The theory of the vibrating wire sensor

1. The theory of the vibrating wire sensor

The vibrating wire sensor is made by using the phenomenon, which the proper frequency vibrating of an elastic body changes according to change of a unit of physical laws. In an elastic body, Quality Factor is high. So reappearance, disassembly and durability is good however signal is very complicated because relationship with output is not a fan shape. But this shortcoming was solved by high technology, which can treat digital signal very simply. Because A/D changing and combining whit computers is very easy by output of frequency, even originally it is a analogue sensor but it can be used like a digital sensor. The vibrators like wire is practically used to get engineering data like angle, pressure, load and displacement.

The vibrating wire sensor is not a electronic converter but a mechanical one in strict meaning. The vibrating wire sensor fixes a vibrating wire with a flange by giving stable tension according to a sensor's structure. And it positions Flucking coil which can make power of electricity on the vibrating wire, if output device inputs a signal to Flucking coil, strong power of electricity occurs and it vibrates the vibrating wire. At this time, the vibrating wire could vibrate and through Flucking coil, the vibrating wire's vibration is measured as resonance frequency and is showed as frequency per second on output device.

Based on this theory, if a sensor, which measures load, pressure, displacement, angle and rate of strain, is applied to a sensor, the vibrating wire's tension changes resonance frequency. The vibrating wire sensor can measure load, pressure, placement, angle, and rate of strain by applying resonance frequency's change to various sensors.

Frequency can calculated according to below numerical formula with length of string, tension, density, gravity acceleration, elastic modulus and rate of transformation.
The vibrating wire sensor's basic value of output is frequency and according to kind of measurement devices, it changes a measurement unit and gets a value of engineering units (load, pressure, angle, replacement and rate of strain) very usefully. Also, because manufacturing companies have different units, sometimes units need to be altered.

2. Calculation of frequency(Hz)

It can show frequency and apply to all the vibrating sensors by its basic value of output, And it can also output as data of the second function

$$\mathbf{F = \frac{1}{2L} \times \sqrt{\frac{\sigma g}{\rho}} = \frac{1}{2L} \times \sqrt{\frac{Eg}{\rho}}}$$

Where,,
F = Frequency (Hz)
L = Length of wire (cm)
σ = Tensile force of wire (kg/cm^2)
g = Gravitational acceleration (m/sec^2)
ρ = Density of wire (kg/m^3)
E = Elastic modulus of wire (kg/cm^2)
ε = Strain of wire