

When the President catapulted loudspeakers to market in 1919 - 100 Years ago

By Birger Schneider

September 19, 2019, we can celebrate the 100 years anniversary for how the loudspeaker overnight changed from a falling star of curiosity to become an essential, and today dominant factor of modern life, communication and entertainment.

What if the loudspeaker had never surfaced? A loudspeaker-less world would be a true nightmare to society of today. No radio, no TV, mobile phone, headsets, computer games, big concerts, hearing aids, many alarm systems, buzzers in household items, etc. A modern society could hardly exist without. But 100 years ago loudspeakers did not exist until Danish-American Peter Laurits Jensen, son of a poor fisherman from Moseby on the island of Falster, Denmark, and his slightly older American colleague, Edwin Pridham, from Iowa, invented the modern loudspeakers. Today, most families possess a huge number of loudspeakers, possibly between 50 and 100 speakers in applications of our homes and cars, and many more have been discarded over the years due to new applications or e.g. just nicer speaker system designs.

September 19, 1919, the loudspeakers breakthrough

September 19, 1919, in San Diego, USA, saw the breakthrough that forever changed the world of sound. Loudspeakers became an invaluable, essential part of our everyday lives, and we unconsciously make use of loudspeakers as an integral part of our daily lives.

Many promising inventions end up living a life of oblivion and hence obtain no real significance in society. This was basically the fate of the loudspeaker invention in mid-1919. Four years earlier, what was seen as a successful demonstration of the world's first dynamic loudspeaker, had stunned a huge crowd on Union Square, San Francisco. Late afternoon of Christmas Eve, 1915, the invention of the two young engineers, Danish born Peter Laurits Jensen and Edwin Pridham from Iowa, had successfully presented "the miracle of the loudspeaker" - Magnavox as the inventors termed it then.^{Ref. 1}

However, not until September 19, 1919 did the business opportunities for the

loudspeaker, and thus its success, really emerge. The opportunity that catapulted new life to what at first had seemed a brilliant idea, but in the years after faded due to lack of business potential, almost from one day to the next were reborn – due to the fate of a sick President of the United States. President Woodrow Wilson needed assistance in his attempt to get the USA to ratify the Treaty of Versailles, following the end of World War I. Suffering from a fragile health, including breathing problems that were worsening day for day, Wilson needed a means for supporting him in speaking to large audiences without exhausting his ill condition. The loudspeaker invention of Jensen and Pridham was the right solution at the right time. It allowed the president to make a formidable speech to almost 50.000 people in San Diego^{Ref. 2} - and it reignited the loudspeaker business opportunity almost overnight. As of the next day, the entire USA knew of loudspeakers and what could be achieved with it^{Ref. 1}. At the same time, parallel to the advent of the loudspeaker, important support items such as vacuum tubes and amplifier designs had come available, not least due to pressure for progress that often emerges in the wake of war – and the incredible opportunities of loudspeaker developments and markets were born.

Today, a 100 years later, where loudspeakers are a fully integrated, and natural part of our lives, and where most families have more than 50-100 loudspeakers in our homes, in radios, sound systems, headsets and ear pieces, telephones, TVs, computers, buzzers, watches, washing machines, door bells, even hearing aids, etc., and where businesses and authorities rely heavily on the communication abilities supported by loudspeakers, it is difficult to fathom, how life could have existed without loudspeakers. However, until September 19, 1919, basically only few people in the world understood or saw the potential – most likely not even the crowd of people, more than 100.000 thousand, that in December of 1915 in San Francisco had

been impressed by the first public demonstrations of a loudspeaker on Christmas Eve at Union Square.

To put the incredible story in perspective and understand how things turned out in favor of highly successful commercialization of the loudspeaker, let us look back in history. The invention of the dynamic loudspeaker, which took place over a long period of four years from February 1911 to 1915, and saw an incredible breakthrough already in January 1915, is a breathtaking story on its own right. We shall not dwell on that part, only refer to other sources, e.g. the book "Danish Loudspeakers, 100 year, 1915 – 2015, <https://www.audioxpress.com/files/attachment/2683>

The stunning demonstration at Union Square

Every year at Christmas Eve, December 24, the San Francisco newspaper, "The Bulletin", sponsored an annual holiday celebration, inviting famous singers to entertain, so also in December of 1915. That year, an agreement had been made with Jensen and Pridham (and their faithful investor, Richard O'Connor) to repeat a demonstration of the loudspeaker to the press on December 10 at Golden Gate Park^{Ref. 1}, but now for a much larger audience. Until this day basically no-one knew of a loudspeaker - or what it could offer to daily life. Not even a proper name existed. On this day in 1915, a crowd estimated to be around 100.000 people attended the event in the afternoon of Christmas Eve at the Union Square in San Francisco. The San Francisco Civic Hall had just been completed after 2 years of reconstruction, following its complete devastating in the earthquake of 1906. So there were more reasons for people to come to Union Square on this sunny afternoon – not just the demonstration of the Magnavox, the "great voice" or the loudspeaker, as we later have come to call it.



01 *The crowd of people on the balcony of the new city Hall in San Francisco on the late afternoon of Christmas Eve, 1915. Edwin Pridham stands to the far right, Peter L. Jensen just to his left, and in front looking toward the camera is Dick O'Connor, their investor. The loudspeaker using an Edison gooseneck horn and the Victrola phonograph are in front of the two engineers.*

At the balcony of the Civic Hall overlooking the crowd, Jensen and Pridham had set up a loudspeaker system, i.e. a unit with a built-on gooseneck horn from an old Edison mechanical, non-electric phonograph. The set-up was placed on a table at the edge of the balcony somewhat concealed behind a Stars and Stripes flag. From the balcony, loudly amplified speeches rang out all over Union Square and even right up the side streets. For the first time, the public experienced the great effects, a loudspeaker can offer. Several people, in addition to Jensen and Pridham, merged in on the balcony, including O'Connor. San Francisco mayor, James "Sunny Jim" Rolph, Jr., made a speech to the assembled crowd, and from a "Victrola" phonograph, a purely mechanical, non-electric "acoustic" gramophone, the two engineers played a 1910 prerecorded Christmas hymn song by the world-renowned soprano, Luisa Tetrazzini – all magnified by the loudspeaker of Jensen and Pridham. 100.000 people shouted hurrah, and the local newspaper next day, December 25, floated over with appraisals like: *"Every ear in this massive crowd of people, even people hundreds of meters away, heard every word the speakers said"*. It continued: *"...Magnavox, an incredible invention that yesterday was put at test for the first time for the public"*, etc.^{Ref. 7}

Governor Hiram Johnson talks to a large audience through the city's power lines

Following the massive success, another great opportunity appeared within days of the Christmas event. A part of the Panama Pacific Exposition Co., a huge hall (Bill Graham Civic Auditorium), had been donated to the City of San Francisco, now that the exhibition had ended in early December. The hall was to become a new Civic Auditorium and was planned inaugurated on December 30, 1915. A committee of people approached Jensen and Pridham and wanted them in the wake of their success at Union Square a few days earlier to put up a huge indoor demonstration of the loudspeaker system for the 12.000 people expected to be present in the large auditorium. The two engineers immediately enthusiastically jumped on the opportunity^{Ref. 7}.

One challenge, however, was that a speech had to be given by California's Governor Hiram Johnson. He uncourtly had fallen ill and was bedded in his home three kilometers away from the Civic Auditorium. In those days, amplifiers of electric systems were not yet available, so using a loudspeaker with sufficient power meant that high currents had to be sent all the way from the microphone (in Johnsons home) to the loudspeaker in the Civic Auditorium. Telephone lines could

not carry the high currents and time and cost put a stop for laying high power cables from Hiram Johnson's home in Green Street to the auditorium. Engineers are creative, so the city administration offered to let Jensen and Pridham use the power line supplying the streetlight poles along Van Ness Avenue. That system consisted of a single wire entering every streetlight pole and ran up to the incandescent lamp and down again. The return path was the city water iron pipe system. Johnson's home was close to Van Ness Avenue, and so was the Civic Auditorium. Short power connections were made to connect to the city light system. The engineers had no time to calculate the actual length of connection, including the ups and downs in every light pole, but trials showed that the speech went through reasonably well, although with some hum on the line.

The event itself was a bit nerve wrecking. The first speaker, the chairman of the Civic Hall, understood to speak into a microphone and that part went well. Second speaker was the architect of the building, the famous John G. Howard. He used the microphone to point at every detail of the building, as he was describing them to a completely fully auditorium. As a result, people would only hear a bit of his speech, when the microphone during his pointings passed close to his mouth. No one understood his presentation and it turned out completely comical. Jensen was embarrassed by the development and when the third speech, that of the governor, was to begin, a new disaster loomed. A choir of about 100 people was on stage and the conductor had positioned his choir in several rows just in the front of the loudspeaker. Pridham was in the mansion of the governor to control the event from there, and Jensen signaled to him to start the speech of the governor. Jensen in his agitated condition then created a minor scuffle in trying to disperse the choir that had massed themselves in front of the horn loudspeaker^{Ref. 1}. Newspapers next days talked about an almost physical fight that had erupted by the interaction of Jensen. However, Hiram Johnson, a brilliant speaker, made an excellent speech and his voice went through very fine to the people in the galleries. People on the main floor had more difficulties in hearing the speech, but when it ended, the address received a loud ovation

What to use a loudspeaker for?

Although highly successful in bringing the message of the loudspeaker invention out to people, in San Francisco at least, the challenges still remained: What to use the new invention for? Retrospectively seen it seems a trivial matter - but not in 1915. The loudspeaker invention was a disruptive invention that had not even been predicted. The market was just not ready; no needs existed, no market pull. People did e.g. not have radios in their homes. Use of the loudspeaker at train stations and sports events had been the inspiration of Galbraith, the blacksmith who had inspired Jensen and Pridham to the invention, but what else? Jensen and Pridham started to experiment.

The enthusiasm was at first great with the two inventors and their investors, but it soon turned out to be a huge challenge to capitalize on the invention. Many things were tried, e.g. use to support speeches in larger assemblies. But many speakers perceived the use of an amplified voice as a weakness of their own speaking ability and appeared uninterested^{Ref. 7}.

The US Navy at Maare Island Naval Station in San Francisco Bay had the idea that a loudspeaker system could be used to communicate from ground to a passing airplane (people in those days sat in open cockpits of biplanes), and the pilot in turn could use the system to communicate to ground. Reality proved the idea useless. The noise from the engines in an airplane was mixed up with speech of the pilot and amplified to a level, where nothing could be heard - not even mentioning the very short time, an airplane was in audible range during a fly-over.

The two engineers had more success in constructing a noise neutralizing micro-



02 Peter Laurits Jensen demonstrating the noise neutralizing microphone and headset used by the US Navy during World War I.

phone. It had proven difficult to keep the noise out from the microphone – even using an insulated mouth piece.

Instead they opened the microphone so that noise could influence both sides of the membrane in the microphone simultaneously, i.e. the pressure of noise was equal on both sides and hence did not influence the signal generating microphone membrane. That cancelled most of the noise and the speaker's voice, entering from one side and close to the membrane, could be heard clearly. The patented noise neutralizing system was installed in airplanes with great success, e.g. in the Curtiss NC-4 flying boat (the first airplane to cross the Atlantic), where crew member were located far apart. To support that flight, 23, mostly destroyers, had been stationed along the route at intervals of about 80 km between Newfoundland and the Azores almost like "pearls on a string". The ships were brightly illuminated at nighttime, and used searchlight into the sky, fired bright star shells into the sky to help the aviators to stay on their planned flight path. Two accompanying Curtiss Flying Boats were downed en-route the Atlantic^{Ref. 3}

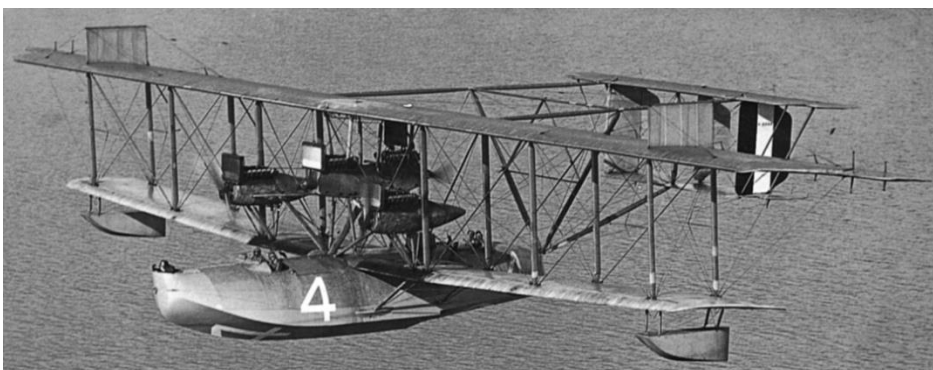
End of the R&D Company and start of the Magnavox Company

In 1917 the R&D Company, "The Commercial Wireless and Development Co.", that had been set up in February 1911 for Jensen and Pridham in Napa, 55 kilometers north of San Francisco, ceased to operate. Despite success in inventions, and huge enthusiasms right after the presentations to the public in San Francisco at the end of 1915, they had failed to develop a useful business activity for the company. The investors faded off. Instead, the company was merged with Sonora Phonograph Corporation in San Francisco, a rather successful company in selling mechanical, non-electric "acoustical" phonographs. The new company was renamed Magnavox, and the consolidated company started on August 3, 1917. O'Connor remained director and chairman of the board, while Frank M. Steers, the former president of Sonora, became CEO. Jensen and Pridham served jointly as "Chief Engineers", normally a hopeless parallel sharing of responsibilities, but the two close friends fared well with the setup. One of the first developments for the two engineers in the new company was to invent the first "all-electric tone arm and pick-up" for phonographs.

Somehow the basic challenge for Jensen and Pridham was rather classical. Scientists and inventors of technology are not necessarily the right people for developing business. The art of business has its own set of conducts and practices that typically require a different breed of people. In the case of Jensen, he had to learn that dimension of life later on.

When the US entered World War I on April 6, 1917, developments related to the progress of a future loudspeaker market were put on hold. The Magnavox Company focused on the military market, primarily telephone production for use in naval ships and airplanes. It included flight communication systems, i.e. the noise-cancelling system and the dynamic receiver in headsets developed by Jensen and Pridham. The company delivered telephones for more than 250 destroyers, and most US airplanes had noise neutralizing headsets installed.

Parallel to their new activities, Jensen and Pridham still fancied their old love, the loudspeaker, and were able to get hold of vacuum tubes to build amplifiers for the



03 The Curtiss NC-4 Flying Boat, the first airplane to cross the Atlantic. Due to refueling and repair, the flight took 10 days and 22 hours from Newfoundland to Lisbon, although flying time was just 26 hours and 46 minutes. May of 1919.

loudspeaker. It meant that now even small signals could be amplified and used in loudspeaker applications – no longer difficult power handling challenges like at the demonstration at the Civic Auditorium on December 30, 1915. They made their equipment available to local institutions, but hardly made any income from the equipment. Jensen judged that their invention was hardly known by any outside the borders of California ^{Ref. 7}.

The end of World War I should prove an opportunity that suddenly changed the situation completely for the loudspeaker – and its importance to society. During the war, there had been a significant development in vacuum tubes, components Jensen and Pridham badly needed to make amplifiers. Vacuum tubes and the use in amplifiers rendered superfluous the need to send large currents through microphones and long wiring systems – as had been the challenge in San Francisco in December 1915. Although successful in manufacturing telephones for ships, Magnavox was in 1919 in search of new markets when all war production ceased abruptly.

The ratification tour of President Wilson, September 1919

But it was President Woodrow Wilson, who significantly changed the options from one day to the next. In 1919, the President had stayed in Europe for six months up until June of 1919 as a follow-up to the World War, aiming at securing peace. He had great thoughts about a balanced peace settlement, but was unsuccessful in his ideas of a balanced ending to the world war.

Instead, it was the winning European superpowers – not least their irreconcilable line with Germany / Austria-Hungary, which won, including the winners' imperialist takeover of German colonies and the surrender of German and Austrian territories to Poland, Czechoslo-



05 & 06 50.000 people cramped into the San Diego City Stadium with permanent seats for only 23.500 awaited the arrival of President Woodrow Wilson – and finally, he arrived, starting his speech at 5:00 pm. Already, when the gates swung open at nine in the morning, hundreds of people who had been waiting for hours streamed in.

vakia, Yugoslavia and the Baltic Republics. Wilson's focus on establishing the League of Nations, the forerunner of the United Nations, UN, absorbed much of the president's work during his six months in Europe. When he returned to the United States and embarked on obtaining support for the League of Nations, Republicans took advantage of this to weaken Wilson. The Republicans, which

held a narrow majority in the Senate after the 1918 elections, were outraged by Wilson's failure to discuss the war or its aftermath with them, and an intensely partisan battle developed in the Senate. Republican Senator Henry Cabot Lodge led the opposition to the treaty; he despised Wilson and hoped to humiliate him in the ratification battle ^{Ref. 9}.



07 People from all over Southern California, dignitaries and welcoming committees, ready for the arrival of the President, and at the north end of the stadium, San Diego High School girls in white middie and skirts and boys in dark suits formed a huge "Welcome" in the stands ^{Ref. 4}.

In an effort to win back his big ideas with a more conciliatory world order, Wilson threw all his energy into convincing the Americans to continue support to his ideas of a better world, and he set out on a journey to the western states of the United States to win support for his ideas, the ratification of the Treaty of Versailles, including the League of Nations and the International Court in The Hague, international bodies that he hoped would help solve international conflicts and prevent another bloody world war like the one from which, the country had just emerged. The journey was by train, lasted 22 days, where Wilson stopped in the major cities on the West Coast of the United States.

The strategy was to establish pressure from the constituencies on to senators and representatives in Congress. Actually, it seemed to work out fine, and after the San Diego visit, he was so elated that he spoke of carrying his campaign all the way back to Massachusetts and "lighting a fire under Senator Lodge."^{Ref. 10}

The entire nation followed the tour of the president with great attention. A large group of reporters from leading US newspapers and bureaus followed closely and had exhaustive reports on all details of the president's speeches, events associated with the trip and issues. A failure of an event would surely prove humiliating to the involved parties.

Wilson's speech in San Diego changed the fate of loudspeakers

When Wilson stopped at the major cities on the West Coast of the United States, cheering crowds would gather at the stations along the way, but Wilson suffered a failing health and adhered to his doctor's advice not to make rear-platform speeches from the train. Sixteen days of travel and speeches had been very fatiguing and took a toll on Wilson. Prior to his speech in San Diego, the southernmost big city of California, his doctor warned him against talking out-of-doors and was about to cancel his planned address to the citizens of San Diego.

The event was planned for the City Stadium (later known as Balboa Stadium), and to protect the frail physical health of the President, a large glass structure had been built at the south end of the stadium. It was from here that Wilson would deliver his speech "to carry the League of Nations to the people over the heads of Congress"^{Ref. 4}. The President had consented to open the glass cage in the front to allow the crowds a better view of him, when he delivered his speech. However, it would be impossible for anyone to hear his address. A group of citizen approached Magnavox and asked for assistance in magnifying the speech of the President. Magnavox agreed. Jensen

was on a business trip to Washington to negotiate contracts with the governments, so Pridham was left with the challenge to go to San Diego on his own.

It was thought "undignified" to ask the President to hold a microphone, and instead it was decided to put up two funnel shaped horns with a microphone installed in each, above the head of the President. Pridham had drawn a circle on the floor within which the President was asked to stand and direct his voice towards the microphones^{Ref. 5}. Magnavox loudspeakers were placed on top of the glass cage structure directed towards the crowd to ensure full effect of the loudspeakers. Pridham employed the latest model of the Magnavox power amplifiers, a three-stage amplifier with two 500 volt tubes in parallel at each stage.

Before the arrival of the President, Pridham entertained the crowd by playing some music through the loudspeaker system. The stadium was filled with about 50,000 people, an incredible number of people when realizing that the entire San Diego City and County at the time only numbered about 73,000 people. Just as President Wilson's motorcade entered the stadium on September 19, 1919 late afternoon and entering the stage, Pridham was horrified when smoke started to emerge from the power amplifier.



08 President Wilson in the glass structure set up to protect his ill health. Wilson's wife, Edith, stands to his right (in dark) and in between is Mrs. Louis Wilde, wife of the San Diego Mayor Louis Wilde. Above the President, the two microphones immersed in horns, can be seen.

"Everything had been going fine for the tests until just before President Wilson started to speak. I had told him of the circle marked on the floor and to direct his speech forward so that it would best affect the microphone. I left the glass enclosure to close the switch on the control box. I no sooner had done this than I saw smoke coming out of the amplifier box. What a fix to be in! Seventy-five thousand (sic) people in the stadium, the President inside the glass enclosure-you couldn't have heard him three feet away without the Magnavox. I looked closely at the tubes and saw one was red hot. I yanked it out without disturbing the circuit. Everything was then okay again".

^{Ref. 6}

Wilson, attired in a top hat and dark suit but looking pale and drawn, was introduced by Mayor Wilde and rose to deliver a particularly impassioned speech that lasted almost an hour. He was frequently interrupted by applause from

the largest and most enthusiastic crowd, he was to experience on the tour. Ref. 4

Wilson delivered, what one reporter described as his "finest speech of the whole tour". Another reporter stated that all but a small portion of the crowd could hear "every word". Whatever the actual success of the experiment, it was, as the *New York Times* reported it next day, a "remarkable spectacle", one "seldom equaled in this country". Newspapers all over the US described the event in San Diego, and from one day to the other, the power and importance of the loudspeaker were becoming increasingly evident to industrialist and many other people in the nation. It was the start of an incredible development of the loudspeaker.

Technically from a sound perspective, the event had proven successful, although also some challenges emerged. The Magnavox system worked so effectively that though not a word could be heard with the instrument off, when the circuit was closed, the President's voice could be heard for a mile (1,6 km) beyond the stadium. However, the sound projection, though loud, had taken a somewhat hollow and indistinct tone, particularly to those in the far north end of the stadium. Pridham later on explained the problem to be related to that his tests had been performed in an empty stadium and before the glass cage was erected. The result caused a hollow sound of Wilson's voice Ref. 4. The rather huge glass cage, proved a challenge on its own right, large enough to accommodate almost fifty people. As Pridham later described it:

"The echoing of the voice vibrations from the glass sides had produced this effect. It was a long time before a solution was found for this trouble and that solution was-never to have any surfaces near the microphone that would permit echoes. Today every studio is so designed so as to minimize echo but not to completely eliminate it". Ref. 5

One event, in one late afternoon, had changed the importance of sound, i.e. the loudspeaker and its importance to society completely. September 19, 1919 became the turning point of the loudspeaker, and a revolution in communication and entertainment had been initiated. Officially President Wilson praised the new Magnavox system and was sufficiently impressed with it to personally thank Pridham during a reception in his honor at the U.S. Grant Hotel. Ref. 4

The San Diego Union
AND DAILY BEE—THE PIONEER NEWSPAPER OF SOUTHERN CALIFORNIA
ESTABLISHED 1885
SAN DIEGO, CALIFORNIA, SATURDAY MORNING, SEPTEMBER 20, 1919
FIVE CENTS

MORE THAN 50,000 HEAR PRESIDENT WILSON DEFEND LEAGUE OF NATIONS

GREATEST CROWD OF WILSON'S TOUR GATHER AT BIG CITY STADIUM
Most Enthusiastic Ovation Ever Given to Chief Executive, Members of His Staff Say; Huge Inclosure Inadequate To Accommodate Crowds; Declines Roosevelt and Lodge Previously Advocated League; Number of Votes Given to Great Britain Defended as Only Just.

SHIP LOST AT SEA ADDS TO DEATH LIST IN GULF HURRICANE
Divers Identify Vaulnera Which Left Spain for Havana and Has Been Missing Since Hurricane Struck
Recovery of Additional Bodies At Corpus Christi Lenses Fears Present Death Roll May Be Doubled
HAD 300 PASSENGERS AND CREW OF 150
Vessel Last Seen Sept. 13 When She Attempted to Make Morris Castle but Prevented by Storm
PROGRESS MADE IN CLEARING DEBRIS
Relief Committees, Co-operating With Military, Report Progress in Bringing Order Out of Chaos

RESIDENT WOODROW WILSON'S VISIT TO SAN DIEGO
His long heralded visit to San Diego yesterday passed away without a hitch, and will always be regarded as one of the really great events in the city's history.
These were the words of Mayor L. J. Wills at the city stadium yesterday afternoon when, in introducing President Wilson to the vast audience, he stood up to the crowd and declared that to a man they awaited the President's visit.
Nor did the mayor overestimate it. In honor of the nation's chief, the great assembling place, the largest of its kind, the first time since the stadium was built it proved of inadequate seating capacity to meet the vast throng. It was San Diego's first time since the war that the city was so crowded.

Two striking scenes in President Wilson's visit to San Diego yesterday. Above: The President in his automobile in front of the U. S. Grant Hotel, soon after his arrival. The official photograph was arranged for Willis C. Baker, head of The Union's

09 The "San Diego Union", Saturday, September 20, 1919, the day after President Wilson, the great but self-righteous man who had led the U.S. to victory in the war, came to San Diego to plead for ratification of the Treaty of Versailles with its provision for a League of Nations after a triumphant tour abroad where many had seen in him a divine inspiration. G.A. Davidson, chairman of the Wilson General Committee later remarked that "September 19, 1919 was the greatest day in San Diego history" Ref. 4

Loudspeakers now were part of a fast rising electronics industry, where not least the radio played a pivot role. Radios for Use of loudspeakers by people in general became common, radio stations emerged quickly across the country, and entertainment utilities like phonographs and others entered a fast growing curve. Many soldiers returning from World War I had developed some acquaintance with military radio systems Ref. 7, and the number of amateurs grew fast. So did experimental radio stations all over the country. The loudspeaker was a vital component needed to ensure that the entire family could enjoy the power of the new technologies. Many house wives complained about the copper wires filling up sitting rooms and other parts of housing. However, as Jensen later on noted, this was quickly forgotten, if the master of the house could tune into radio station XYZ 500 miles away Ref. 7. Soon the market turned into a more professional

business segment, where complete solutions were made available. The market for radio components in e.g. the USA told an obvious story of its own. In 1922, the total business of radio components was about US\$ 60 million. The following year the business segment had grown to US\$ 136 million, and 1924 revealed a market place of US\$ 358 million. The loudspeaker was a vital part of this market, and Magnavox conquered its significant share of the market. A commercial success of the loudspeaker was born!

But as Peter L. Jensen later on noted: Eventually the "sleeping giant", American Telephone & Telegraph Co, ATT, the huge and dominating Bell telephone company, eventually woke up and saw the business opportunities of the loudspeaker. Already in 1920, ATT entered the market for loudspeaker systems for the 1920 president election campaigns for both the

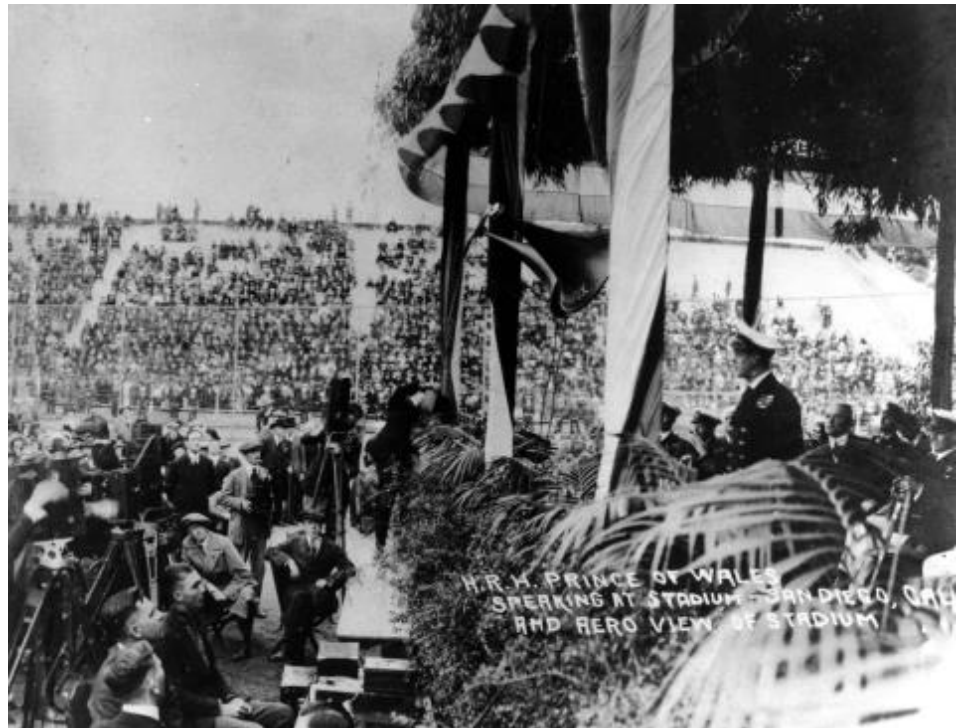
Republicans and Democrats. Magnavox still managed to be selected for delivering loudspeakers services in the campaign of both president candidates in 1920, Harding and Cox, but eventually ATT completely captured this segment of the business^{Ref. 7}. However, Magnavox had an almost monopoly of supplying loudspeakers to industry at large in the first few years of the 1920'es.

The stroke of President Wilson

In a sad aftermath, the health problems of President Wilson deteriorated. Wilson was reaching his physical limits. Admiral Grayson, the President's physician, halted the presidential train on the way to Los Angeles the same evening so that Wilson might get a sound sleep at a nearby inn, and also advised the President that there should be no more rear platform speeches and handshaking^{Ref. 8}. Six days after his San Diego address, September 25, when he was in Pueblo, Colorado, Wilson collapsed from fatigue while continuing his tour, and had to cancel the rest of his tour and return to Washington. On October 2, 1919, Wilson suffered a serious stroke, leaving him paralyzed on his left side, and with only partial vision in the right eye. He never really recovered and for the rest of his term as president, he was heavily incapacitated. The illness affected his personality in various ways, making him prone to "disorders of emotion", impaired impulse control, and defective judgment. For the rest of his term, i.e. almost 1½ year up to March 3, 1921, the presidency was to a large degree run by Edith Wilson, his second wife since 1915, after his first wife had died. The serious state of the President was to a large degree hidden for the public, and several scholars see Edith Wilson as the "First female President of the USA", although not elected. The judgment of her reign is not always a positive one^{Ref. 9}.

1920 Relive of the great San Diego event – Prince of Wales

For Magnavox, and not least Pridham and Jensen, September 19, 1919 had proven the ultimate success. The press all over the USA had the technical achievement of the loudspeaker system in their editorials the following days.



10 When the Prince of Wales (later King Edward VIII January 20 – 12 December, 1936, then Duke of Windsor) visited San Diego on a sailing trip around the world, the only port in the USA visited, townsmen of San Diego saw an opportunity to relive the President Wilson visit. Now Peter L. Jensen had the opportunity to control the loudspeaker event in San Diego^{Ref. 7}.

Half a year later, April 1920, the Prince of Wales, later Edward VIII (when abdicated Duke of Windsor), visited San Diego on a sailing trip around the world, the only port in the USA visited on that trip. Townsmen of the city saw an opportunity to relive the great event with President Wilson a few months earlier. Somehow they convinced the Prince of Wales to come to Balboa Park Stadium and give a short speech. This time it was Jensen, who had the duty of controlling the loudspeaker system. Afterwards in the evening, he was invited onboard the Prince's ship, "Renown", where he also met Lord Louis Mountbatten. During the hours visiting the Prince's ship, Jensen entertained the Prince and Lord Mountbatten on the vision on loudspeakers. Jensen also gave the Prince a complete loudspeaker and amplifier system on behalf of Magnavox.

Lord Mountbatten, a bright young man, was impressed by the technical achievements of Jensen and his colleagues and curious to technical details. He invited Jensen to visit him in England, which Jensen later on in 1922 had the opportunity to, actually the day before Mountbatten got married on July 18, 1922..

The success in business of Magnavox, and later on "Jensen Speakers"

From this point on, the success of Magnavox was secured. In 1921, President Harding used the Magnavox loudspeaker system in his campaign for running for presidency. Speaker solutions were later on also used at his inauguration as President on March 4, 1921, but this time the "sleeping giant", AT&T managed to capture the scene.

In 1922-23, the Magnavox Company made incredible profits, paying out dividends of 20 cents per share and additional extraordinary 15 cents. But now the "big companies" started to see the business opportunities in loudspeaker systems and AT&T entered the scene, and took over systems for big events. AT&T controlled the vacuum tube industry, which now was lifeblood for Magnavox, and AT&T could dictate terms. Magnavox instead focused on making radio systems with loudspeakers, the new entertainment item that every home started to need. O'Connor past away in 1924. The following year Jensen had enough of being

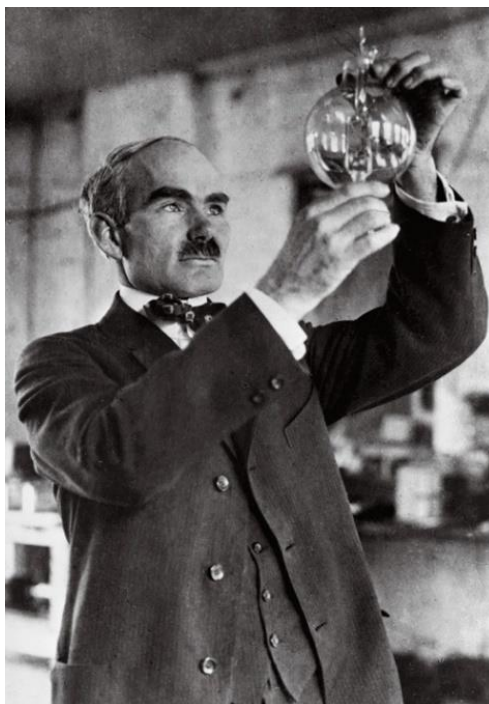
controlled by aggressive business people and left Magnavox. O'Connor, who had influenced the success of Jensen so much, and whom Jensen had respected sincerely, was no longer around to mediate. In 1927, Jensen founded the 'Jensen Radio Manufacturing Company' in Chicago. The product was "Jensen Speakers" and he operated under a license of Magnavox. In 1929, Jensen Company manufactured 60% of all speakers being made for independent radio producers. During these years, Jensen and his new development manager, Hugh Knowles, nurtured high fidelity audio. In 1942, Jensen presented the first commercial coaxial two-way loudspeaker. However, the following year he had enough of his shareholders reign, and he resigned from Jensen Manufacturing, just shortly after to set up his new company, "Jensen Industries", which he ran until 1961, when he died of lung cancer - having been a heavy smoker during his adult life.

Hugh Knowles left Jensen Manufacturing three years later when he founded Knowles Electronics, one of the world's major manufacturers of microphones, especially for medical applications.

Amplifiers and the Vacuum tube

President Wilson's speech in San Diego, September 19, 1919, obviously was the turning point for the loudspeaker. But without vacuum tubes and amplifiers to enable the use of loudspeakers, the sudden change in market pull for the loudspeaker would not have seen its quickly rising market opportunities.

The advent of the vacuum tube and not least 3-stage amplifiers are interesting stories in their own rights. Lee de Forest (1873-1961), the inventor of the vacuum tube, was an incredible inventor and pioneer in the radio industry. Over his career, he managed to obtain about 180 patents - one of them for the 3-terminal vacuum tube, then called the "Audion". In addition to being an inventor, Lee de Forest was a fascinating entrepreneur. He undertook many activities, nurtured ideas and established a number of companies in wireless communication, vacuum tube manufacturing and in sound-on-film recording used for motion pictures. However, de Forest also suffered a business character of flawed nature. De Forest had been involved in stock fraud in



11 Lee de Forest was an American inventor and pioneer of radio systems, and in 1906 he had invented the Audion, a triode vacuum tube, later on successfully used by industry in amplifiers. The vacuum tube was later on in 1911-1912 nurtured and improved during Lee de Forest's employment at Federal Telegraph Company, a successful radio company based on wireless transmission technology licensed by Danish inventor Valdemar Poulsen. .

more cases, and de Forest and four other company officials from his previous companies were in March 1912 arrested in an U.S. government's crackdown on stock fraud, for events that had taken place prior to his moving to California. The arrest was during his employment at the FTC Company in Palo Alto, but the company bailed out de Forest. Three of his colleagues from New York were found guilty, but de Forest managed to get acquitted.

De Forest had a reputation of "stealing" or at least borrowing ideas of others, and through life he was involved in numerous court cases. Several of his patents seem to have been originating by others, but he had a strong sense for quickly picking up ideas and filing for patents.

In 1906, Lee de Forest had experimented with the Fleming Valve, a tube based diode invented by British John Ambrose Fleming ^{Ref. 11} two years earlier. De Forest added a third terminal, the "grid", and this later on proved to form a solution to amplify signals. In 1908 he received a

patent for his vacuum tube invention. However, the Audion was for some years put aside in his activities due to other thriving businesses of de Forest.

In 1904 Danish inventor, Valdemar Poulsen, had presented a paper on an arc transmitter at the 1904 Louisiana Purchase Exposition ^{Ref. 13}. De Forest was present at the event and soon after managed to develop an arc transmitter solution largely based upon the ideas of Valdemar Poulsen, hence infringing the Poulsen patent. However, de Forest managed to sell 25 huge arc transmission systems to the US Navy Great White Fleet to be installed on ships. The solutions never became a success, basically non-functioning and were eventually removed again from the ships.

In 1909 the "Poulsen Wireless Telephone and Telegraph Company" was established close to Stanford University in Palo Alto, south of San Francisco. The company led by Cyril Elwell had acquired the license rights for the Valdemar Poulsen arc transmitter for the USA. It was to this company that Valdemar Poulsen at the end of 1909 had sent Peter Laurits Jensen across to California to assist in setting up the first Poulsen arc transmitters and help in establishing license manufacturing in the USA ^{Ref. 12, Ref. 13, Ref. 14}. During his work at "Poulsen Wireless", Peter L Jensen had met his future colleague, Edwin Pridham. Early 1911, the "Poulsen Wireless Telephone and Wireless Co." had run out of funding and was reorganized into "Federal Telephone Company", still in Palo Alto and still with Valdemar Poulsen and his investors as partial shareholders, although now at a smaller share. This new company, FTC, became successful in delivering Poulsen arc transmitters in the USA, not least to the US Navy and to radio station for overseas wireless communications and dominated the world of wireless communications.

Lee de Forest moved from New York early 1911 and joined FTC as an R&D engineer, where he together with Charles Logwood and Herbert van Etten continued experiments with and improvement of his vacuum tube technology. They had some success, although vacuum technology still was in its infancy, and lacked stable production and quality of vacuum tubes. During this work, the three of them claimed to have invented the feedback based amplifier in 1912. The invention was also done around the same time by Edwin Howard Armstrong at the Columbia

University in New York^{Ref. 15}. In January 1913 Armstrong had prepared a series of comprehensive demonstrations and papers that carefully documented his research and had applied for patent in late 1913 for what he referred to as the regenerative circuit (positive feedback). The patent was issued in October 1914. The following year, beginning of 1915, de Forest filed a series of patent applications that largely copied Armstrong's claims. Based on note book claims, de Forest defended that he on August 6, 1912 had stumbled across the feedback principle, which was then used in the spring of 1913 to operate a low-powered transmitter for heterodyne reception of FTC arc transmissions. However, he seemed rather unaware of the significance of his finding, as it appears from his lack of follow up. He even misunderstood the involved physics. The battle between the two ended up in court right after World War I, and in 1921 the court ruled against de Forest. Later on, the case ended up in the US Supreme Court in 1928 and 1931, and although Armstrong had clearly won the previous court cases, the final ruling to the surprise of the technical community ended up awarding Lee de Forest the patent.

The single biggest contribution of Lee de Forest to the development of radio communication was the invention of the vacuum tube. Lee de Forest eventually sold his rights to the vacuum tube to AT&T for about US\$ 140.000. FTC had granted him the rights for also the work done during his employment at FTC. However, the company maintained a right of manufacture, which it utilized later on. AT&T now zealously controlled the vacuum tube technology and prevented others access to the technology. AT&T used vacuum tube technology to protect its dominant telephone business, where the company could now offer long distance calls with little or no loss in quality. Harold Arnold of Bell Telephone eventually perfected the vacuum tube and the amplifier solution in the course of years.

Jensen and Pridham had been colleagues of de Forest and Logwood during their employment at Poulsen Wireless and FTC. When the two, Jensen and Pridham, visited New York in 1914 for a period of 6 weeks in an attempt to sell their dynamic loudspeaker invention to AT&T, they also visited the new company that de Forest now had set up in New York, and where Charles Logwood was now employed.

During these meetings, Jensen and Pridham obtained samples of the vacuum tubes that they would later on use in their developments in San Francisco.

It is interesting to note that the pioneering efforts of the radio and loudspeaker industries were done by a small group of people. Both Valdemar Poulsen and Peter Laurits Jensen played pivot roles. Many people recognize "The Poulsen Wireless Telephone & Telegraph Co." and its successor, "The Federal Telegraph Co." as the start of Silicon Valley south of San Francisco, in Palo Alto. Several companies were spun off from these first electronic/electric companies like Litton Industries, Magnavox and others.

100 years have past

And what about loudspeakers 100 years later - what have changed? Well in essence the basic principles of the electrodynamic loudspeaker still remain almost like they were in 1919 and 1915. Several improvements, some of these patented like the moving-coil cone principle by Chester W. Rice and Edward W. Kellogg in 1924, and several others since, but still honest to the principles of the Jensen and Pridham and their significant contributions to mankind.

Every year billions and billions of loudspeakers are being manufactured. Most homes possess may be fifty to one hundred loudspeakers in a variety of applications. In addition, many loudspeakers, we already owned, have become obsolete and have been substituted by new generations and in new application.

Today amplifiers associated with loudspeakers are, of course, very different from the vacuum tube amplifiers of 1919 that Jensen and Pridham struggled with. Microelectronics and smart support like wireless control and transfer now dominate.

In 2019, the reproduction of sound is also shifting focus from hardware improvements to software support. Employing e.g. Artificial Intelligence, AI, and not least Deep AI, feature a new area of loudspeakers and their applications- so loudspeakers will be with us for many years to come – in new applications and versions, but still dynamic loudspeakers as in the days of Jensen and Pridham.

About the author

Birger Schneider is an electronics engineer and business manager with strong interest in history.

Education: BSc.EE in 1972, and employed at DELTA from 1973 until 1992, serving as section head, later on division manager and from 1987 to 1992 Vice President, Technology.

In 1979, he received the "Electro-Prize Award 1979" for outstanding contribution, dedication and performance in R&D (Danish Society of Engineers).

In 1985 he undertook initiative to establishing a microelectronics R&D centre in Denmark, which eventually came to be the Microelectronics Centre (now DTU Nanotech).

Birger Schneider ran his own company, microLEX Systems A/S, from 1992 to 2008, focusing on test solutions for video, audio and electronics in general, delivering system solutions worldwide to companies such as Apple, Microsoft, Philips, Nokia, CERN, Cisco, Oticon, GN-Resound, Vestas, MAN B&W and many others. Schneider sold the company to National Instrument in 2008, and served at NI in R&D management and finally as Director for global Business Development, Video & Audio test.

In 2012 he rejoined DELTA as Vice President, Road Sensors, Optics & Light, at DELTA from July 2012 to the end of 2018 (DELTA is now part of FORCE Technologies). As of February, 2019, he again has been running his own companies CHAMAJ, and CHAMAJ Consult.

Birger Schneider is a member of the Danish Academy of Technical Sciences (ATV). He also serves on the steering boards for the Danish Sound Network and Nordic Test Forum.

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