EARLY MICROPHONE HISTORY

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THE TELEPHONE ERA

The word "microphone" comes from the Greek words "micro," meaning "small," and "phone" meaning "sound." It first appeared in a dictionary in 1683 as "an instrument by which small sounds are intensified." This was in reference to acoustical hearing devices such as the ear trumpets and megaphones of that era.

Microphones as we know them started with the first articulate telephone transmitter, developed almost simultaneously by Elisha Gray and Alexander Graham Bell. This was the liquid transmitter of 1876 (Fig. 1). This transmitter would be classified as a variable-resistance device. Its operation was as follows: the user talked into the black funnel-shaped mouthpiece, at the base of which is a stretched membrane diaphragm. A metal pin through the center of the diaphragm extends down into the metal cup below. The cup contains a dilute acid. An ohmmeter between the cup and the pin will show a fixed resistance. Any movement of the diaphragm will move the pin up and down in the liquid and the resistance will vary accordingly. If wires from the pin and cup were connected in series with a battery and telephone receiver, any talk directed into the mouthpiece would produce articulate speech in the receiver.

Mr. Bell did not want to use battery power with his telephone system, so he tried to get around this obstacle. His first leased telephone system in 1877 used two of his box telephones (Fig. 2) with only wire: no battery. These sets, referred to as magneto transmitters, were actually telephone receivers. As receivers they worked well, but as transmitters their signal output was too weak to carry any great distance. Two of these box telephones, with three miles of wire between them, required the user to shout in order to be heard. What was heard on the receiving unit was very feeble. So one can imagine how inconvenient this system was to use: first to shout into the mouthpiece, then to listen intently at the mouthpiece for the called party's weak reply. Bell and his associates came to the conclusion that the transmitter would have to be improved, which would then upgrade the whole system.

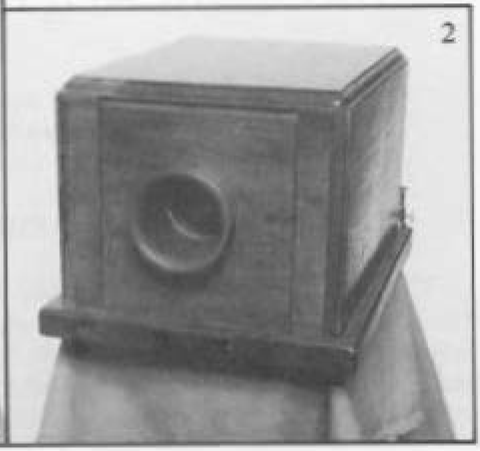


Fig. 1. Bell's Liquid Transmitter.

Fig. 2. Bell's First Magneto Telephone.

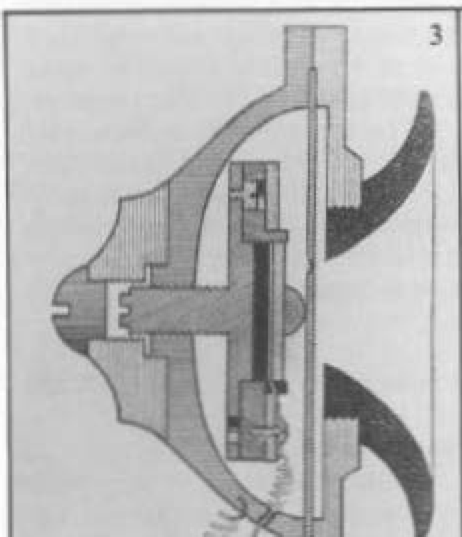


Fig. 3. Edison's Lampblack Transmitter.

Fig. 4. Blake's Carbon-Block Transmitter with Desk Stand.

Western Union entered the telephone business late in 1877. Now, with two companies trying to develop a better transmitter, other experimenters began to appear and offer their devices. Emile Berliner with his loose-contact metal-to-metal transmitter, Edison with his many forms of carbon transmitters and an electrostatic (condenser) design, Hughes' carbon rods, Blake's carbon block, and Hunnings' carbon-granule type were a few of the new names and devices to appear. Both Berliner and Hughes used the term "microphone" to describe their transmitters. This was due to the high sensitivity of both of their devices compared to the others. However, added sensitivity in these units resulted in more erratic behavior and reduced dependability.

After the magneto type, the next improved transmitter to be put into use was Edison's lampblack carbon unit (Fig. 3), another variable-resistance design. This transmitter was used in the Western Union system. It outperformed the Bell magneto transmitter. Not to be outdone, Bell purchased the Blake transmitter (Fig. 4) in 1878. It was troublesome at first but with Berliner's help it was made more sensitive and reliable, needing adjustment only occasionally. The Blake was used up into the early 1880s.

The next important step in transmitter design was by Henry Hunnings of England. He used granules of coke between the diaphragm and a metal backplate. This design (Fig. 5) originated in 1878 and was patented in 1879. This transmitter was very efficient and could carry more current than its competitors. Its one drawback was that it had a tendency to "pack" and lose its sensitivity.

In 1886 Edison improved this type of transmitter by designing a small button-type container and using processed anthracite granules. In 1892 A. C. White improved upon this button by using a polished carbon block as a rear plate and a similar block in front against a mica disc, with the carbon granules in between. Due to the flexibility of the mica disc, it worked like a piston. This button, mounted firmly in the transmitter housing, gave the industry its first 100% reliable transmitter. Known as the White "solid-back" type (Fig. 6), it was used from 1892 until about 1925.

PRE-BROADCAST ERA

At this point I should mention that wireless telegraphy had been invented in 1895. By 1900 experimenters were trying to modulate wireless (radio) waves so that speech could be sent on them. This, then, could be another job for the transmitter (microphone) in addition to telephony. The telephone transmitter was the only available microphone in 1900. Consequently, it was used in early radio modulation experiments. Keep in mind that there were no amplifying circuits in those early years, so the microphone was connected into the antenna

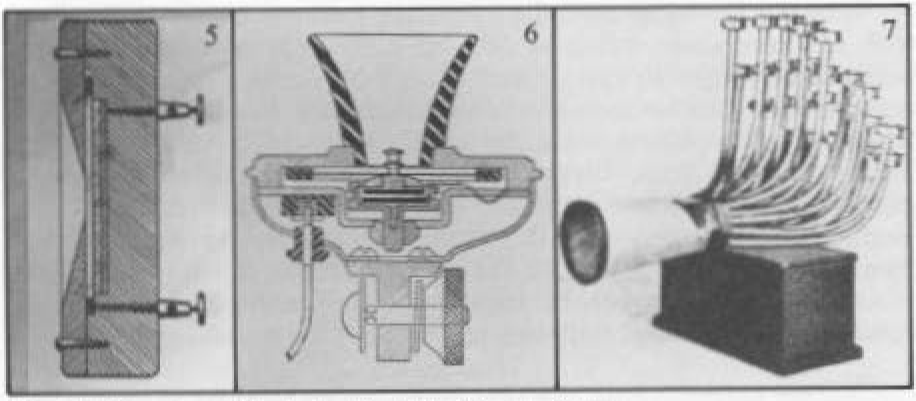


Fig. 5. Hunnings' Carbon-Granule Transmitter.
Fig. 6. White Solid-Back Transmitter.
Fig. 7. Lorenz Multiple Microphone.

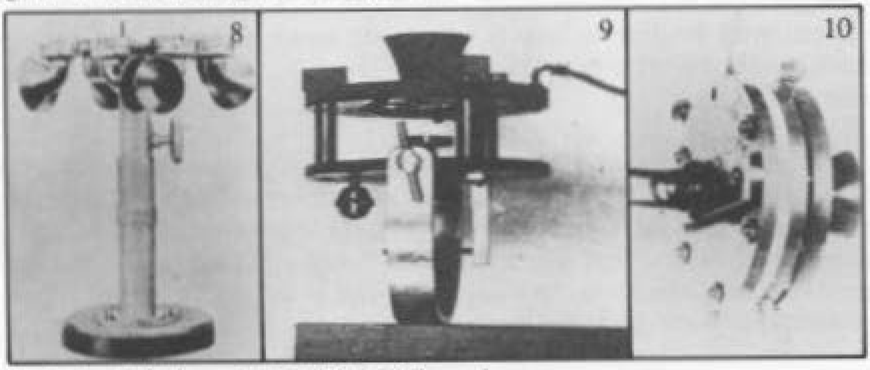


Fig. 8. Lt. Ditchman's Multiple Microphones.
Fig. 9. Fessenden's Condenser Microphone.
Fig. 10. Fessenden's Trough Transmitter.

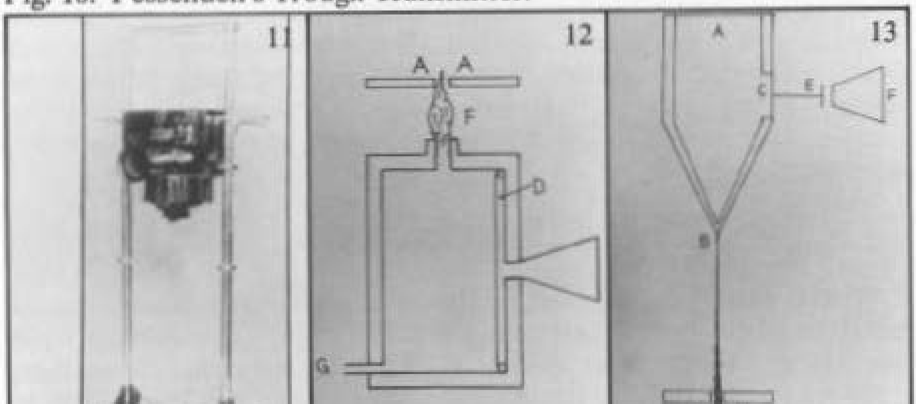


Fig. 11. J. Berliner's Heavy-Current Microphone.
Fig. 12. Blondell's "Flame Controller."
Fig. 13. Majoranna's "Hydraulic Microphone."

and had to carry the full current produced in that circuit. Since telephone transmitters could handle a maximum of only about one-half ampere, only very low-power radio transmitters could use this form of microphone. As radio power was increased, new forms of microphones had to be developed.

One of the first alternatives was to use multiple microphones with a common mouthpiece (Fig. 7). Another approach was that of Lt. Ditchman: to mount four sets of dual microphones on a stand (Fig. 8) and rotate them into the circuit at short intervals to avoid overheating. Multiple microphones had their various problems, one of which was that a short circuit in one microphone would render the whole group inoperative. This was solved in a patented circuit by Rudolph Goldschmidt, "Means for Working Microphones in Parallel."

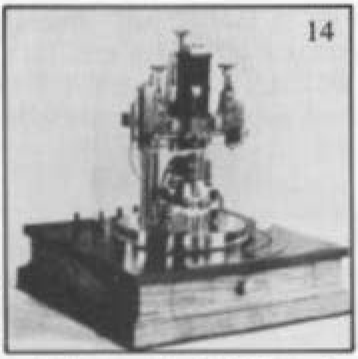
Back in 1879 and 1881, Edison and Dolbear had introduced condenser transmitters. They were not practical at the time for telephone use, but now, with the search for high-power microphones, they were reintroduced.

As early as the spring of 1900, Fessenden had transmitted and received intelligible speech at a distance of one mile. By 1906 he had built a high-power radio transmitter and two microphones to match. These microphones could handle up to 15 amperes of current without burning up. One was a condenser type (Fig. 9); the other was a water-cooled carbon- granule type he called his "trough transmitter" (Fig. 10).

European wireless experimenters came up with a varied lot of high-power microphones between 1900 and 1915. J. Berliner (Telephone Mfg. Co. of Vienna) made a high-current carbon microphone that was air cooled by a fan mounted under the microphone, and an adjustable stand to go with it (Fig. 11). Anyone familiar with the inherent noise of an early carbon microphone can imagine what the signal-to-noise ratio was with this microphone, plus the added sounds of the motor and the rushing air.

Blondell and Chambers had developed flame microphones in 1902 and 1910. Blondell's "flame controller" (Fig. 12) worked as follows: A and A are spark rods in an oscillating circuit adjusted just short of sparking. Flame F is adjusted to reach up to the gap. By speaking into mouthpiece M, diaphragm D vibrates and alters the pressure of the gas supply, causing the flame to change its length. As the flame varies its entrance into the gap, the resistance between the gap points varies, and sparking occurs in response to its movements.

Majoranna, Chambers, Vanni and Sykes had developed "liquid" or "hydraulic" microphones in 1906, 1910, 1912 and 1914 respectively. Majoranna's microphone (Fig. 13) worked as follows: A is the reser-



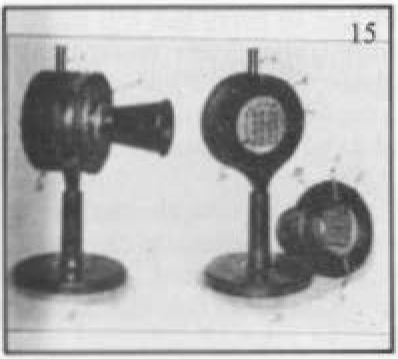


Fig. 14. Fessenden's "Microphone Relay."

Fig. 15. C. Egner and J. G. Holmstrom's High-Current Microphone.

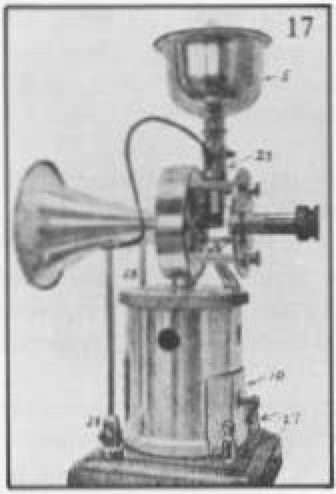


Fig. 16. Alexanderson's Magnetic Modulator.

Fig. 17. G. B. Marzi's Carbon-Powder Microphone.

voir that holds the conducting liquid that flows down and out of B in a very fine stream. C is an elastic diaphragm driven by a metal diaphragm E behind mouthpiece F. About five feet from the reservoir the stream breaks into droplets. A set of contacts H is located at this point. Sound variations on the diaphragm vary the pressure of the stream. Consequently, the thickness of the stream at the contacts varies, producing a variable resistance in proportion to the sound on the diaphragm. Using a voltage of 65 volts at 12 amperes gives us 780 watts: a one-horsepower microphone! It is appropriate to point out one serious problem with this design. If someone would open or close the door to the room where the microphone was being used, it would create an air disturbance that would move the stream out of the gap momentarily, thus interrupting transmission.

Fessenden and Dubilier developed heavy-current microphone relays in 1906 and 1911 respectively. A differential magnetic relay was operated by a telephone. It, in turn, operated a heavy-duty carbon transmitter in the antenna circuit. These devices were capable of handling up to 15 amperes of antenna current. Figure 14 shows the Fessenden relay. Tucker and Koepsel experimented with "hot wire" microphones around 1907 but developed only specialized "large gun" detectors.

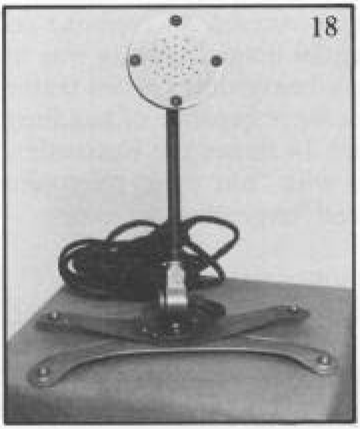
One of the better high-current microphones was developed by C. Egner and J. G. Holmstrom of Stockholm in 1906. This microphone (Fig. 15) was water-cooled and consisted of 16 separate carbon units. By connecting the carbon units in different series and parallel combinations, various voltages and currents could be handled, from 10 volts at 20 amperes to 30 volts at 10 amperes.

In 1911 Alexanderson designed a special transformer he called a "magnetic modulator" (Fig. 16) for use with his RF alternator. This unit could handle up to 75 kilowatts. General Electric made three smaller versions of this unit with model numbers UT-1643 (.5 to 1.5 amperes), UT-1357 (1.5 to 3.5 A) and UT-1367 (3.5 to 5 A). These were for the radio amateur using five- to 100-watt transmitters.

One other high-current microphone worth mentioning is one developed by G. B. Marzi of Cornigliano, Italy (Fig. 17). The patent defines it as a "microphone with carbon powder fall for strong currents." As the patent description implies, it is another variable-resistance device using very fine carbon grains. The cup-shaped reservoir at the top holds the carbon grains that flow through a set of contacts, one of which is controlled by the diaphragm. A cup in the base of the unit catches the used grains. When this cup is full, the user must stop talking, remove the cup, transfer the contents to the upper reservoir, replace the cup, and then continue the message.

WORLD WAR I MICROPHONES

Lee de Forest invented the Audion in 1906, received his patent in 1907, and introduced it to AT&T engineers in 1912. The Bell System, looking to replace its mechanical repeaters with new technology, improved the vacuum tube and developed circuitry not only for repeaters but also amplifiers and radio. World War I created immediate demands for improved communications. Vacuum tubes not only helped meet these demands, but also put the microphone back into a simple circuit that no longer required bulky, complex, high-current designs. Standard telephone transmitters could be used again, regardless of the radio transmitter power. World War I microphones were telephone transmitters adapted for use with the new tube-type equipment.



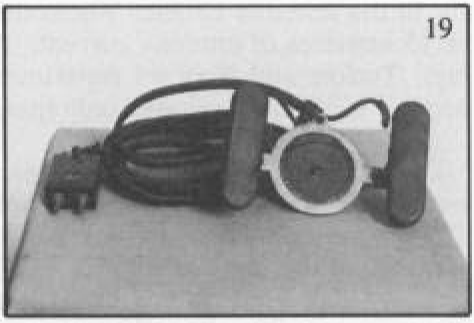


Fig. 18. WE D-14298 (T-1).

Fig. 19. Magnavox Noise-Canceling Microphone.

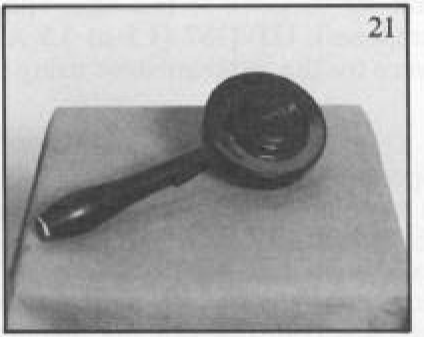
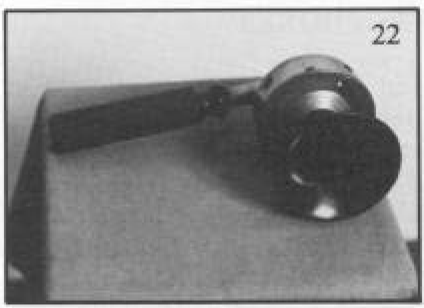


Fig. 20. WE T-12.

Fig. 21. Western Electric 318W with Push-to-Talk Switch.



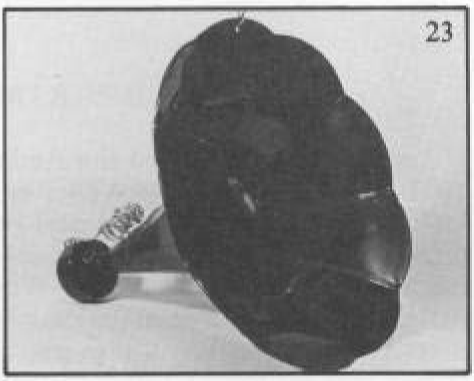


Fig. 22. Magnavox ST-4.

Fig. 23. WE 360BW Microphone with 4A Horn.

Western Electric developed specific microphones such as the D-14298 or T-1 (Fig. 18), to be used with their SCR-68 Army aircraft radio transmitter. They also supplied a slight variation of this microphone, the T-3, to General Electric. GE in turn used it with the CG-1104A radio transmitter set sold to the Navy. This was an early form of noise-cancelling or "close-talking" microphone. Western Electric used their No. 326 close-talking telephone transmitter in the CW-930 hand microphone and the CW-1053 bulkhead microphone. These were used with the CW-936 5-watt radio transmitter which they supplied to the Navy to use aboard submarine chasers.

The Magnavox Company produced a noise-cancelling microphone (Fig. 19) for the Navy to be used aboard its "mammoth NC planes." This same microphone was supplied to General Electric with a spray-shield cover. General Electric in turn supplied this microphone along with other equipment to the Navy. Western Electric provided the Army with other microphones for special purposes. A No. 337 telephone transmitter was mounted on a wooden handle for some field equipment. WE also produced a 273W hand microphone and a T-12 hand microphone (Fig. 20) using a 323BW transmitter, to list a few.

PUBLIC-ADDRESS APPLICATIONS

Around 1915, Western Electric supplied a very simple "loudspeaking outfit" under two names, "Shawphone" and "Chau-Phone." The Shawphone was used for very small paging applications, while the Chauphone was for chauffeur-driven cars. Both used the 318W hand microphone with a 182 horn and a six-volt battery. The microphones (Fig. 21) were available in dull black, nickel and polished brass.

After World War I, the radio industry grew by leaps and bounds. Radio amateurs were introducing the public to radio. Companies like Magnavox and Western Electric were introducing the populace to "public-address systems," or sound-reinforcement systems as we know them today.

Magnavox, a small company on the West Coast, had developed a good horn-type speaker and some small amplifiers. Their experience during the war with special microphones gave them the expertise to manufacture a telephone for noisy areas. They also produced a sound system called "Telemegaphone." This was a complete system consisting of a large 18-inch horn speaker, a control box, a six-tube amplifier, and a model ST-4 four-button carbon microphone (Fig. 22). This system, plus an additional horn, was used to broadcast President Woodrow Wilson's speech to 50,000 people assembled in the San Diego Stadium in 1919.

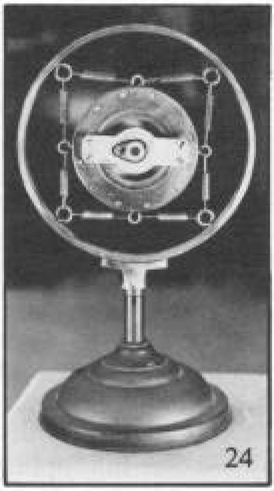


Fig. 24. WE 369 Double-Button Carbon.

Fig. 25. WE 370 Condenser Microphone.

Fig. 26. WE 323 Transmitter in Candlestick Telephone with Modified Switch and "Long-Distance" Mouthpiece.

Fig. 27. Birdcage Stand with Megaphone-Type Microphone.

Western Electric had been experimenting with "loudspeaking" systems since 1907 in response to requests for this type of equipment. In 1912, they developed a high-efficiency transmitter and horn-type speaker to be used between the test desk and the frame room of a telephone central office to expedite servicing. The microphone used evolved into the No. 360BW transmitter with a 4A horn attached (Fig. 23). A few other special public-address experiments were performed. One, in particular, used a water-cooled carbon microphone to transmit speech 120 miles over 12-gauge wire to loudspeakers addressing a group of 300 people. Three very large public-address setups by the Bell

System using Western Electric equipment were for the Victory Loan drive in New York in 1919, the ceremonies attending burial of the Unknown Soldier at Arlington National Cemetery in 1921, and the inauguration of President Harding in 1921. The first event used a new-type double-button carbon microphone numbered D-76577. The second activity used the same microphone, now identified as No. 369 (Fig. 24). The third event used the No. 370 condenser microphone (Fig. 25) that the Bell System was using in its acoustic research program.

BROADCAST ERA II

Radio amateurs in the late Teens were becoming entertainers. Some of the more experienced and knowledgeable amateurs were playing records and using microphones with their rigs. This made radio more popular, and the general public was looking for receivers to get in on this new phenomenon. So the year 1920 ushered in the commercial broadcast era. Since there were now advanced tube-type circuits, microphones reverted to the simple single-button carbon types that were plentiful in the telephone industry.

The early radio station used the candlestick telephone for a microphone. The typical transmitter element at this time was the Western Electric No. 323. At first it was used as-is, talking into it as one would use a telephone. With the receiver off-hook, the speaker was on the air. As time passed, the receiver was removed, along with the hook switch and contacts, leaving the microphone "on" at all times. In this case the volume and on-off function were controlled by the engineer. In some cases the hang-up arm was cut off, leaving a stub so the announcer could use it as a press-to-talk lever, or, with the contacts reversed, as a "cough" or pause switch. Also, in some applications the short mouthpiece was replaced with a brass megaphone six inches long (Fig. 26). This allowed the announcer or performer to work at greater distances from the microphone. The next step was to provide entertainers with a microphone that would allow them to stand and perform. For this application, the constructor took the transmitter off the candlestick telephone, replaced the short mouthpiece with the megaphone, slid this combination into a felt-lined bakelite sleeve about eight inches long, and put small eyebolts on each end to suspend it from above.

Next came microphone stands. The first ones were modified birdcage stands and wooden plant stands. The birdcage stand was modified to suspend microphones, while the plant stands were used with the candlestick and other desk-type housings like the Western Electric 1A. Also, some crude wood stands were made with counter-balanced boom arms. Some of them had a rod extending out at waist height to keep the performer a proper distance from the microphone (Fig. 27).

Some performers experienced "mike fright." They would have a tendency to freeze up when they approached the microphone, so attempts were made to disguise or hide it. This resulted in various types of microphone housings. RCA made a cloth-covered globe that was placed on a plant stand, with the microphone hidden inside. GE used a floor lamp and hid the microphone under the shade. The performer was told to sing by the lamp. Another problem with early singers, especially sopranos, was volume control. If the performer did not keep a good distance (about two feet) from the microphone, "blasting" would occur. This was, in reality, overloading the input circuitry and causing distortion. Some engineers worried about sopranos singing high notes that might shatter their tubes! Some singers were asked to sing an octave lower, which brought about the new form of singing called "crooning" which became very popular.

MICROPHONE MANUFACTURERS

In the early Twenties, three major companies were producing microphones: Westinghouse, Western Electric and General Electric. Westinghouse put radio station KDKA on the air in 1920; KYW, WBZ and WJZ in 1921. Because proper microphones were not available, Westinghouse began to custom-build them for this group of stations, continuing up to about 1927. After the candlestick-telephone period they began to work on higher quality units. They modified and used a "phonetron" cone-type speaker (Fig. 28) which was later dubbed the "dishpan" microphone. This was quite an improvement over the telephone transmitters since they all had a squeaky high-pitched sound, whereas the "phonetron" had bass and midrange which made it sound mellow in comparison. Their next generation of microphones were double-button carbons. The clamping rings were made of half-inch thick bakelite, the diaphragm was heavy paper with a strip of gold leaf on each side, and the bridges were light-weight brass with brass cups and felt washers. These microphones were put in felt-lined brass cylinders about three and one-half inches long and about four inches in diameter. The back was closed with a one-half inch thick piece of bakelite. The front was a brass end cap with a two and one-half inch opening covered with fine brass screen. Three binding posts were provided under the microphone for connections. All these units had tabs with holes for suspending them. Some units had wood bases with felt bottoms and the binding posts on the front of the wood base. Later a similar cylinder with a condenser element patterned after the Western Electric condenser was provided. Because of their appearance (Fig. 29), they picked up the nickname "tomato can."

In 1925 Westinghouse made a condenser microphone (Fig. 30) that was relatively portable. The old condenser element in the cylinder housing had to be within ten feet of a lowboy phonograph console that contained the preamplifiers and power supply. The new condenser was

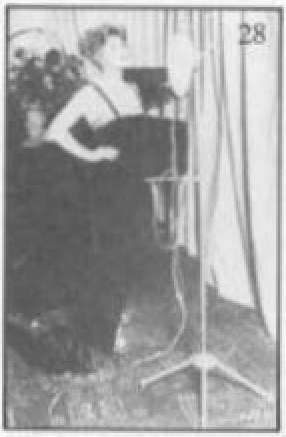


Fig. 28. Birdcage Stand with Modified Phonetron Speaker. Note "Distance" Rod on Stand.

Fig. 29. Westinghouse "Tomato Can" Microphone with Wood Base.

Fig. 30. Westinghouse 1925 Condenser Microphone.

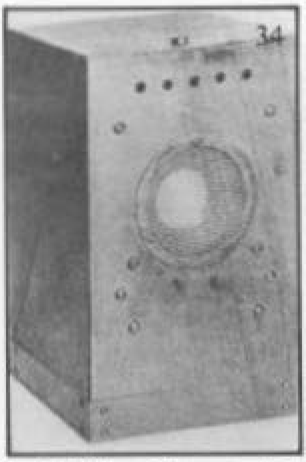
Fig. 31. Westinghouse Hushaphone.

built into a box that measured 10-1/2 inches high by 5-1/2 inches wide by 4 inches deep and had three compartments. The upper one contained the output transformer; the center compartment held the condenser element; and the bottom space was felt-lined and held the tube wrapped in felt. The tube was a non-microphonic PJ2 type with leads – no socket.

An unusual microphone produced by Westinghouse was the "Hushaphone" (Fig. 31). This was a microphone for noisy areas. The radio studio became busy at times with one or two people preparing for a program and the announcer trying, for example, to give the news. The announcer could talk into this microphone and it would not pick

Fig. 32. Westinghouse: Last Style of Double-Button Carbon.

Fig. 33. RCA Type 1 Double-Button Carbon.



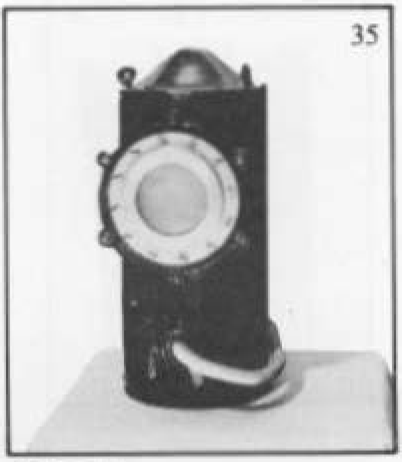


Fig. 34. GE Experimental Condenser Microphone.

Fig. 35. 1926 GE Bullet Microphone.

up anything in the background. However, the inside of the cylinder was lined with half-inch thick felt. After a short time of smokers' breath, liquor breath, and just plain bad breath, odors absorbed by the felt made this design unpopular.

The last of the Westinghouse microphones was a higher quality double-button carbon made of heavy brass with a stretched duralumin diaphragm (Fig. 32), much like the Western Electric units. Westinghouse had made a dynamic microphone in 1922, but because it required more preamplification and equalization than was deemed practical, it was never manufactured. They also produced a "glow discharge" design in 1923 that was considered the microphone of the future. It was written up in many of the trade magazines with very favorable reports. It used a 3000-volt DC power supply to give the "glow" at the microphone. I suspect that it appeared ominous to the users and, since it needed a special power supply and required regular adjustment, it too was deemed impractical.

General Electric made most of the microphones sold by RCA (along with other equipment) between 1919 and 1927. RCA during this period was basically a sales organization owned by GE, Westinghouse, AT&T, the United Fruit Company, and others. At first, GE microphones were used in GE's and RCA's radio stations. An early double-button carbon microphone was an exact copy of the Western Electric No. 369. The print on the bridge of this microphone (Fig. 33) read "Radio Corp. of America Type 1."

In 1925 GE made a condenser microphone that was mounted in a housing like the "tomato can," with a large-size coaxial cable 10 feet long that went to a preamplifier box on the floor. The B-batteries for this microphone were in another box on the floor, with a six-volt car battery to provide the filament voltage. The microphone was mounted on a heavy three-legged floor stand, making the whole setup rather cumbersome. Later, the microphone element and preamplifier were mounted in a rectangular box (Fig. 34) with a multi-conductor cable for power in and audio out.

In 1926 a "bullet" microphone was built with a removable top which allowed access to the 01A preamplifier tube. The microphone element protruded out the upper half of the cylinder, making it look more like a lantern than a microphone (Fig. 35). Other one-of-a-kind condenser microphones were built for specific jobs. These varied in size, shape, and tube complement. The bullet-type that GE produced in late 1927 became their standard condenser for a little over a year. The instruction book referred to it as the "RC" condenser, later called Model 3A. This microphone (Fig. 36) was almost identical to the 1926 "bullet" in appearance. In reality it was half again larger and had a three-tube, two-stage preamplifier under the hinged top. The tube complement was one 859 and two 199s.

The last of the GE condensers was the "box brownie" or 4A style. This unit was turned over to RCA in early 1928. Les Anderson and Harry Olson reworked the preamplifier, and RCA began building them in 1929 in their new Victor plant. It became available as the Model 4A condenser microphone. If purchased with the "announce" or desk stand, the model number was 4AA. If bought with the floor stand, it was the model 4AP (Fig. 37).

Western Electric was the leader in microphone engineering and development. As a subsidiary of the American Telephone and Telegraph

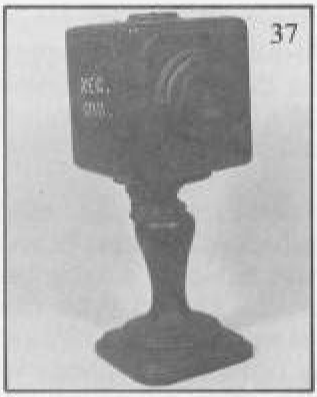


Fig. 36. GE Bullet Condenser, RC or 3A.

Fig. 37. RCA 4AA Condenser Microphone.

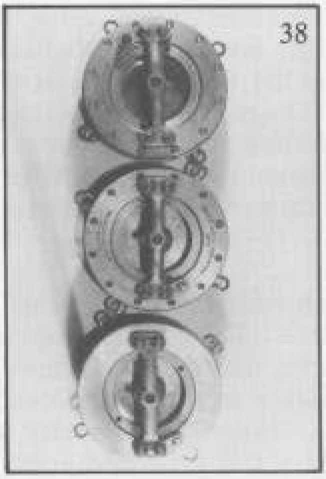


Fig. 38. WE Nos. 373W, 387W, and 600A.

Fig. 39. WE No. 371.

Company since 1882, having made telephones as early as 1878 for Western Union, WE was well qualified. Through these early years they made a wide variety of transmitter-microphones. After the 369-type double-button carbon, they made three more similar models for the broadcast industry: Nos. 373, 387 and 600A (Fig. 38). They also made two desk models for general use such as announcing, paging, and dispatching. These were the 371 and 389 (Fig. 39).

In 1922 when AT&T put WBAY and WEAF on the air, it was trying to use the latest technology in all areas. This resulted in the trial use of their condenser microphone for broadcasting. This experimental model was quite large. The microphone element was mounted in the

1A bronze housing, which sat atop a wooden plant stand. A short coaxial cable connected to a floor-standing Victrola cabinet, which housed the preamplifiers and batteries (Fig. 40). It was interesting to note the station engineer's log of August 10, 1922: "First use of condenser transmitter. Have been using carbon microphone up to now." August 16: "First broadcasting over WEAF, W. E. Co. West St. Tried condenser transmitter but it failed almost immediately. Resumed on carbon mic. Programs from WBAY studio." August 17: "WEAF has trouble. WBAY starts up again. 360 m. Condenser transmitter. Sign off with statement that WEAF is being used instead of WBAY." August 18: "Condenser mic. sounds 'wheezy.' Change to carbon." August 23rd: "Condenser transmitter working fine. Sing [oscillation] eliminated." September 14th: "Condenser microphone 'drips' — Intermittent clicks. We sign off for WJZ time signals." September 21st: "Condenser transmitter in trouble. Blew it out with hot air. WEAF still using WBAY studios."

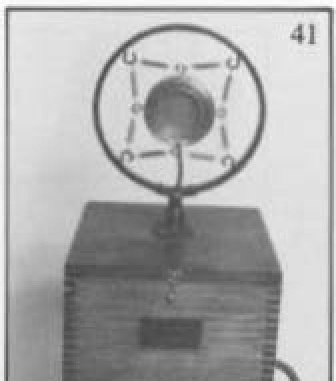


Fig. 40. First WE Condenser Microphone and Amplifier.

Fig. 41. WE D-70837 Condenser Microphone and D-80513 Amplifier.

In 1925 a more compact version of this microphone was produced and sold in some quantity. This was the D-80513 amplifier with the microphone element mounted on top in the 1A housing, or spring suspension ring (Fig. 41). The amplifier box measured 8-1/4 inches square by 5-1/4 inches high. It was lined with sheet metal for shielding and contained a one-tube preamplifier. A six-conductor cable brought power in and audio out. The microphone element was the new D-79897, later to be given the number 394. In 1928, five styles of condenser microphones were introduced, using the 394 condenser element. The 47A and 53A were cylindrical types (Fig. 42). The 47A was a one-tube (239A) unit, while the 53A used two tubes. The 7A and 9A were desk types that looked like mantel clocks. The 7A was "artistic dull black" and the 9A was "statuary bronze" (Fig. 43). The 8A and 10A were matching floor-standing units in dull black and statuary bronze.

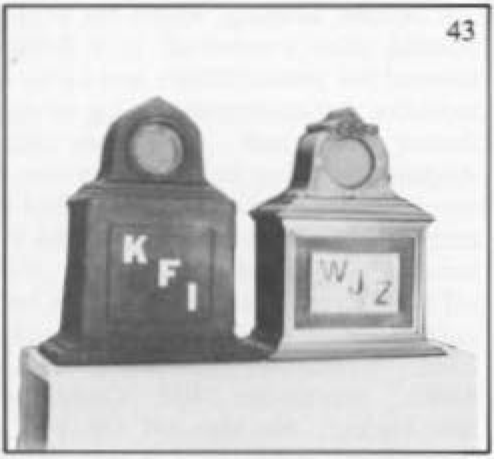


Fig. 42. WE 394 Condenser Microphone and 47A Amplifier.

Fig. 43. WE 7A and 9A Condenser Microphones.

Fig. 44. RCA PB17 Ribbon Microphone.

Fig. 45. RCA 44A Ribbon Microphone.

By 1931 Westinghouse and GE were out of the microphone business, leaving Western Electric and RCA. RCA had been manufacturing the 4A condenser microphone since 1929 and was now introducing the ribbon velocity microphone. Western Electric came out with the 618A dynamic, and Brush introduced the crystal microphone. Electro-Voice entered the market in 1927, custom-building double-button carbon microphones. Microphones were not generally available to radio amateurs, bands, or the general public, so small companies like Electro-Voice were beginning to appear all over the country to satisfy the demand. In the 1930s there were over 50 microphone companies in the U.S.A. For this article I will continue only with RCA and WE, who were supplying the microphones for the broadcast and movie industries.

The first microphone RCA made for the movie industry was the PB17. The housing for this mic was the same as some of the one-of-a-kind GE condenser types. It was a sandblasted aluminum cylinder 17 inches long and 6 inches in diameter. The bottom was rounded, with a yoke to hold the ribbon element, which had a protective perforated screen. The magnetic structure used an electromagnet requiring six volts at one ampere. The cylinder housed a three-tube preamplifier using 864s (Fig. 44).

The first RCA broadcast ribbon (Fig. 45) was the 44A. Early units used electromagnets; later production used three horseshoe permanent magnets. The 44A was finished in antique bronze. The 44B came out in the late 1930s, finished in black and chrome. In the late 1940s the 44BX was changed in color for television to avoid light glare. RCA called the new colors "TV" or "umber" grey and satin chrome. The gray was actually more of a dark beige, while the screens were natural aluminum.

Until ribbon types came on the scene, microphones were omnidirectional in their pickup patterns. This means they picked up sound from all directions, and were pressure-operated devices. However, most nominally omnidirectional microphones became relatively directional at higher frequencies. The ribbon microphones were bidirectional. They picked up sounds equally from front and rear, but little from the sides, top or bottom. This was referred to as a figure-eight pattern. Ribbons are velocity or pressure-gradient types, meaning that the signal voltage is proportional to particle velocity.

In 1936 RCA introduced the 77A ribbon microphone (Fig. 46). This was the first unidirectional type. This microphone used two ribbons. One operated as a velocity and the other as a pressure type. Since the phase relationships of the two are different, the resulting pickup pattern becomes cardioid or heart-shaped. The lower part of this microphone consists of a stack of grooved discs with lambs's wool in the grooves. The purpose of this design is to absorb the pressure behind the pressure ribbon.

A more steamlined version of this microphone was supplied to the movie industry, as the MI-3043 or KU2A "skunk mic" (Fig. 47). The nickname "skunk" came from the colors: all black with a wide white stripe down one side of the screen for directing it. The RCA 77B was a smaller, more streamlined version of the 77A. The 77C (Fig. 48) looked identical to the "B" except for a ring-type switch on the lower part of the microphone. This was for selecting the velocity ribbon (figure-eight pattern); the pressure ribbon (omni pattern); or the com-

Fig. 46. RCA 77A.
Fig. 47. RCA MI-3043 "Skunk."

Fig. 48. RCA 77C.
Fig. 49. RCA 74B.

Fig. 50. RCA 50A Inductor Microphone.
Fig. 51. RCA 88A Dynamic.

Fig. 52. WE 630A with Directional Baffle.

Fig. 53. WE 633A "Salt Shaker" Dynamic and 8B Transmitter Attachment (Baffle).

bination of two (cardioid pattern). Later technical and color changes resulted in the 77D and 77DX. Physical appearance stayed the same.

RCA produced other microphones during this period. The 74A and 74B were small versions of the 44-type. Weightwise they were 2-1/2 pounds, compared to the 8-1/2 pound 44s. These were for less demanding applications, such as remote broadcasts. The 74A had a simple yoke and the finish was brown wrinkle. The 74B was first black and chrome, then umber gray and aluminum, with a swivel mount replacing the yoke (Fig 49). To compete with the Western Electric 618A, RCA produced the 50A (Fig. 50). This was called an inductor microphone. In reality it was a pressure type. Later came the 88A (Fig. 51), which was a moving-coil or dynamic type. A "bantam" velocity microphone, the KB-2C was introduced as a desk microphone for general announcing. This covers the RCA broadcast type microphones up to about 1950.

Western Electric followed their 618A with the 630A "eight-ball" (Fig. 52). Then came the 632C, a close-talk announce mic, and the 633A "salt shaker" (Fig. 53). In 1937 WE introduced the D-99098 tubular directional element, which converted the 618A omnidirectional unit into a "shotgun" or "rifle" microphone. This design (Fig. 54) was used for long-distance pickups. In 1938 ERPI (Electrical Research Products, Inc.), a division of Western Electric working with the movie industry, produced a small condenser microphone. This was given the number D-99848. It used a new condenser element with the model number 640A. It looked like a large bullet, and had a black wrinkle finish.

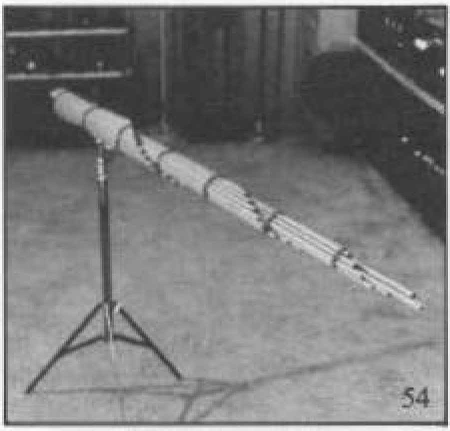


Fig. 54. WE 618A with D-99098 Directional Element.

Fig. 55. WE 639A.

Fig. 56. WE RA1142.

Fig. 57. WE 640AA Condenser Microphone and RA-1095 Amplifier.

In 1939 WE introduced the 639A microphone. This was nicknamed the "bird cage." It was a rather large unit because it contained a ribbon and a dynamic element. It had a three-position switch which selected the ribbon (bidirectional), the dynamic element (omnidirectional), or a combination of the two (unidirectional). The later 639B (Fig. 55) contained a six-position switch which allowed variations of these three patterns. ERPI supplied this same microphone in a different housing for the movie industry under the model number RA1142 (Fig. 56). This housing was larger and made of perforated metal with a bail for boom use. The last Western Electric broadcast microphone was the 640AA (Fig. 57) with the RA1095 amplifier. It looked very much like the 1938 movie condenser except for a chrome finish. This microphone was introduced in 1946 and aimed at the FM broadcast market.

Both RCA and Western Electric made a variety of other microphones for non-broadcast use. WE sold its microphone and loudspeaker line to Altec in 1949. Altec continued to make the 632C, 633A, 639A, and 639B for a while and introduced its own condenser microphone, the M11 system, in 1949. RCA continued to make microphones up into the 1970s but eventually phased out of this business.

There were other early companies that made broadcast microphones on a small scale, usually condenser types. A short list would be Brush, Bud, Carrier, Collins, Gates, Jenkins and Adair, and Remler. Most of the companies that started around 1930 produced broadcast microphones, but were unable to penetrate the broadcast market at that time.

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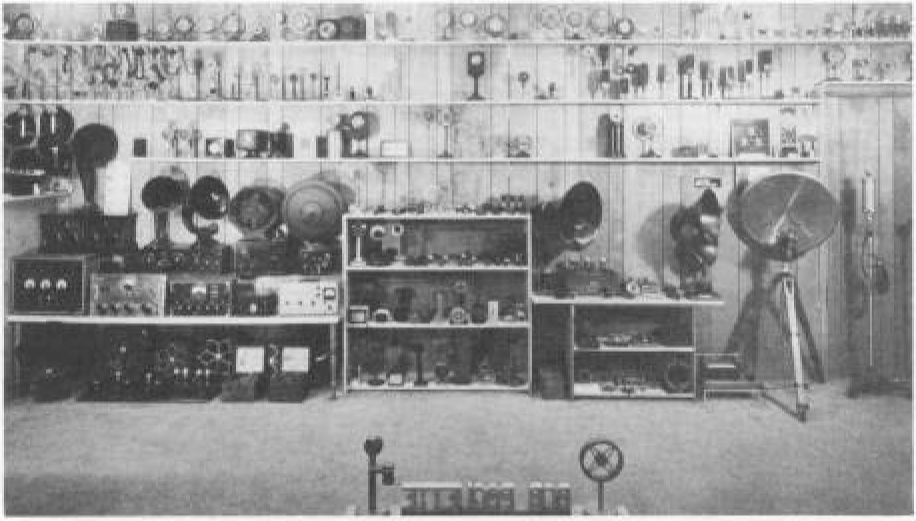
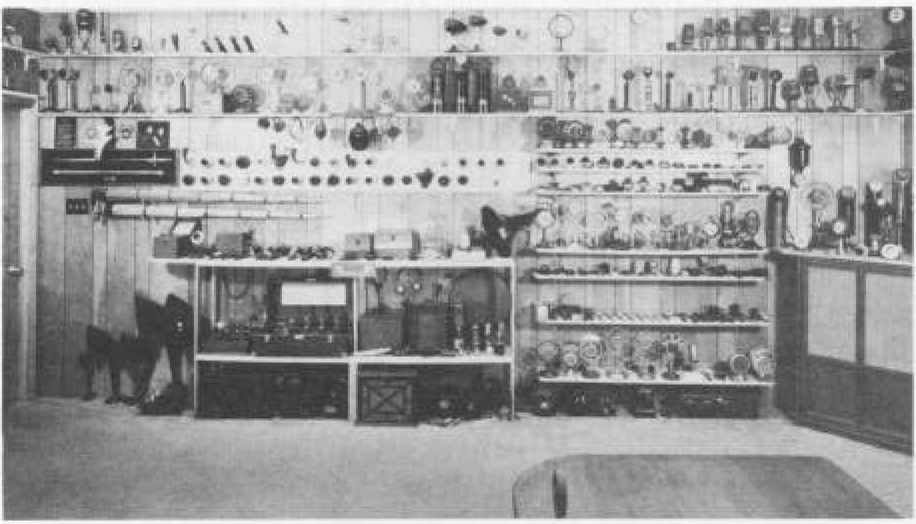
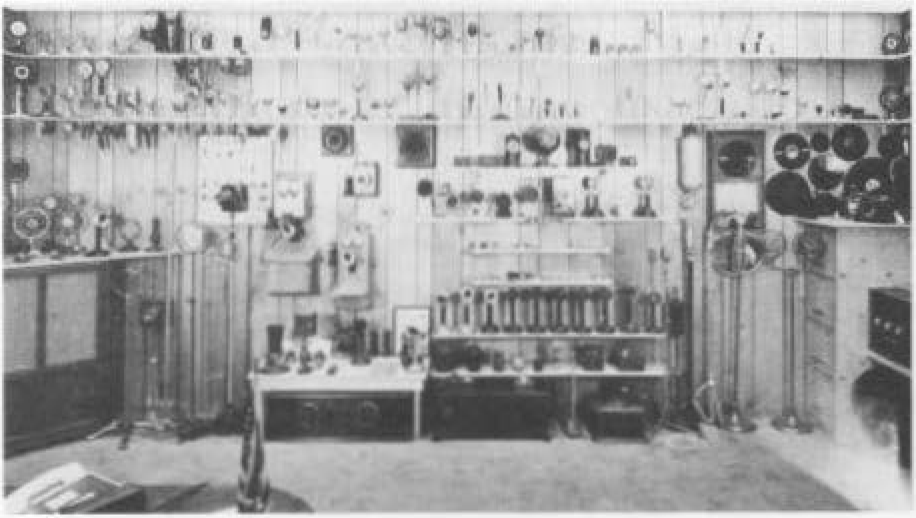


Bob Paquette's Microphone Museum is a private collection started in 1950 and displayed since 1970. It is the result of a continuing research into the history and evolution of the microphone. The museum contains over 800 different makes and models of microphones, the majority of which are pre-1950. Many items associated with microphones and their use are also displayed. This includes many types of desk and floor stands, microphone enclosures, transformers, preamplifiers, amplifiers and test equipment. On file is a collection of specification sheets, patent copies, catalogs, advertising literature, technical papers and copies of articles that appeared in early books, magazines, and technical periodicals. Three displays are set up to show the service and rebuilding process of the early carbon and condenser microphones along with the



special apparatus used. Since the microphone evolved from the telephone, a variety of telephone transmitters are on display along with a few early telephones. To make the museum more interesting, early radios, crystal sets, headsets, horns, speakers, tubes, radio parts, keys, sounders, test equipment, phonographs and a library of early wireless and radio are also included.

The Microphone Museum trades for unique units. Since the museum is a permanent collection, none of the units are for sale. The museum is open to the public by calling (414) 645-1600 — SELECT SOUND SERVICE, INC., 107 E. National Ave., Milwaukee, Wisconsin 53204.



Bob Paquette

Bob Paquette, born 18 December 1929 in Milwaukee, Wisconsin, became interested in radio at age 10: did telegraph and crystal-radio projects for extra credit in primary school. Built many simple radios and amplifiers during high-school years. Quit school at age 16 in 1947 and went to work for a commercial sound contractor building and testing radios, amplifiers and phonographs. Enlisted in U. S. Army Air Corps in 1948. Taught basic electricity in Armament School, and a five-week electronics course for remote-control turret school, at Lowry Air Force Base. Took various radio and math courses through U. S. Armed Forces Institute while in the Air Force. Received honorable discharge in 1950. Worked for commercial sound contractors from 1950 to 1958. Took audio-engineering correspondence course in the 1950s. Started his own commercial sound company, "Select Sound Service," in 1958 and still operates it. Has been collecting microphones and related information since 1950. Has given numerous talks on the history and evolution of the microphone to amateur clubs, broadcast groups, acoustical groups, antique radio clubs, schools, Scouts, etc. Has written numerous articles on the subject.