

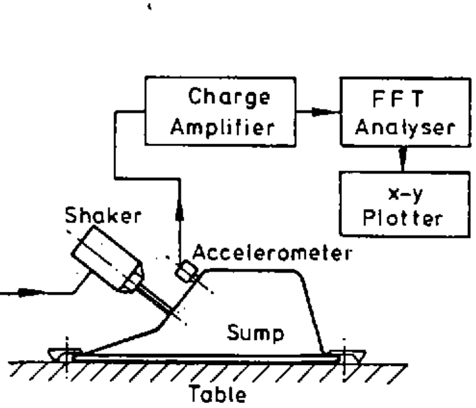

Fig. 1. Test arrangement

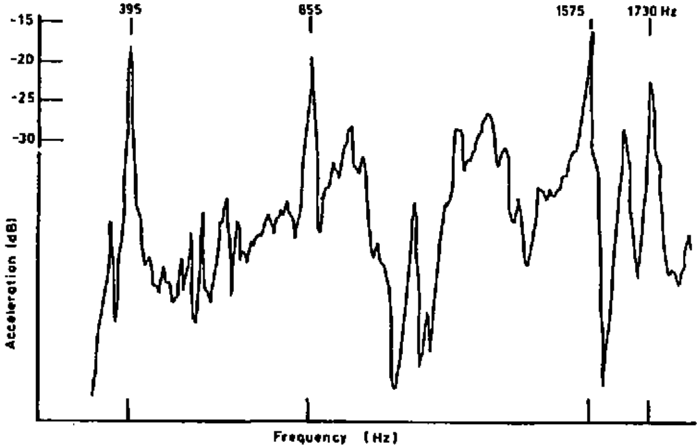

Fig. 2. Unmodified sump frequency response

frequency range had previously been identified to be 400-1600 Hz. Sump response was measured with an accelerometer. Although excitation and measurement could be carried out at any point on the sump surface, particular test points were chosen for comparison purposes. Fig 2 shows the measured sump response with a 2N rms exciting force.

When excited at a resonance the nodal lines were carefully located; this was necessary to decide the plate fixing points. Contact pressure was controlled by pressing dimples of specific size and location in the plates, so that when the plates were fastened to the sump the contact areas, location and pressure were optimised for the frequency range considered.

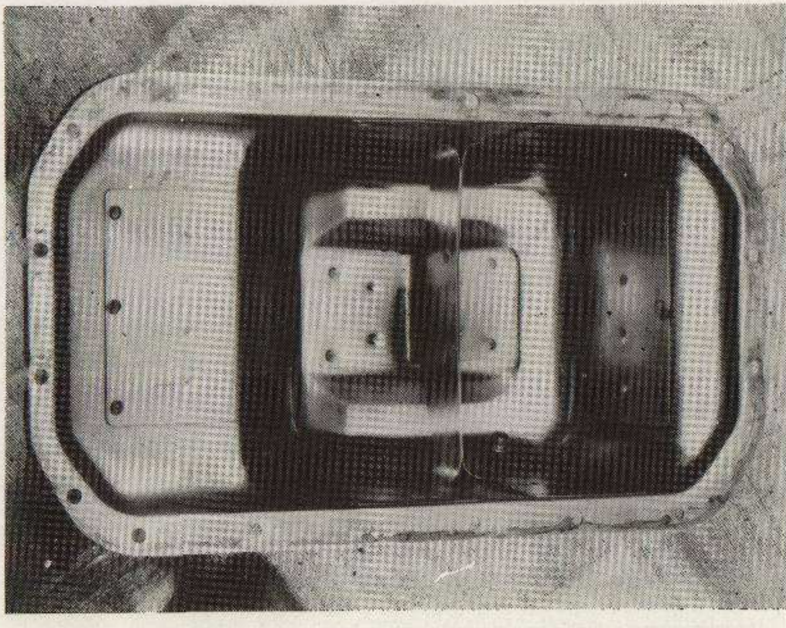

Fig. 3. Prototype sump

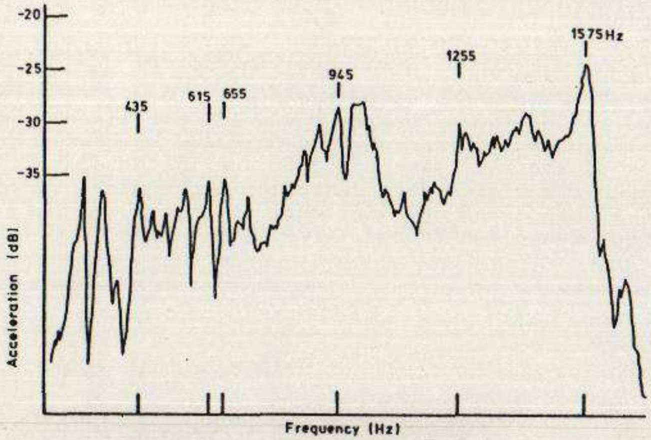

Fig. 4. Prototype sump frequency response

After testing the sump, plates were bolted to its surface. The plates, which were cut from 20g (0.9mm) steel sheet, increased the sump mass by about 20% to 4.4kg. A series of tests were carried out, varying the contact points and pressure. The prototype sump had end plates spot welded in position and a laminated baffle. Fig 3. Dimples 1mm deep were used. The prototype sump response with oiled interfaces is shown in fig 4.

It can be seen from Figs 2 and 4 that the modified sump had a 435 Hz acceleration resonance peak about 19 dB below the unmodified sump 395 Hz resonance, and at 1575 Hz the reduction was about 8 dB. Reductions in response were obtained throughout the frequency range.

ACKNOWLEDGEMENT

The author would like to thank the Ford Motor Company for their support and for supplying test pieces.

REFERENCE

[1] C.F. Beards "The Damping of Structural Vibration by Controlled Interfacial Slip in Joints." ASME DET Conf Hartford USA. Sept 1981. Paper 81-DET-86.