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# NOISE ANALYSIS OF IMPACT HAMMERS - FULL SIZE WORKING SCALED MODEL COMPARISON

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This paper compares the initial results of some frequencies, mode shapes and noise radiation of full size and working scaled model forging hammers. Extensive vibration measurements were taken together with the noise radiation measurements using a specially constructed and calibrated directional tube. Certain advancements from the work already reported [1 - 3] are presented. In that two different working scaled models are compared with two full size hammers. Firstly a 10 cwt Ross type steam hammer and a Davy Bros Arch type forging hammer. Both hammers have accelerated tups. It appears in both cases that consistency with high noise radiation locations are established despite both machines having a different geometrical configuration.
To establish the viability of scaling it is important that the geometry, frequency and accelerations are scaled and that the damping of the material is the same. Work is in progress to establish all the above parameters and so far for the results obtained the scaling property is consistent for frequency.

Some Results Figure 1 and 2 shows the sketch of the two makes of hammers chosen for measurements. In order to determine the main noise radiating areas both model and full size hammers were excited through their platens as shown in the Figures. The mode shapes obey the characteristics of cantilever type vibration and the models and full size hammer show close agreement in the mode shapes.

The anvil has a larger peak amplitude than the column by a factor in excess of ten in acceleration. Nevertheless as shown in current work by the authors [4] the column has a longer persistence of ringing than the anvil.

Directional Tube To capture the noise radiated by just one known area of the structure a directional tube is used. The microphone is inserted through a hole in the enclosed end of the tube with the open end placed against the required area of the structure. The microphone is thus totally enclosed by the tube and so does not receive the externally radiated noise.

Before the tube can be meaningfully employed it is necessary to know firstly what effect the tube has on the radiated noise travelling down it to the microphone, as the tube will act as a complex filter amplifying some frequencies and attenuating others, and secondly, the attenuation of noise by the walls of the tube. These two characteristics were obtained over a frequency range of 20 Hz to 20 kHz. No filtering effects were present at the frequencies of interest. The attenuation ranged from 20 dB at low frequencies to 60 dB at higher frequencies.

Results for Directional Tube The sound spectra Figure 3 shows that the sound radiated by each component of the machine is related to the sound radiated by its neighbours. The vibrations originate during the impact in the upper and lower platens and travel in two directions, one through the cylinder to the upper part of the column and the other through the anvil and base plate to the lower part of the column. There is a slight change in the spectra between each component but a great difference between the spectra from the upper and lower parts of the column. The acceleration spectra showed the same trend. During the recording of acceleration signals from each component it is noted that the peak acceleration level dropped consistently along these vibration paths. These three factors coupled with the common resonance frequencies for the components proved the existence of the vibration paths. The column is therefore excited from the vibration of the platens rather than from the force between the cylinder and anvil.

The spectra of Figure 3 are summarised along with the corresponding accelerations in Figure 4 where also the corresponding Rigby model resonant frequencies are given. It is clear that the geometrical one twelth scale is constant for the main frequencies. This figure also shows that the column radiates the highest noise levels over a greater frequency range of all the components examined. This coupled with the longer duration and the larger resonating area justifies that the column radiates the greatest acoustical energy.

## CONCLUSION

The results show the following:

1. The mode shapes of the models and full size hammers are the same.
2. The frequencies corresponding to the mode shapes scale consistently with the geometry of one twelth.
3. The column is the main contributer to the radiation of acoustical energy, of the components examined.
4. The column is excited from the platens and not from the forcing part of the cylinder and the anvil.

## REFERENCES

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## ACKNOWLEDGEMENT

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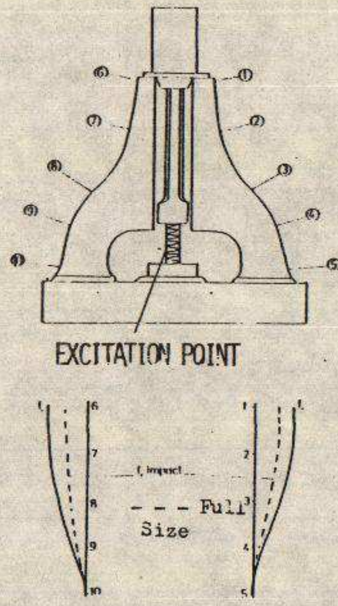
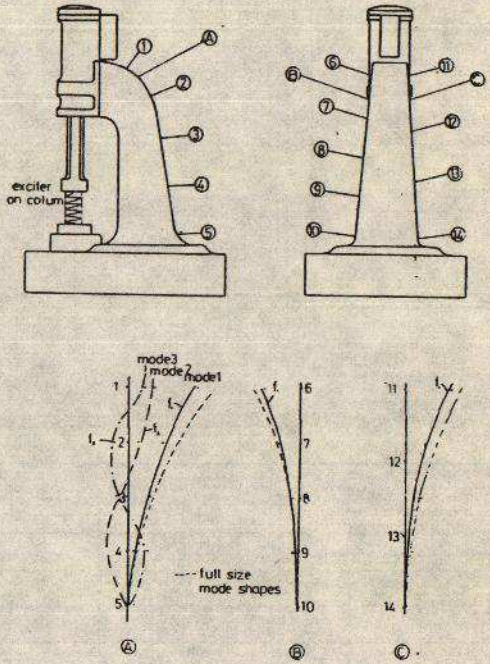


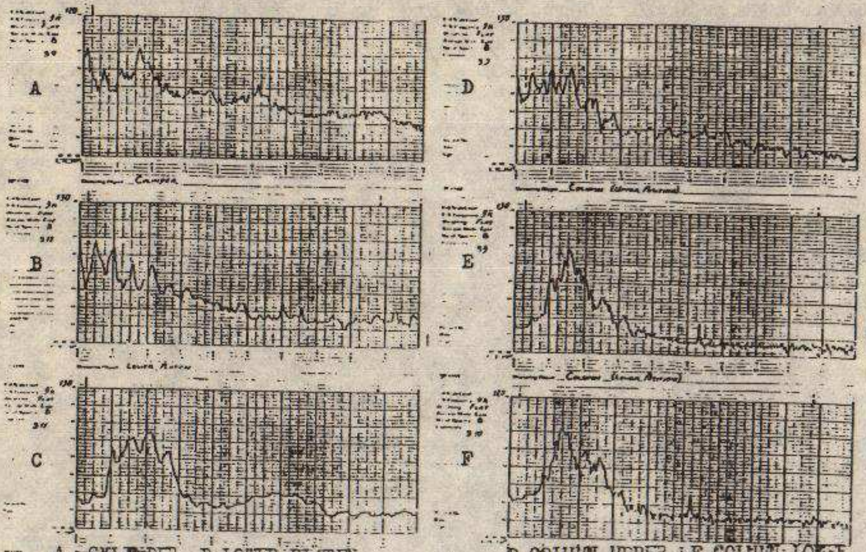
MODE SHAPES FOR ARCH-TYPE MODEL

FIG.I



Mode shapes for point excitation of model and full size hammers

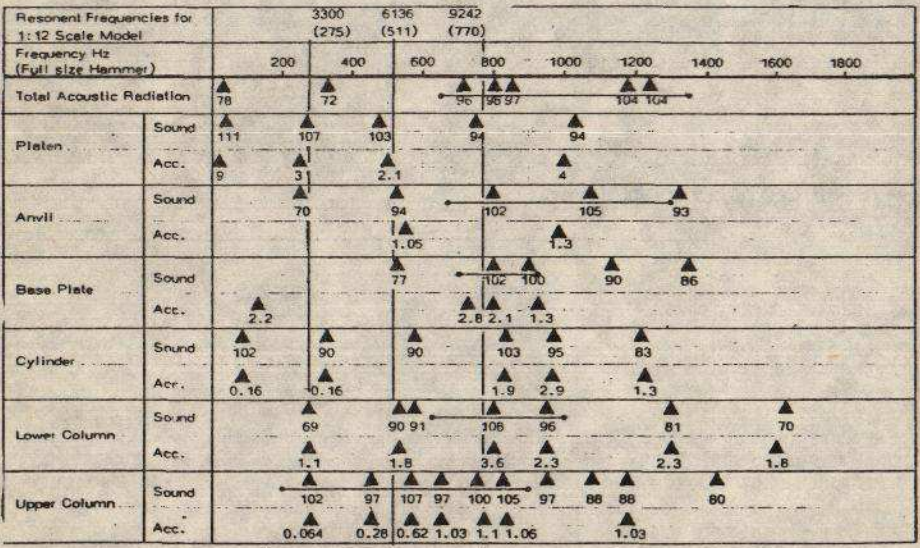
FIG 2



A CYLINDER B LOWER PLATEN
C ANVIL

D COLUMN UPPER E COLUMN LOWER
F BASEPLATE

FIG 3 SOUND SPECTRA FROM MACHINE COMPONENTS



NOTATION ALL SOUND LEVELS ARE R.M.S. dB(A)
ALL ACC. LEVELS ARE R.M.S. g

DENOTES SECTION OF SPECTRUM ABOVE 90 dB(A) R.M.S.

FIG 4 SUMMARY OF SPECTRAL DATA