Bridge, Electrical Encyclopedia Article

Bridge, Electrical

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One problem facing scientists experimenting with electricity in the mid-1800s was taking accurate measurements of electromotive force (emf), current strength, and resistance. A galvanometer was fine for indicating current flow, but it was an unstable device for making an actual measurement, and there was no standard way to calibrate it. As far as determining the unknown resistance in an electric circuit, a solution was invented by English physicist Charles Wheatstone in 1843. Wheatstone had come across a neglected German publication written in 1827 by Georg Ohm (1787-1854) which set forth the theory that emf, current, and resistance were all mathematically related. This finding put Wheatstone on the right track.

Wheatstone created an electrical bridge circuit which included four resistors, three having a known value, with the fourth unknown. When an emf is applied to the inputs of this four terminal network, the output terminals of the circuit in question are "bridged" with a detector such as a voltmeter. Using a calibrated variable resistance, which Wheatstone called a rheostat, he could adjust the components in the network, "balancing" the voltage across the bridge (bringing it to zero as detected on the voltmeter). Since the components in the network have specific relations to each other, the resistance of the fourth component could be determined from the resistances of the other three.

The Wheatstone bridge is one of the best known electrical bridges, but there are a variety of other bridges used to convert physical quantities like temperature or pressure into electrical quantities like voltage or current. Examples are the Carey-Foster bridge, which also measures resistance; the Kelvin double bridge, which has eight arms instead of four; the Wien bridge which measures alternating current capacitance, as does the Nernst high-frequency capacitance bridge; and the Heaviside mutual inductance bridge and the Maxwell bridge, which compare inductance with capacitance.