Microphones: A History in Words and Pictures

By Ron Holmes

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Foreword

I would like to dedicate this overview of microphone history and technology to all the creative engineers who dreamed this stuff up, made it real, and managed to figure out to manufacture it.

This history of microphones is also about my personal discovery of microphones, electronic amplification and the path to understanding sound manipulation. Microphones held a fascination for me since I was 8 years old and built my first amplifier. I have played with them, puzzled over them, and been mesmerized by how they worked. When I could get an old broken one, I would take it apart and try to figure out how to repair it. In 1957 there were no Radio Shacks and all I could find were discarded radio parts. Then, I discovered *Allied Radio* and *Popular Electronics* magazines which opened the door to ordering parts by mail!

I took up near residence at two local TV repair shops who indulged me and would sell me components and answer my endless childish questions. There was also an amazingly patient High School Physics teacher, Mr. Ken Baker, who shared his knowledge and electronic parts with me. A big "THANK YOU" to everyone who helped me to understand the process of capturing sound. Please check out Professor Coutant's incredible microphone photos at: www.coutant.org.

Ronald L Holmes, Clovis, California, 2018

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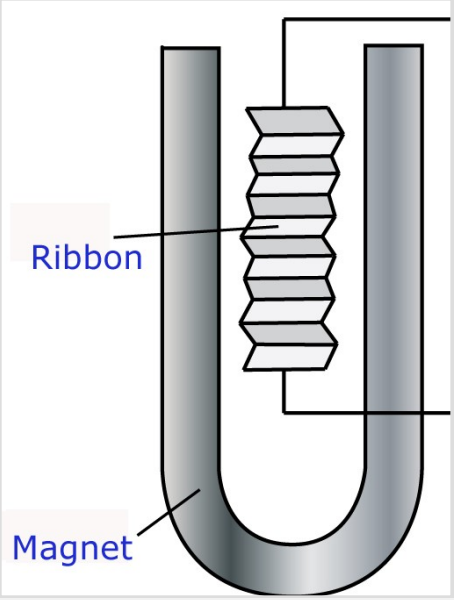
Ribbon Microphones (Velocity Microphones)

Ribbon mics are interesting because they are made from a small, thin piece of corrugated "duralumin" (a special alloy of aluminum) suspended between poles of two strong permanent magnets. The very thin strip of Duralumin is "cranked" through a corrugating machine to form tiny pleats. The foil strip is suspended on both ends centered inside the magnet's field.

What's so special about them is the alloy they are made from. It is mostly aluminum, but also manganese, copper, and magnesium. This alloy was first used in *The Graf Zeppelins* in the 20s-30s. It was strong and light. The term is now obsolete but you will see it in microphone books-because that's the history. Now it's mainly aluminum and copper.

The shops that specialize in ribbon microphone repairs actually roll-pleat new strips of duralumin and remount within the magnetic structure. The ribbon gets stretched out and deformed over time and misaligns in the magnetic field. So it must be replaced with a new one. They make small hand-cranked machines that roll the duramin straight to create the pleats.



Here is a diagram to show the placement of the magnet and the ribbon.

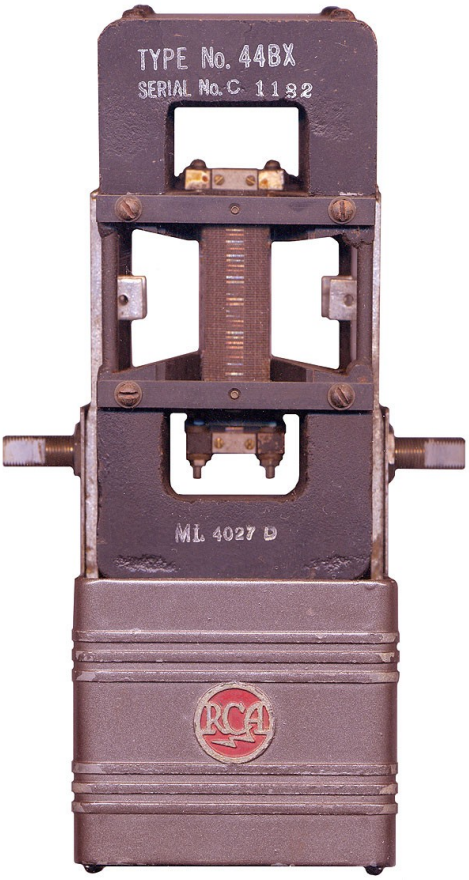
A small signal is generated when the foil strip vibrates back and forth within the magnetic field. The foil strip is pleated to lower resonance issues from vibrations. The foil strip lies flat as it is suspended. The signal is very sensitive to air movement and subtleties in sound movement from music, voice, etc.

Ribbon mics cannot be used out of doors due to wind movement. Radio disk jockeys like the RCA 77 DX ribbon microphone because of it's "proximity effect". When they get close to microphone, it exaggerates the "big bottom end" they like so much. The Mr. Radio voice! Shown below page is the RCA 77DX.

Here is the RCA 77 DX. It's one of the most identifiable "radio microphones" in studio use. These mics are expensive and durable as long they are used indoors. If they are used outside, the duralumin corrodes from the moisture.

Since the only AC resistance is the duralumin strip, the output impedance (and signal voltage) are very low. Most ribbon microphones use an internal transformer to boost the output impedance (opposition to an alternating current similar to DC resistance) to a higher level. This also "steps up" or increases the output signal voltage. Since the signal output is so low, noise shielding is critical. The preamp this mic plugs into also must have noise shielding. These microphones need a really high-gain AND low noise preamplifier to make their output usable.

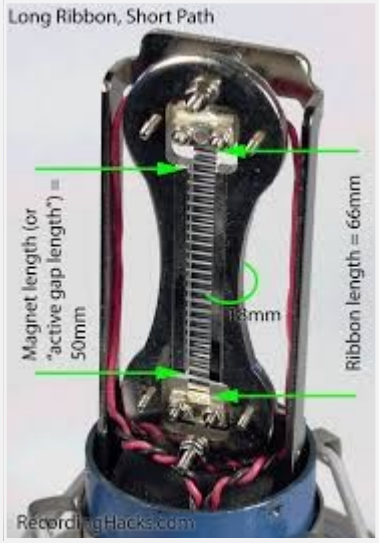
Shown right below is a classic vintage RCA ribbon or velocity microphone. This is a RCA 44 BX bidirectional microphone - another favorite of disk jockeys and interviewers. It can pickup sounds from both sides so it can be used to interview two people sitting at a table at same time. It is also extensively used in recording studios as it has a fine performance. These photos courtesy Coutant.org. You can visit this premier microphone website at: http://www.coutant.org. It is a virtual encyclopedia of the finest microphones with gorgeous photos.



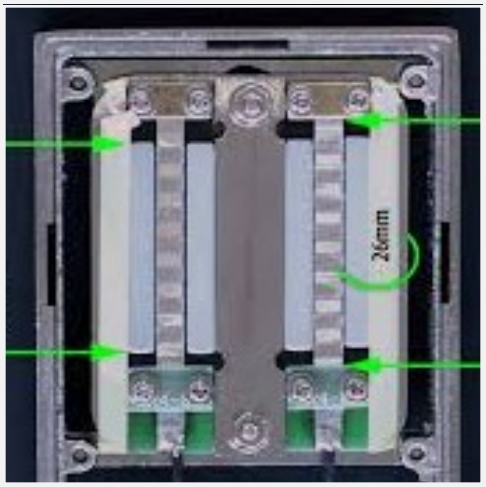
The 44 BX is about 8" tall. Here, you can see how small the ribbon pickup element is. Notice how the pickup element is surrounded by a large permanent magnet structure. These magnet structures are sensitive to any air currents moving enough to shake the light ribbon. The case has to be tight to prevent hum and noise as the output voltage is very tiny.

Shown here are two ribbon microphone pickup "motors" or elements. In both cases you can see the thin foil suspended within a strong magnetic field. The entire mechanical structure has to be free of any resonating or loose mechanical parts. Usually it is mounted on an internal shock-mounting system to decouple any floor, stand, or case vibrations.

Any repair work on these microphones has to be done by a specialist. Sometimes the thin foil gets stretched or deformed and has to be replaced. It must lie flat within the magnetic field for optimum performance quality. Do not try to repair these unless you know what you are doing!

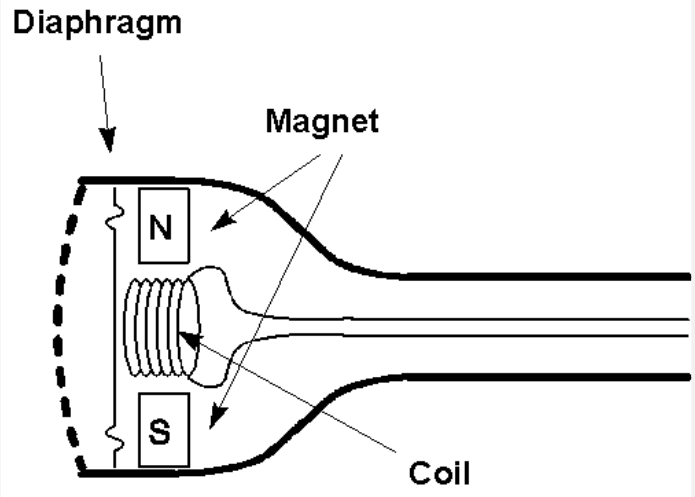


Right is a photo of a dual-ribbon design. These ribbons of foil are very small. You can see them suspended on ends and surrounded by permanent magnets.



DYNAMIC MICROPHONES

Dynamic microphones are workhorse microphones you usually see on stage and television. They are constructed like a miniature speaker. Facing sound entrance end is a thin plastic diaphragm with a coil of small copper wire wound on thin bobbin and attached to a rear surface of the diaphragm. The coil rides in a circular channel surrounded by a permanent magnet. It is made similarly to the way a speaker is constructed. See directly below.



Right is a high quality Sennheiser dynamic microphone. Shown in the inset photo is the diaphragm with the attached coil and bobbin structure. The diaphragm is made of pleated plastic film like Mylar .

This is a dynamic Sennheiser MD835 - mic. (above) The ribbony thing (Right) is the voice coil and diaphragm from a dynamic mic - macro shot - to show the wire coil. It's about a 1/10 human hair thickness,

Shown here are three popular dynamic microphones manufactured by Shure Co. Shown above are the dynamic microphone, element and matching transformer to a popular a hand -held microphone known as SM 58. Above right is the little transformer that steps up the 10 ohm (or so) capsule impedance to 150 ohms. 150 ohms is the typical input impedance of PA systems and recording devices. These mics are rugged and work for decades with a little care.

The SM 58 microphones have become pretty much the standard microphone for hand-held use. They have a single diaphragm and are uni-directional. There is an omni-directional version that picks up sound for full 360 degrees.

Left is the ever-popular Shure Company model 55. This is the “Unidyne II” which had a single diaphragm element. It became known as the classic “Elvis Mic”. The Unidyne II design created a directional pickup pattern from the front with side and rear rejection. By adding acoustic delays using internal ports, a single diaphragm microphone could be made highly directional so as to reject side sounds that often create feedback.

The popular Shure Company 545 Unidyne III hand-held dynamic microphone. It is a directional microphone and quite sturdy.

Below is an Electro-Voice model 664. I owned two and they are beautiful microphones (and quite heavy). They tend to be "dark" sounding microphones, rather than "bright" sounding. I ended up giving mine to the guitar player and friend Ronnie Montrose. He liked the way they looked!

Above is the Electro-Voice 636 hand microphone commonly used as a broadcasting reporter's microphone. Many radio and television stations keep many in inventory. They are very durable microphones. As a broadcast engineer, I found they rarely needed to be repaired. They were most commonly used to record news segments.