Vorl

Backus, John
Resonance Frequencies of the Clarinet
1968 JASA 43, 1272–1281

Dia 21/32

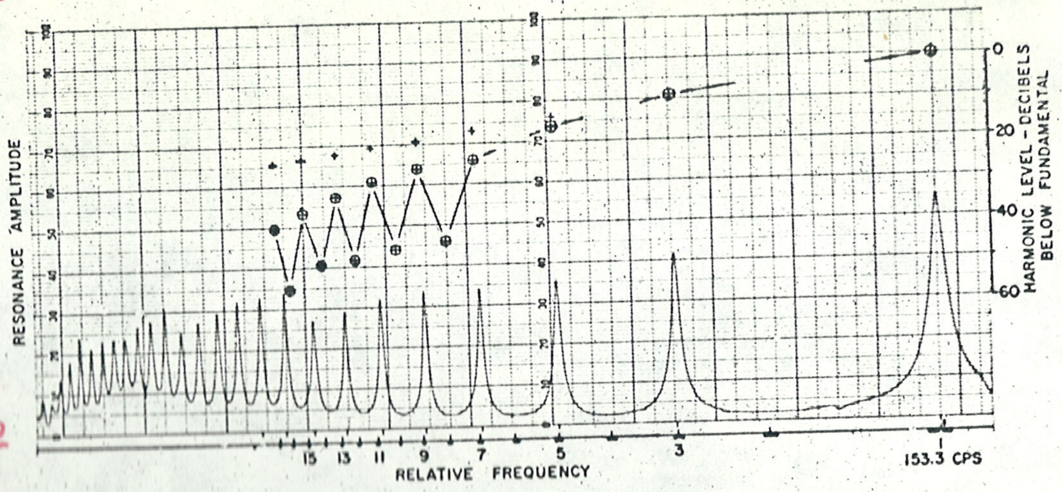

FIG. 3. Pressure resonance curve for a clarinet mouthpiece attached to brass tubing 47.6 cm long. Relative harmonic levels for the standing-wave sound pressure at the mouthpiece, when the clarinet is blown by an artificial embouchure, shown by crosses enclosed by circles.

components. This output in turn is fed to the grids of a pair of power tubes whose plates are connected to the event marker on the chart recorder. Now, as the beat-frequency oscillator frequency is swept through a value n times the pulse generator frequency, the voltage applied to the grid of the right-hand power tube will be a small alternating voltage whose amplitude will increase and whose frequency will decrease as the oscillator frequency approaches the multiple of the pulse-generator frequency. When the difference frequency becomes low enough, the event marker is actuated and makes a series of dips on the line that it is tracing on the recorder chart. When the difference frequency becomes zero, the event marker ceases to function for a moment; then, as the difference frequency increases again in the other direction, the event marker makes another series of dips and then stops. The over-all result on the event-marker trace is two groups of dips separated by a small interval that marks the frequency of the harmonic of the fundamental. In this fashion, we obtain from the recorder chart a plot of the resonances of the clarinet together with marks indicating the harmonic frequencies of the lowest resonance. Probably never before has a clarinet had attached to it so much sophisticated electronic equipment.

The frequency dial on the beat-frequency oscillator is logarithmic, so the positions of the harmonic marks should also be on a logarithmic scale. A given percentage change in frequency thus corresponds to a certain constant distance on the recorder chart. However, discrepancies between the actual oscillator frequencies and those indicated on the oscillator dial produce some distortion of the logarithmic scale of the harmonic marks. This is of no consequence, since a mark is produced when the beat-frequency oscillator frequency is exactly n times the RC oscillator frequency and does not depend on the calibration of the beat-frequency oscillator dial.

To obtain some sort of standard to which to compare clarinets, a chart was made of the resonances of a piece of brass tubing of 1.57-cm ($\frac{5}{8}$-in.) i.d. and 47.6 cm long, this length being such as to give the written "E_3" (concert D_3, the lowest note on the B♭ clarinet) when attached to the mouthpiece with an adapter of length 1.8 cm. (The B♭ clarinet sounds one whole tone lower than written; and in subsequent work, it will be convenient to designate the written note—where it is different from its sounding note—by enclosing it in quotation marks.) The chart for the brass tube is shown in Fig. 3; 25 well-defined resonances are visible in the plot of relative pressure amplitude as a function of frequency marked "resonance amplitude" in the Figure. The operation of the chart recorder is such that the frequency scale increases from right to left and the vertical scale, for the relative sound pressure at the mouthpiece, is

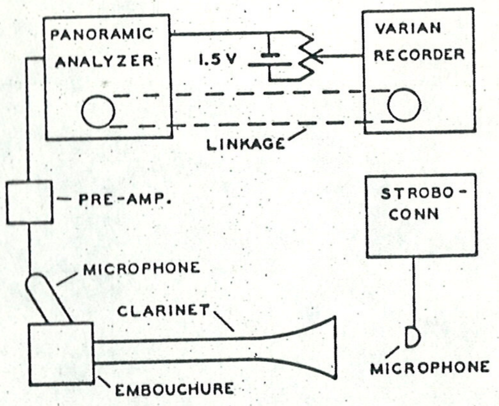

FIG. 4. Block diagram of equipment to plot the harmonic structure of the mouthpiece pressure produced by sounding the clarinet.