The Moving Coil Loudspeaker

Our world today is dominated by speakers. Daily activities like listening to music, watching videos, and talking on the phone simply could not be done without them. They have become so common that we hardly notice or think about them anymore as we walk around the mall which is happily playing Christmas tunes, or turn off our blaring alarm in the morning as we struggle to get out of bed. But what is making all of these things produce so much sound? The moving coil loudspeaker, or dynamic loudspeaker, is one of the most common types of speaker that is being used today. We have been improving on the same design that was created almost a century ago to make them louder, more efficient, and more realistic in their reproduction of sound. The audio production industry has benefitted more than any from the invention and improvement of this type of speaker, as it has allowed vastly increased sound quality, bandwidth, and clarity compared to its predecessors. While there have been other types of loudspeakers produced since the dynamic loudspeaker, it has remained the most popular as a result of its reliable and accurate sound reproduction, which has allowed the audio production industry to thrive.

The loudspeaker’s main function is to convert electrical energy into acoustical energy, and the moving coil-permanent magnet transducer is the most common type of transducer used in loudspeaker technology. The speaker is all held together by a metal frame, with a cone attached by flexible suspension. The vibration of this cone is what is generating soundwaves. It does this by way of a permanent magnet and a voice coil in the body of the loudspeaker. The permanent magnet creates a strong, persistent magnetic field that surrounds the voice coil. The voice coil is rigidly attached to the speaker cone so that the movement of the cone mimics the movement of the coil. When the coil receives an electrical signal from the amplifier, it causes it
to exert a force which is proportional to the voltage of the electrical signal. A progression of different voltages over time drives the coil to vibrate, which in turn causes the cone to vibrate along with it. The flexible suspension which attaches the cone to the frame and another suspension called the “spider” attached to the coil allows for free movement in the horizontal direction while restricting movement in the vertical direction. This keeps the coil from coming into contact with the permanent magnet as well as providing a restoring force for the coil as it vibrates. In order for the speaker to be as efficient as possible, the gap between the coil and the magnetic pole is made as small as possible, which allows for the production of more sound power with a smaller magnet.

One of the important traits that makes the moving coil speaker so superior to other speakers is the suspension system which allows for greater excursions. The sound pressure that a speaker needs to produce is directly proportional to the volume of air flowing times the frequency. This means that in order for low frequency sounds to be produced, a much larger volume of air must be moved so that the sound level remains the same. Rather than creating a massive transducer or combining several of them together, the dynamic loudspeaker solves this problem by being able to move larger quantities of air with a relatively smaller body. The moving coil and flexure system are the key to this in that they allow for greater excursions by the cone to displace a greater volume of air molecules.

To understand the impact of the dynamic loudspeaker, it is necessary to understand some of the history behind it. The earliest moving coil transducer was created in 1874 by a man named Ernst Werner von Siemens. He does not immediately use it for sound transmission, but it does come into use several years later to be the main mode of transduction in the phonograph during the acoustic era. In 1908, Anton Pollak improves on Siemens’ dynamic coil by designing the
“spider” which became part of the flexure system meant to keep the coil in place. Finally in 1924, Edward W. Kellogg and Chester W. Rice invent a direct radiating loudspeaker which incorporates the flexible suspension and the centering spider in its design. Further development went into making the dynamic speaker a medium for sound in motion pictures. Bell labs was able to develop a moving coil type speaker that allowed for the first sound films. This was revolutionary for the time as there had been several costly failed attempts at incorporating sound into motion pictures, and it wasn’t until these advances were made in moving coil speakers that it was able to become a reality.

However, dynamic loudspeakers have impacted much more than just the theater. It also made speakers available for home use, for use in studio monitors, and for live sound reinforcement. The clarity and the flat frequency response that the moving coil driver can produce has made it possible to reproduce sound in almost any environment without sounding like it is artificial or distorted. Audio engineers have been able to use the dynamic speaker in the studio to hear and correct the slightest nuances in a recording. Before the moving coil, speakers’ sound quality and range were simply not sufficient to be able to reproduce sounds to their full extent. The dynamic speaker is able to much more accurately play sounds especially in the bass range that could not have been made by previous transducers. Furthermore, the realism of the sound produced meant that the speaker could be used in live performance to amplify a performer without causing distortion that would detract from the source. This allowed music to be played in front of huge audiences and contributed to the creation of new genres of music.

The dynamic loudspeaker has been one of those inventions that revolutionizes an industry by making previous technology obsolete while itself remaining relevant for almost a century now. While there are other niche speakers that perform certain tasks better than the moving coil
loudspeaker can, it has yet to be beaten in overall quality. The high power output, high sensitivity, wide dynamic range, and relative simplicity of design have made it a favorite of anyone from the casual listener to the professional producer, and it has allowed the audio production and entertainment industries to reach new heights and compete with other industries to be some of the most integral parts of American and international culture.