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A Commentary on Microphone Design and Operation in Acoustics

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Commentary

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ABOUT THE STUDY

Microphones are devices which convert pressure fluctuations into electrical signals. There are two main methods of accomplishing this task that are used in the mainstream entertainment industry. They are known as dynamic microphones and condenser microphones. Piezoelectric crystals can also be used as microphones but are not commonly used in the entertainment industry. For further information on piezoelectric transducers

This type of microphone converts pressure fluctuations into electrical current. These microphones work by means of the principle known as Faraday's Law. The principle states that when an electrical conductor is moved through a magnetic field, an electrical current is induced within the conductor. The magnetic field within the microphone is created using permanent magnets and the conductor is produced in two common arrangements.

The first conductor arrangement is made of a coil of wire. The wire is typically copper and is attached to a circular membrane or piston usually made from lightweight plastic or occasionally aluminum. The impinging pressure fluctuation on the piston causes it to move in the magnetic field and thus creates the desired electrical current. The second conductor arrangement is a ribbon of metallic foil suspended between magnets. The metallic ribbon is what moves in response to a pressure fluctuation and in the same manner, an electrical current is produced. It provides a sectional view of a ribbon microphone. In both configurations, dynamic microphones follow the same principles as acoustical transducers.

Condenser microphones

This type of microphone converts pressure fluctuations into electrical potentials through the use of changing an electrical capacitor. This is why condenser microphones are also known as capacitor microphones. An electrical

capacitor is created when two charged electrical conductors are placed at a finite distance from each other. The basic relation that describes capacitors is:

$$Q=C*V$$

Where Q is the electrical charge of the capacitor's conductors, C is the capacitance, and V is the electric potential between the capacitor's conductors. If the electrical charge of the conductors is held at a constant value, then the voltage between the conductors will be inversely proportional to the capacitance. Also, the capacitance is inversely proportional to the distance between the conductors. Condenser microphones utilize these two concepts. The capacitor in a condenser microphone is made of two parts: the diaphragm and the back plate. The diaphragm is what moves due to impinging pressure fluctuations and the back plate is held in a stationary position. When the diaphragm moves closer to the back plate, the capacitance increases and therefore a change in electric potential is produced. The diaphragm is typically made of metallic coated Mylar. The assembly that houses both the back plate and the diaphragm is commonly referred to as a capsule. To keep the diaphragm and back plate at a constant charge, an electric potential must be presented to the capsule. There are various ways of performing this operation. The first of which is by simply using a battery to supply the needed DC potential to the capsule. The resistor across the leads of the capsule is very high, in the range of 10 mega ohms, to keep the charge on the capsule close to constant.