mass constant m, stiffness constant s and mechanical resistance r of a electrostrictive vibrator can be represented in terms of the electrical constants L', C' and R' respectively in the ordinary equivalent electric circuit as follows.

$$\left.\begin{aligned} L' &= m/A^2 \\ 1/C' &= s/A^2 \\ R' &= r/A^2 \end{aligned}\right\} \qquad (1)$$

where A is the transformation constant generally called the force factor, which is proportional to the electrostrictive constant λ. Then, if we measure the electrical impedance of the vibrator, we are able to calculate the numerical values of m, s, r and A (if we know one of these constants) according to the following relations.

$$\left.\begin{aligned} &|\dot{Y}_{mo}| = 1/R' \\ &\dot{Y}_d = \omega_r\ C_d = 2\pi\ f_r\ C_d \\ &\omega^2{}_r = (2\pi\ f_r)^2 = \frac{1}{L'}\left(\frac{1}{C'} - \frac{1}{C_d}\right) \\ &\Delta = \pi \cdot \Delta f = \frac{R'}{2L'} \end{aligned}\right\} \qquad (2)$$

where Y_{mo} is motional admittance, Y_d is damped admittance, f_r is resonant frequency and Δ is so called damping constant.

Impedance measurements were carried out about many samples in the D.C. biasing field or previously treated in the D.C. field. The mechanical constants or material constants of $BaTiO_3$ ceramic vibrators were deduced by the method above mentioned, and it was confirmed that $BaTiO_3$ has excellent electromechanical transducing properties.

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13. Study on High Dielectric Constant Ceramics. (XI) Electrostrictive Vibrations of Rectangular $BaTiO_3$ Ceramic Plate

Kiyoshi Abe, Tetsuro Tanaka, Sigeru Miura and *Isao Saito*

(Abe Laboratory)

In the previous report (K. Abe and T. Tanaka: This issue. 20 (1050), 55.), we treated the longitudinal length mode of vibration which can be excited in the long thin bar of $BaTiO_3$ ceramics. In rectangular plate, two kinds of vibration, except thickness mode, can be excited, one of which is that of length direction (longer side direction) and the other is breadth direction (shorter side direction). In the course of experiments, it was found that the frequency constants and intensity of these two vibrations differed considerably, and these were always high in the vibration of shorter side compared with those of longer side. Table 1 shows the results of preliminary tests of frequency constants about several samples.

Table 1

Sample	l in cm		f_R in k.c.	$f_R \times l$ in k.c.-cm
1	l_1 l_2	3.85 3.01	54.25 77.31	208.86 232.86
2	l_1 l_2	3.05 2.09	67.30 108.08	205.27 225.88
3	l_1 l_2	3.80 2.65	53.83 83.86	204.55 222.23
4	l_1 l_2	3.49 2.12	58.63 102.25	204.62 216.77

In order to obtain enough data to explain the above result, we carried out the following experiments. A rectangular plate of 4.305cm long, 3.18cm wide and 0.225cm thick was used and after polarizing treatment, the longre side of 4.305cm was shortened step by step while the side of 3.18cm wide remained constant and at every step the impedance was measured precisely. Table 2 shows some part of the results, where l and l_0 are length and breadth, $(f_R l)_l$ and $(f_R l)$s are frequency constants and λ_l and λ_s are apparent electrostrictive constant (dynes/Volt/cm) calculated from the impedance measurements corresponding to the vibration of longer and shoter side respectively.

Table 2

l/l_0	$(f_R l)_l$	$(f_R l)_S$	λ_l	λ_S
1.3	200.5	228.6	20.4	59.2
1.2	197.7	228.6	15.1	60.8
1.1	192.9	233.3	7.0	66.7
1.0	182.5	242.2	0	75.9
1/1.1	193.3	231.8	6.8	71.0
1/1.2	198.2	226.2	15.4	64.0
1/1.3	202.1	223.5	21.4	58.6

Thise experimental results show the existence of the effect of interferrence between two vibrations. This effect appears most strongly when the frequencies of the two vibrations become almost the same, that is the case of $l/l_0=1$.