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Corrosion Measurement Using a Reference Fork

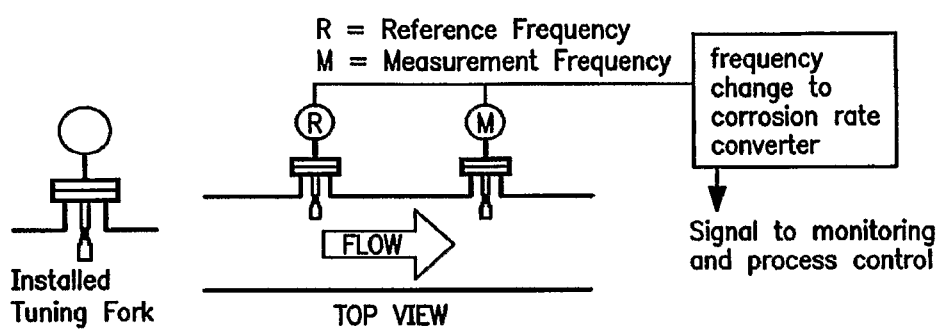


FIG. 1a

Frequency Change to Mass Loss by Two Similar but Not Identical Tuning Fork Oscillators

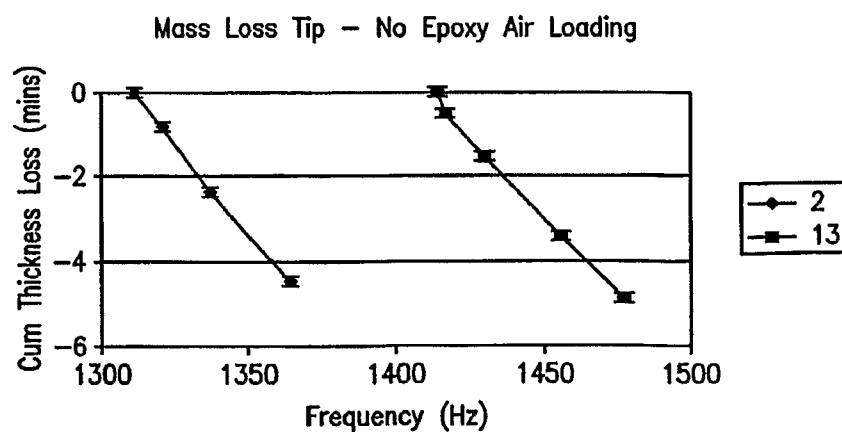
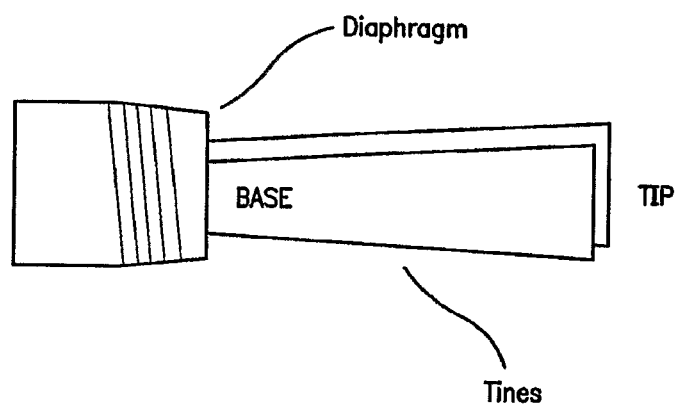


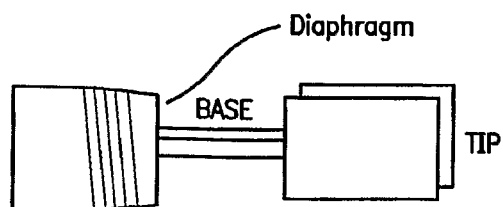
FIG. 1b

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Components of Commercial Tuning Fork Level Sensor (Fork A)

**FIG. 2**

Components of Commercial Tuning Fork Level Sensor (Fork B)

**FIG. 3**

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Distinguishes Deposition and Mass Loss as a Function of Position on Tine for Fork A

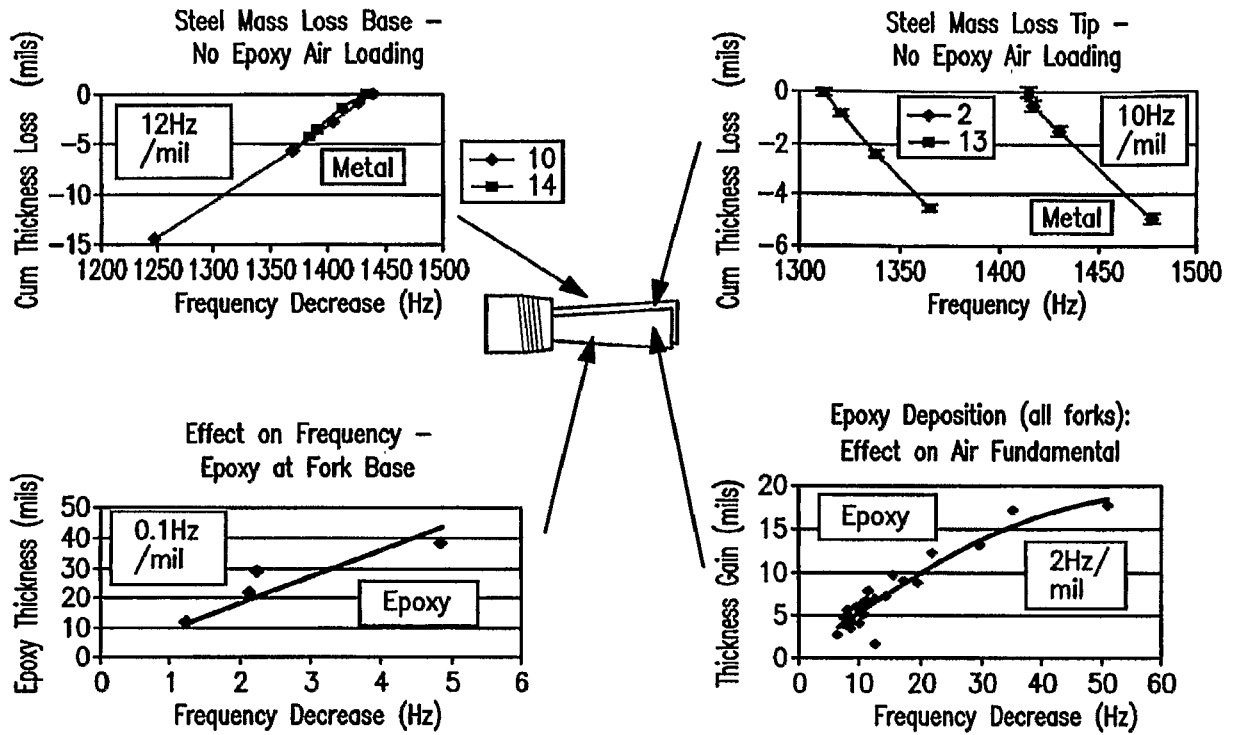


FIG. 4a

Frequency response at base to metal loss and epoxy deposition plotted on the same axis

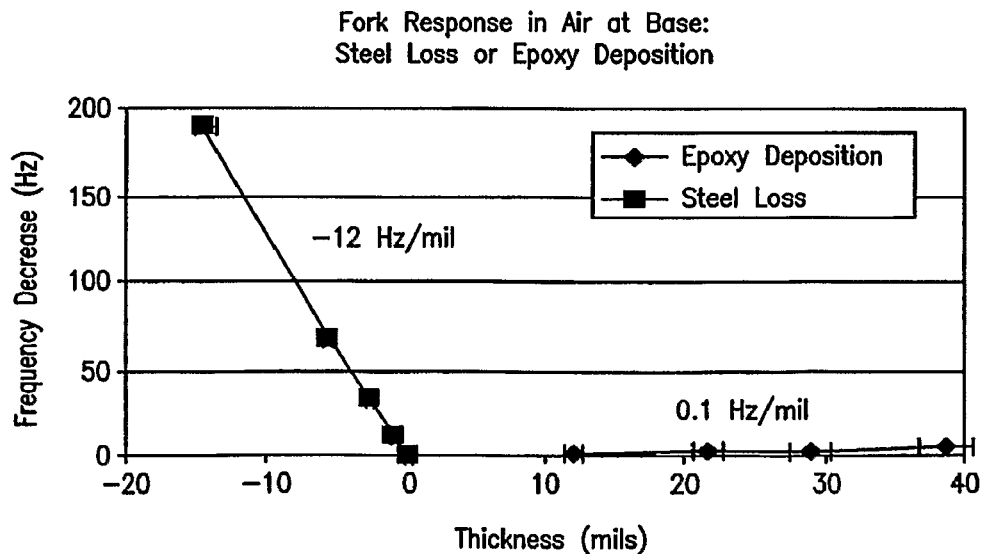
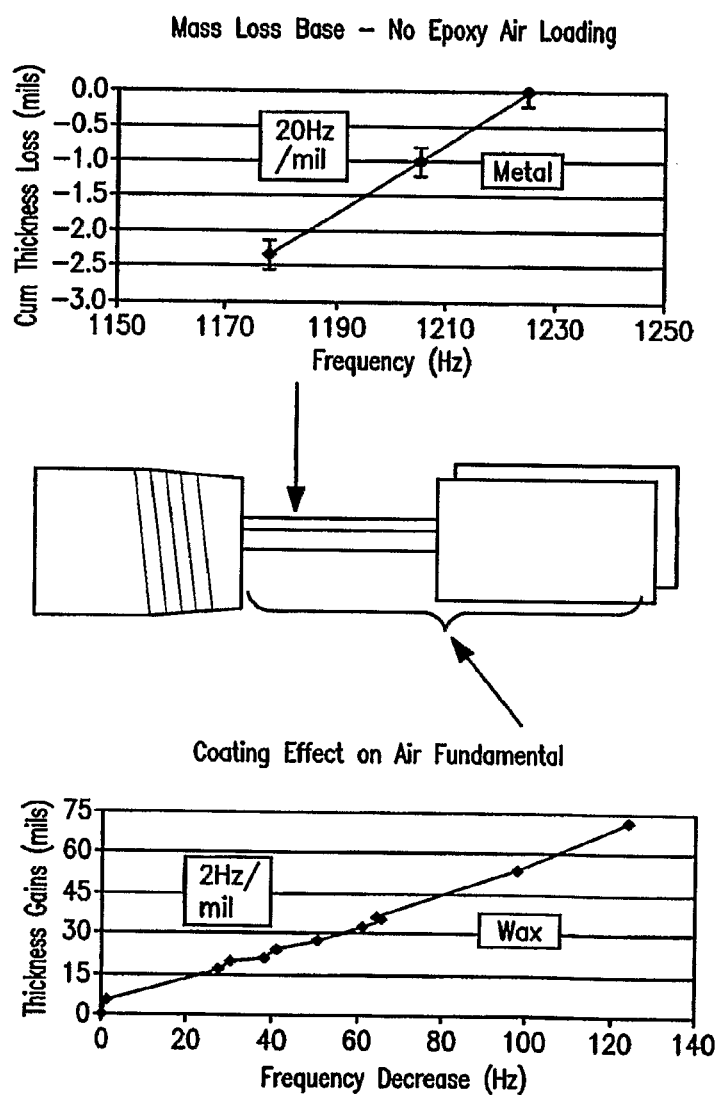


FIG. 4b

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Deposition over the entire fork tine and Mass Loss as a Function of Position on Tine for Fork B

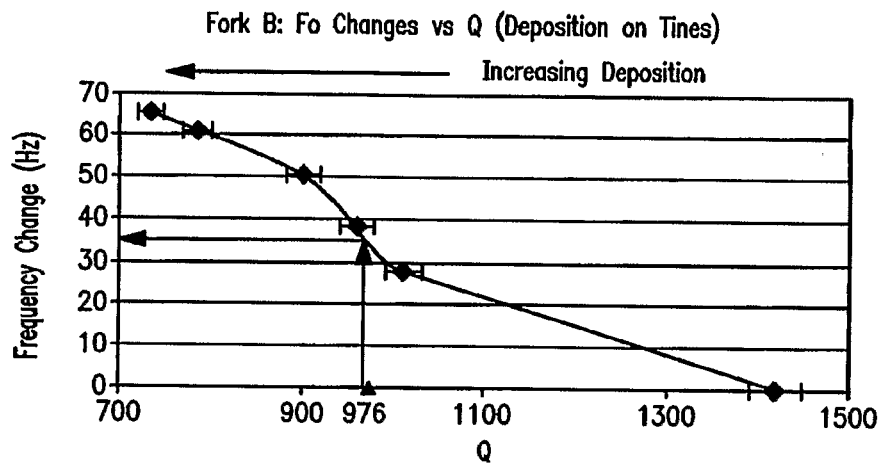
- Metal loss = $H(\Delta f \text{ steel loss})$

**FIG. 5**

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Effect on Q and Resonance Frequency of Deposition on Tines and Diaphragm (Fork B with a metal mass loss = 0.250g))

a. Relative effect of resonance frequency and Q as a function of wax deposition
Arrows show approach used in the example for estimating the impact of frequency shift of deposition using the parameter Q.



b. Absolute effect on frequency with respect to deposition

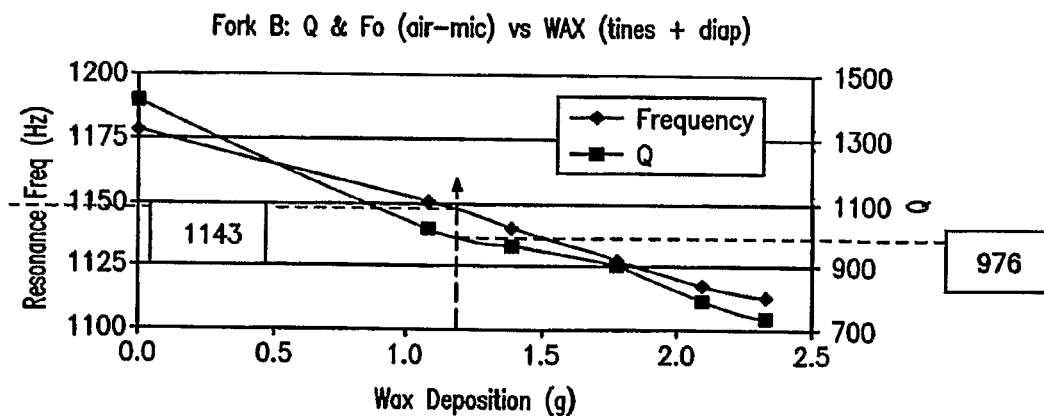


FIG. 6

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Change in Q From Metal Mass Loss at the Tine Base (FORKS A and B)

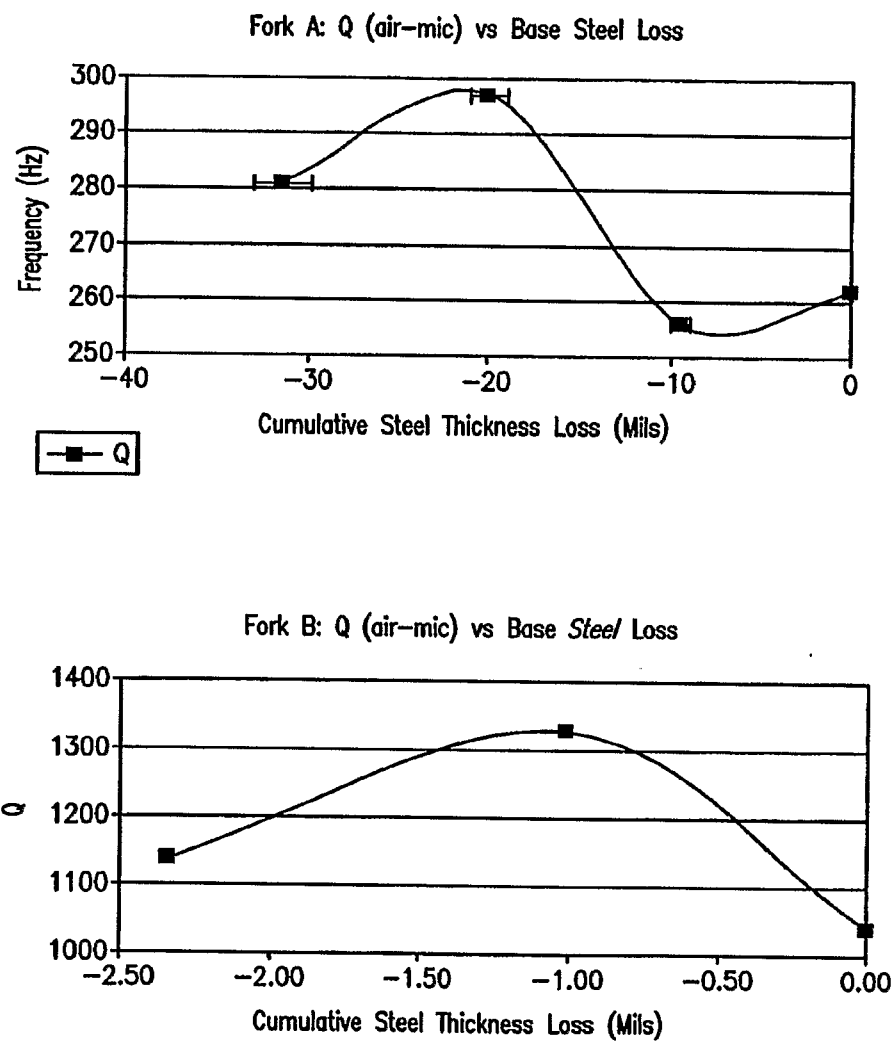
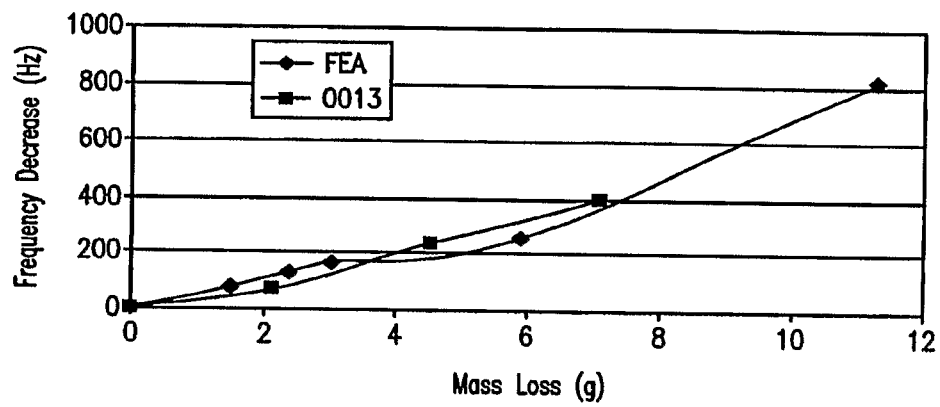


FIG. 7

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Comparison between Experimental and FEA Results

FEA vs Measured Steel loss at Base



FEA vs Measured: Epoxy Gain

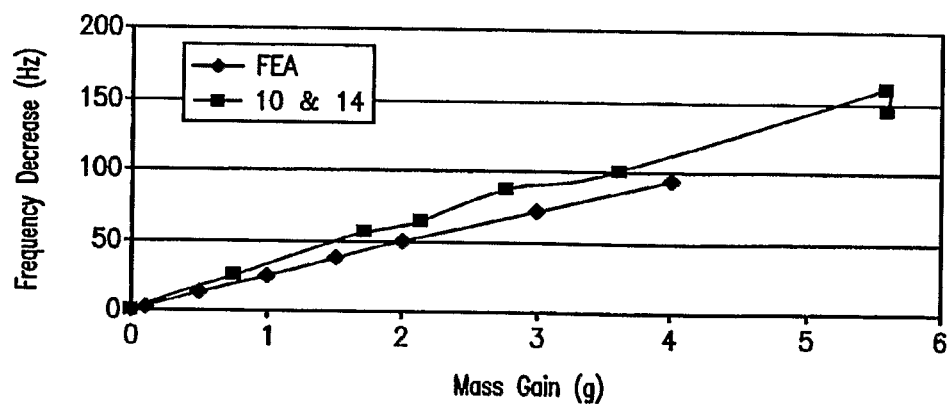


FIG. 8

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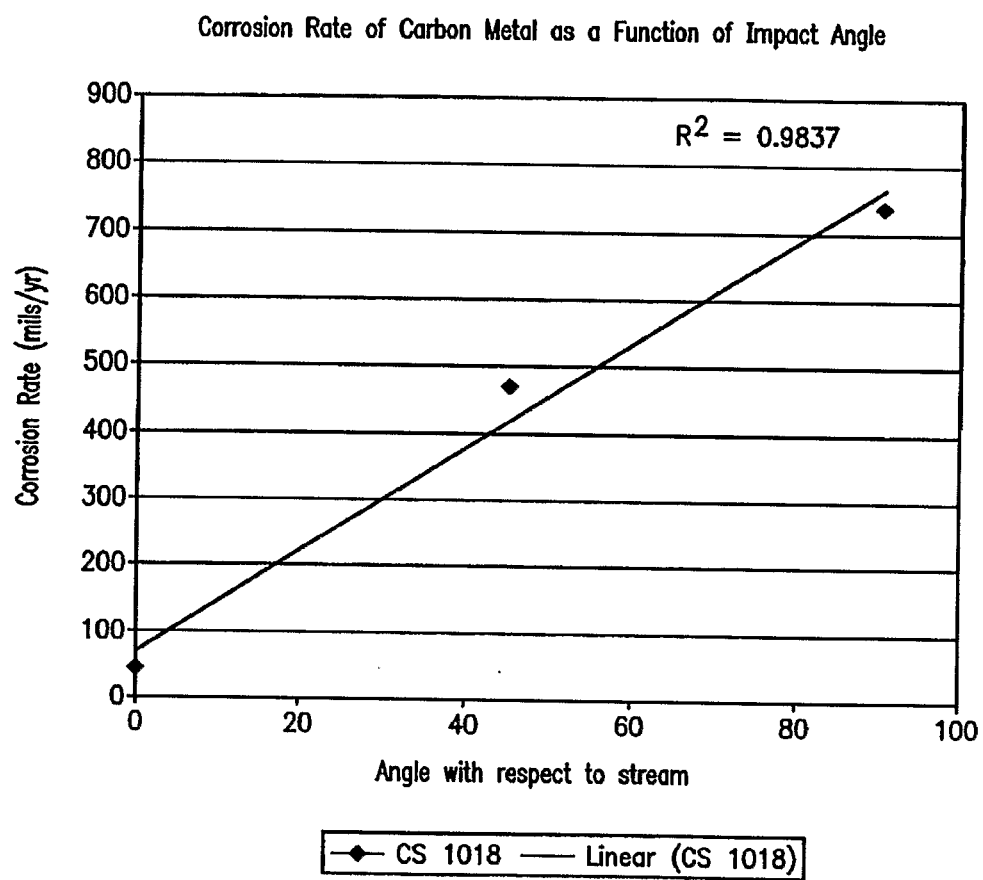


FIG. 9

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Tuning Fork Oscillator Resonance Frequency as a Function of Temperature

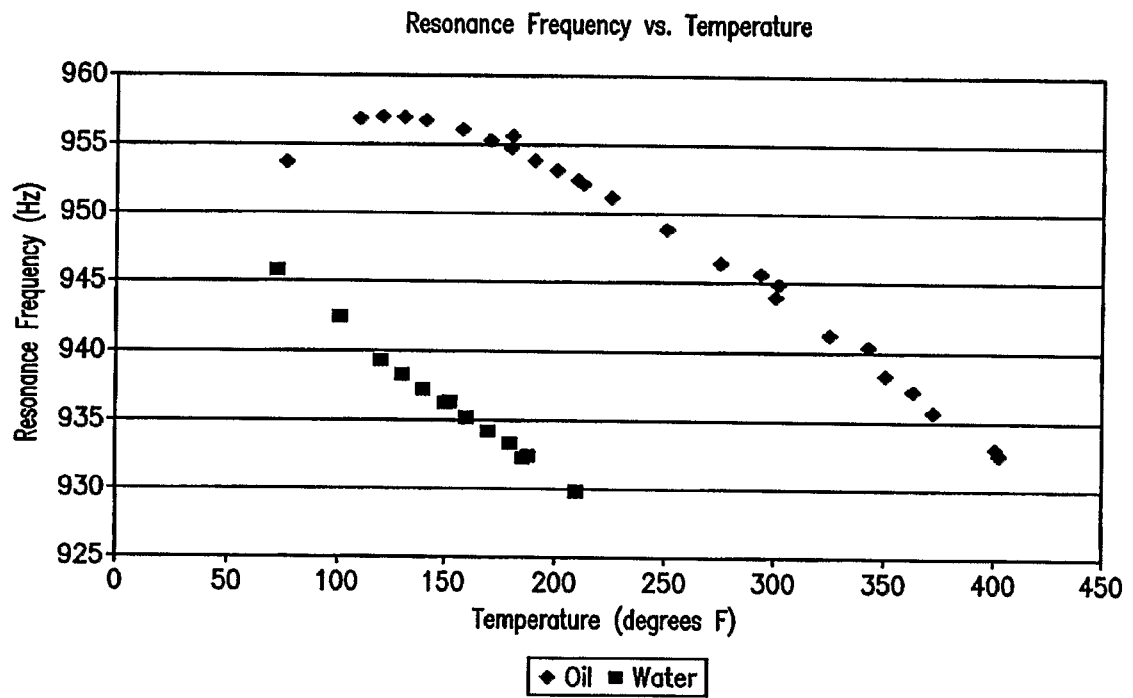
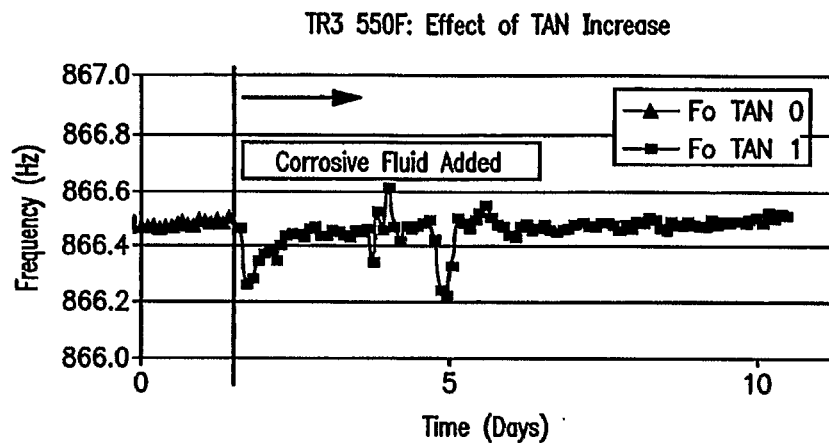


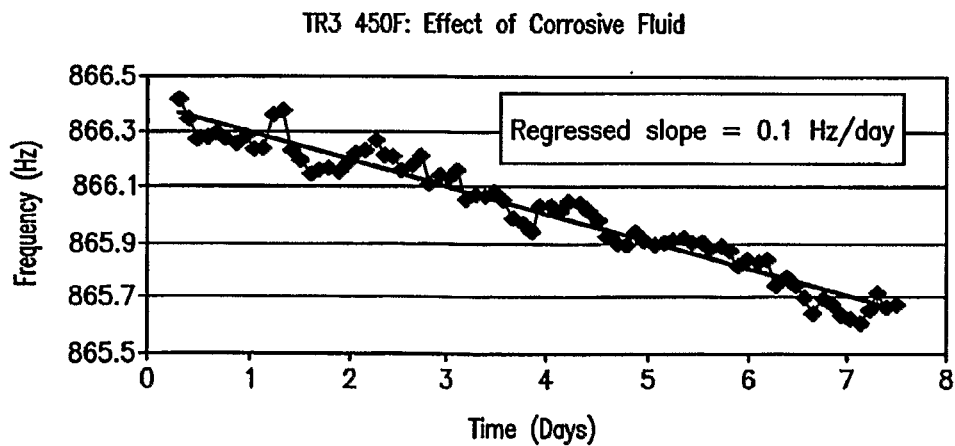
FIG. 10

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Example Where Corrosive Fluid Addition Has No Impact on Resonance Frequency

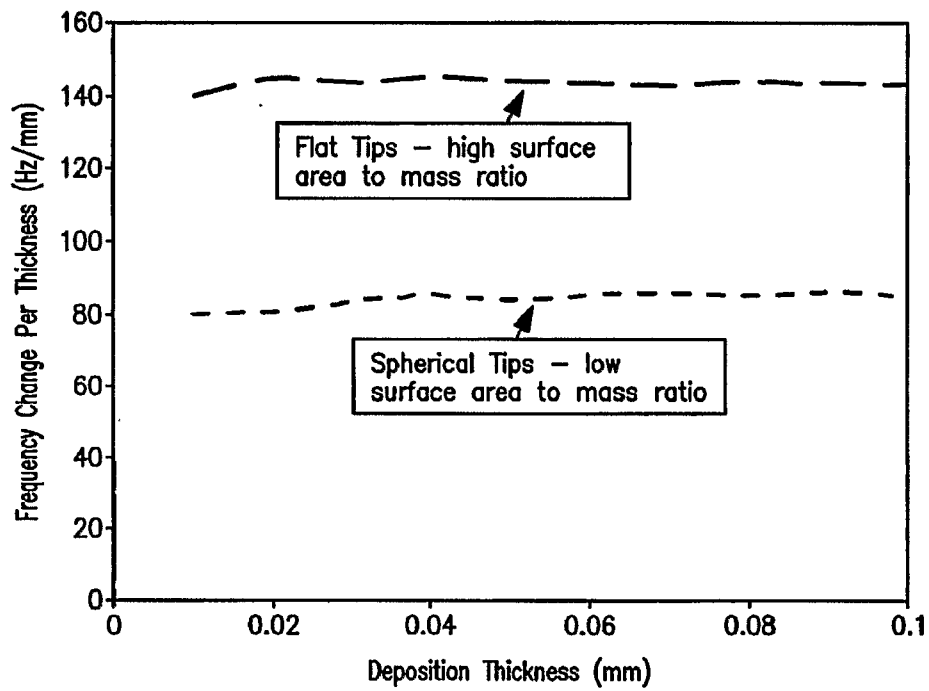
**FIG. 11**

Example Where Corrosive Fluid Has Impact on Resonance Frequency

**FIG. 12**

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Application of Finite Element Analysis (FEA) Optimize the Paddle Shape by
Minimizing the Effect of Deposition Material

**FIG. 13**