

# CBS MEMORANDUM

**FROM:** H. Suzuki  
**TO:** M. MATTHIAS  
**DATE:** March 16, 1983

**cc:** R. Finger, E. Torick

**Subject:** Measurement of Wood and Carbon Shank Hammers

The force-time pattern and resonance frequencies of the hammer-shank systems were measured for the two treble grand hammers (which will be referred to as "A" and "B"). The force-time patterns were measured using the Key-Action Model at CTC. Figures 1 and 2 show that the hammers with carbon shanks give wider force-time patterns than the wood shanks. This result agrees with those obtained from the calculation of the mathematical model. The reason for this is considered due to the increased effective mass of the hammer, since a larger portion of the carbon shank moves together with the hammer than for the wood shank. The effect of this may be adverse at least for the treble hammer. The "ideal" shank may be made of an infinitely rigid and infinitely light material. In this case, some vibratory motion of the shank can be avoided during the contact time between the hammer and the string, and also the mass of the system can be controlled by adjusting the mass of the hammer itself.

Figures 3 and 4 show the resonance frequencies of the hammer shank system when the flange side is fixed firmly. The figures indicate that the carbon shank gives approximately 50 to 80% increase in the bending stiffness. The weights of the carbon shanks were very close to those of the wood shank.

From the above discussions, it is suggested that the carbon shank should be made to weigh less than the wood shank, so that the force-time pattern of the carbon shank becomes narrower than that of the wood shank. An optimum shape and material of the carbon shank should be pursued further for this purpose.

*[Handwritten signature]*

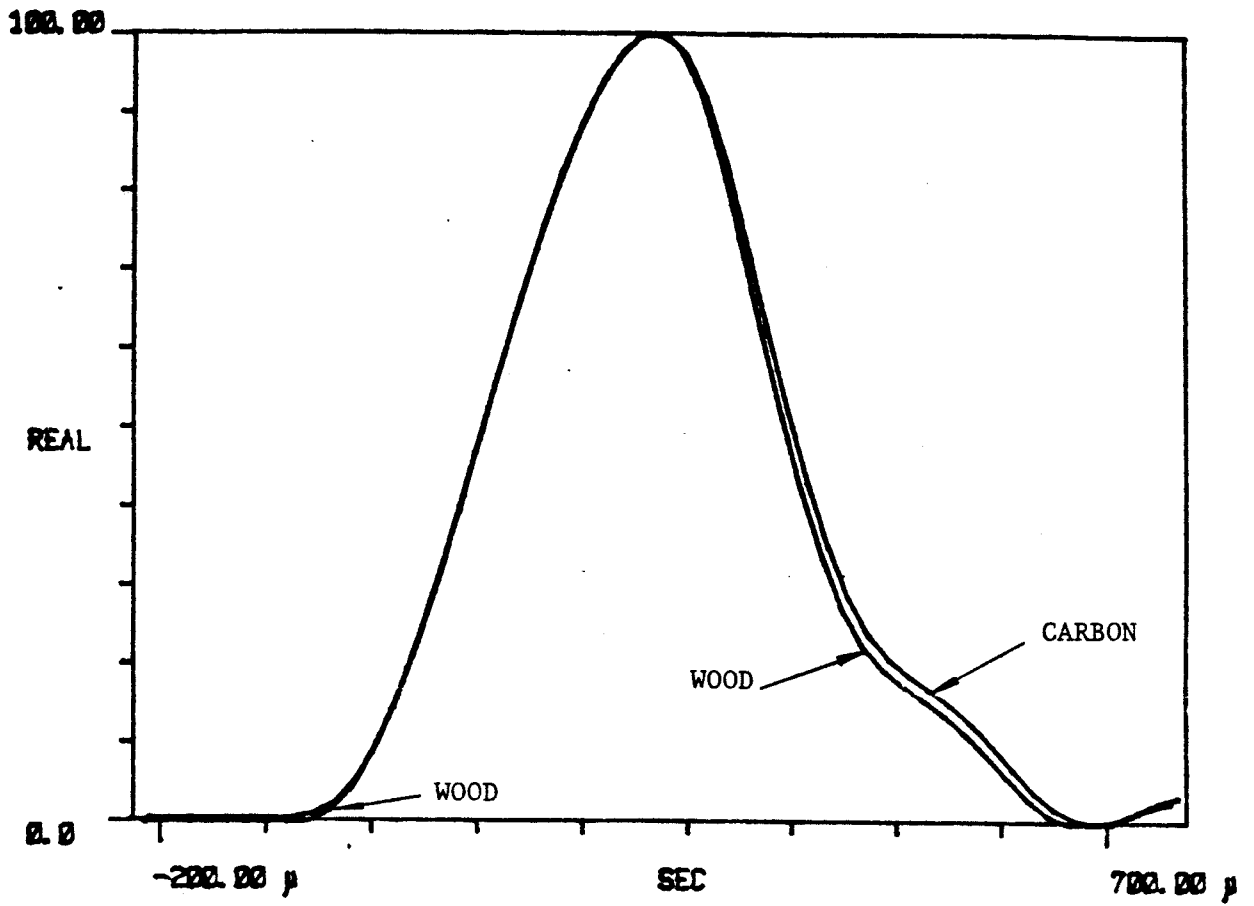


Fig. 1 Force-time patterns of a treble hammer "A" with carbon and wood shanks.

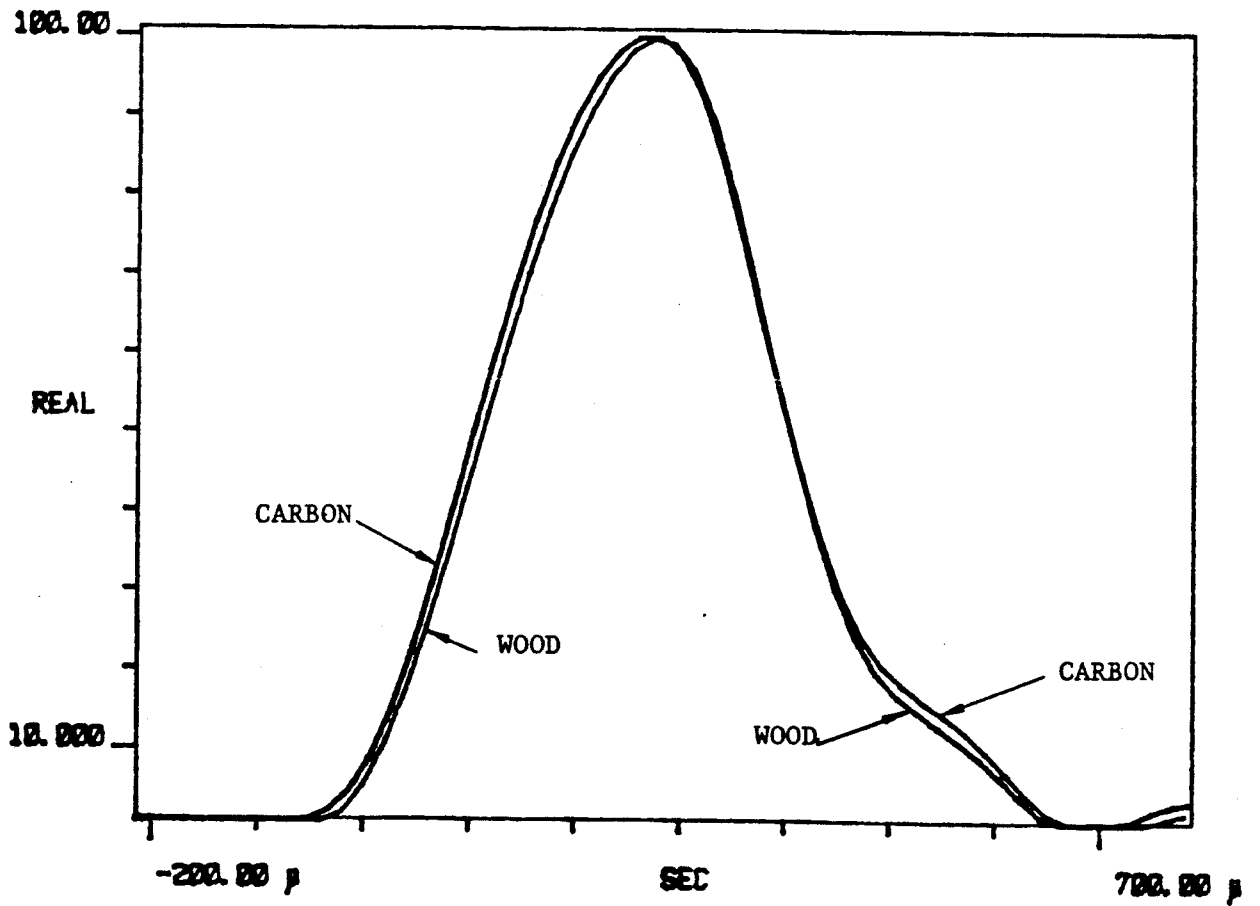


Fig. 2 Force-time patterns of a treble hammer "B" with carbon and wood shanks.

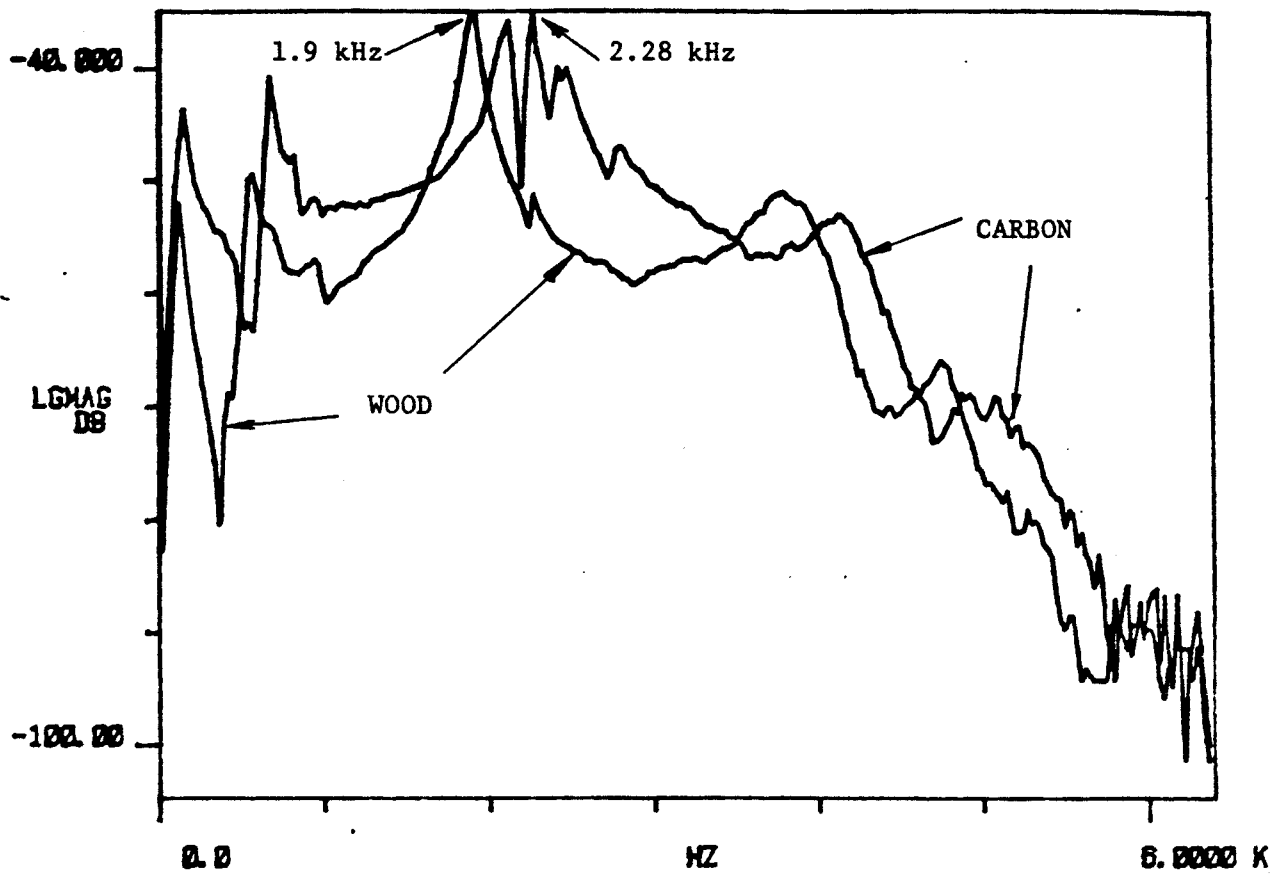


Fig. 3 Resonance frequencies of a treble hammer "A" with carbon and wood shanks.

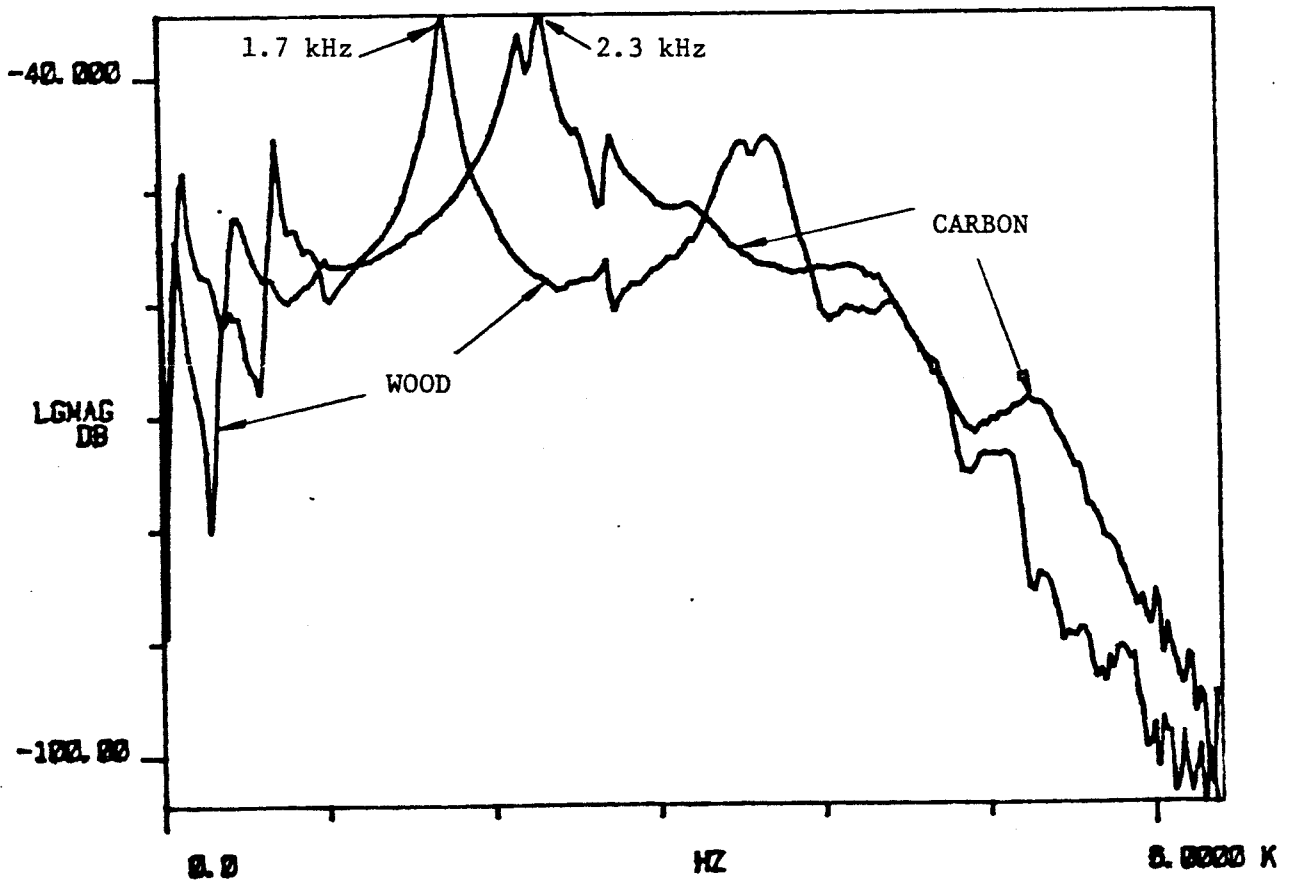


Fig. 4 Resonance frequencies of a treble hammer "B" with carbon and wood shanks.