Clarence D. Tuska (1896–1985)

A Centenary Appreciation of a Paradigm Pioneer of Radio

Abstract

Born in the last years of the 19th Century, Clarence D. Tuska started out as a kid with a coherer at the beginning of the 20th Century, and ended up as RCA's Director of Patents. As a teenager he nurtured the nascent American Radio Relay League as its chief (and only) operating officer. He helped the Army implement the new technology of radio communications. He turned to manufacturing parts and then elegant, now collectable, radios for the burgeoning home market of the "Radio Fad" 1920s. The Superdyne circuit he invented cured a flaw in the vacuum tube circuits of the day. He flourished as an inventor, and wrote often about the creative process of invention. In joining RCA, he joined the cohort of talented radio pioneers that David Sarnoff brought together to manage one of most successful companies of the electrical age.

Inventor Tuska Speaks for Inventors in the Culmination of his Career

Clarence D. Tuska (Figure 1) always hoped that inventors would benefit from their ingenuity. But the big picture also loomed large in his maturity; for example, in 1957 he wrote:

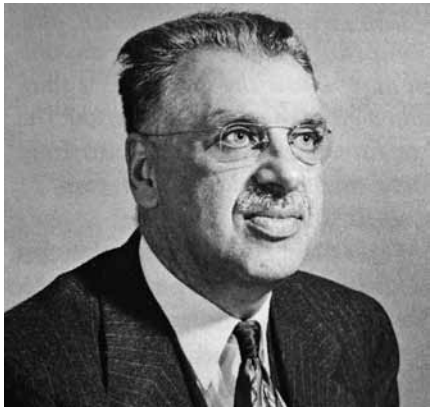


Fig.1. Clarence D. Tuska about 1960 from 1 AWA Review 49.

> "Without adequate patent protection it is doubtful if capital would be forthcoming to make further inventions and to develop the inventive things that can continue to do so much for an improved way of life."[1]

A summary of one of his books for inventors, a summary likely written by Tuska himself, points to his concern for inventors:

> "What Mr. Tuska's book does is to erect clear warning signals

> along the path which leads from the conception of an invention in the inventor's mind to his ownership of a patent. Properly heeded, these warnings may constitute the difference between acquiring wisdom from bitter experience and acquiring valuable patent rights." [2]

This comment does have a personal ring to it. In the 1950s Tuska also wrote articles for the Franklin Institute encouraging invention and creativity.[3]

Tuska wrote at least four books on invention and inventors, each going into multiple editions, and two popular articles.[4] He had "walked the walk," patenting various sorts of devices. He lucidly explained technical matters. Tuska's inventiveness resulted in unique devices in the new radio field, a company of his own to manufacture them, a novel and clever circuit to improve broadcast radio reception (the Superdyne). He managed the national amateur radio organization as a teenager, and then took a direct commission into the Army to help organize its radio training in the First World War. As a post-war civilian, he rose to the top of the electronics industry of the 20th Century, by managing inventions and inventors.

In the beginning: wireless telegraphy, amateur radio, and the American Radio Relay League

Around 1907, Tuska, as a young boy about 11 years old, got into the wireless game with a metal filings coherer.[5] This he used to detect the signals of the new-fangled wireless telegraphy so well promoted by the likes of Tesla, Marconi, De Forest and Fessenden, and much used by the Navy. Tuska had first experimented with his metal filings coherer detector. Within three years he had graduated to a spark coil transmitter (albeit untuned), two antennas configured as dipoles, and for his receiver, a tuning coil with two slides. An electrolytic detector from Hugo Gernsback's E.I. Importing Company "… did not operate at all well …" so he moved on to a crystal detector. Next came a loose coupler, and a pair of headphones,[6] top-of-the-line Brandes. Working at this technical level, he and Hiram Percy Maxim met about 1910.

The amateur experimenters joined the professional communicators in exploring the possibilities of the novel medium of wireless telegraphy. The relatively low transmitting power available to the amateurs put a premium on experiment and cooperation. The high power commercial, maritime and Navy installations always made for a plethora of signals to hear, some very interesting indeed. Then in 1912, after probably justified claims of some amateurs interfering with Navy and commercial traffic, the U.S. Government exiled the amateurs to wireless Siberia, to wavelengths of "200 meters and down"[7] (*i.e.*, 1500 KHz and up). So some folded their antennas. Many amateurs took this restriction to be merely advisory with no enforcement until 1916, thus keeping amateur radio more alive than the law's sponsors intended. (This was to prove

in the national interest in World War One.) Others, however, such as Tuska and his Hartford, Connecticut neighbor, businessman Maxim, persevered and within the law. They laid a foundation ultimately to worldwide, low power, frequency agile, multi-mode communications as public service as well as an engaging technical and social hobby.[8] Their work resulted in the American Radio Relay League in 1914.[9]

As was often an American trait of that last century, high school student Tuska wanted to make some money for himself. Tuska had made money by offering toy airplanes, and various wireless components, of his own design and manufacture, on consignment at a local toy store. He likely made them on his kitchen table. He put together a wireless receiver and offered it in the toy store. Maxim's son had an interest in wireless. At the toy store, Maxim saw and bought Tuska's receiver for his son. But Tuska found out that Maxim had returned it to the store. This occasioned some discussion in the Tuska home, likely at that kitchen table.

In a later reflection, Tuska remarked, with respect to his mother, "During most of my youth, she had to be both father and mother." So she insisted: go call on Mr. Maxim to ask why he'd brought the receiver back. A boy with gumption, he did just that. It turned out that there was nothing wrong with Tuska's construction. Maxim, however, had some knowledge of the new wireless enthusiasm. A more professional set was more to his liking. Tuska reached for state of the amateur art, and built one for Maxim, probably much like his own. The Maxim family and Tuska soon communicated by wireless telegraphy with the self-assigned callsigns of SNY, SNW, and for Tuska, SNT. The elder Maxim and Tuska soon developed '… a friendship … more of a father-foster-son relationship."[10] Maxim later urged Tuska to go to college and facilitated his entry into Hartford's Trinity College.

Maxim, with the collaboration of "… that brilliant Hartford youth, Clarence D. Tuska, launched our League …"[11] (ARRL) in 1914, one hundred years ago. Tuska, about fourteen years old, had just started high school in Hartford; Maxim was a more than forty -year -old successful businessman and inventor. Maxim was the older, wiser partner, and instigator in the novel organization. He was, in fact, "The Old Man" of early American Radio Relay League *QST* magazine commentary, for example "Rotten QRM." Just a "young squirt," (see Figure 2) Tuska worked in the attic of his home and nonetheless became ARRL's Secretary and most devoted officer.[12] He and Maxim founded *QST* privately in 1915. They also incorporated the League in 1915, along with their lawyer. The ARRL's incorporation permitted it to protect its ideas and operations, even as a non-profit entity.

Tuska came to own *QST* although the League assumed its operations in 1919, paying off Tuska's associated but personal *QST* debts with a bond issue.[13] Tuska handled the organization of ARRL in 1914 but Maxim announced its formation as a relay league of amateur

Fig.2. Tuska about 1915, ARRL photo. Maxim's son, Hiram Hamilton, remarked on Tuska's striking green eyes. Immigration records suggest that most Tuska families came out of Eastern Europe, mostly Hungary.

wireless operators.[14] The then short range and low power of amateur stations limited them in terms of distance, but those very characteristics thereby created an opportunity to link nearby amateurs in all directions in order to relay messages longer distances.

"It may be that we have in this idea a great organization in the making" Maxim, a man of vision, noted at the time. The relay concept, already in use by other services, not only passed traffic, but it also linked amateur wireless men regionally and soon nationally. ARRL relay stations were licensed at a special wavelength, 425 meters,[15] about 700 KHz. These were the days of spark sets capable of maybe a 30-mile range, at best a little more. Yet other ways of communicating faced limitations of their own. U.S. Mail could take a long time before airmail service. For telegrams, Western Union charged a monopoly price, limiting use mostly to businesses. Telephones were few and far between, and used primarily for local business. Long-distance telephone service had to await the coming of vacuum tube amplifiers in the 1920s.

Maxim and Tuska knew that enthusiastic amateur wireless operators lived everywhere in the country, as was shown by a number of publications. An amateur radio message relay network, they realized, could meet a demand for conveying personal messages, perhaps even across the continent (as it soon did, in January 1917).[16] Moreover, the price was right: free. This network could thus demonstrate an important virtue of amateur wireless. It could and did also show the promise of rapidly evolving amateur radio. But as Maxim and Tuska foresaw, just handling the traffic would bind together amateurs around the country. The events of 1912 had shown that amateur radio had faced an existential risk; other such risks could (and would) be in the offing.

In his history of ARRL, Clinton B. DeSoto, writing "Two Hundred Meters and Down" in 1936 points out that in this period after 1912 amateur wireless evolved from primarily experimentation to primarily communication.[17] The many wireless and radio publications of the day facilitated

experimentation. Yet the attempted organizations of amateurs did not flourish. These groups did not have as a purpose inter-communication in the ether among their members, but that is exactly what Maxim, Tuska and ARRL accomplished with the notion of amateur relay traffic. ARRL knit a nationwide social fabric with the strength to muster thousands for First World War service,[18] later in defense of amateur radio itself, and in the ensuing decades in emergency service and national defense.

Clarence Tuska as a young man devoted several years to ARRL and edited its magazine *QST*, and defended amateur radio after the First World War. He held several radio licenses from the U.S. Department of Commerce: 1AY, 1WD, 1ZT (a special class) as of 1915, and later 1XV, experimental class, 1920–'21.[19] (Maxim held at least two callsigns before his final call W1AW.[20])

In 1915, the Institute of Radio Engineers made Tuska a member, a signal honor for an amateur.[21] At the time, Major Edwin Howard Armstrong's new regenerative circuit and its "oscillating Audion" vacuum tube heart had captured the imagination of the radio world. Tuska explained it to amateurs in an article for *QST* in 1916.[22] With this one-tube regenerative receiver Tuska copied Honolulu from Connecticut.

Tuska Anticipates—and Practices—Broadcasting

David Sarnoff at R.C.A. later claimed that he thought up the "Radio Music Box" for the home in 1916.[23] Maybe so, maybe not, but Tuska as early as 1916 grasped the power of oscillating vacuum tubes to broadcast speech and music by modulated continuous waves. So he did it:

> "It was not long before I had a 50-watt oscillator and a 50-watt modulator in operation. I was able to transmit understandable speech and music of passable quality over a normal radius of 25 miles. It was a common occurrence for other amateurs to ask me to transmit music for visitors… Regular broadcasting, as we know it today, had not started. I foresaw a real future for paid broadcasting because I knew that the audience was starting to grow."[24]

A photo of Tuska at his radiophone (Figure 3) appeared in *Wireless Age* magazine in February 1917.[25] Like Lee de Forest and Charles D. "Doc" Herrold, among others, Tuska helped to invent broadcasting before the post-World War One technology advances made it a household amenity.

Tuska Serves in the War to End All Wars

In early 1917 war loomed. *QST* editor Tuska wanted to play his part:

> "By the end of July, QST had just about run out of money and had about used up its credit, and its Editor and factotum wanted a more active part in the War

Fig.3. Tuska at his broadcasting radio-telephone station circa 1916–'17, from *Wireless Age*, February 1917 at 352. Note the spherical audion to the left, and the large inductance at the top right, and a bank of vacuum tubes at the bottom of the transmitter on the right. The original caption notes. "… By making his victrola a part of his transmitter he has been giving wireless concerts for the benefit of amateurs in and about Hartford…."

> effort. QST was put to bed, and its editor left for Washington."[26]

In the Great War, Lieutenant Tuska, with outstanding recommendations, served in the Signal Corps, a natural fit. He directed a radio school as Officer in Charge and served in two other assignments as a Radio Officer.[27] In the first volume of the AWA Review, he told of his wartime experience.[28]

His first assignment as a new Signal Corps officer was to establish a radio school in Texas. He served there with an experienced commercial operator and early (1910) aviator, Elmo N. Pickerill. Figure 4. A little later Tuska met K.B. (Kenneth) Warner, who so impressed Tuska that he talked Warner into taking over *QST* and as Secretary of ARRL after the war ended and amateur radio could once again take to the ether in 1919.[29]

Like Tuska, "… [d]ozens of the more competent amateurs were taken directly from private life and given commissions on the strength of their amateur proficiency" according to ARRL.[30] Tuska's bailiwick was to organize radio training in the Air Service. Tuska wrote, near to the events:

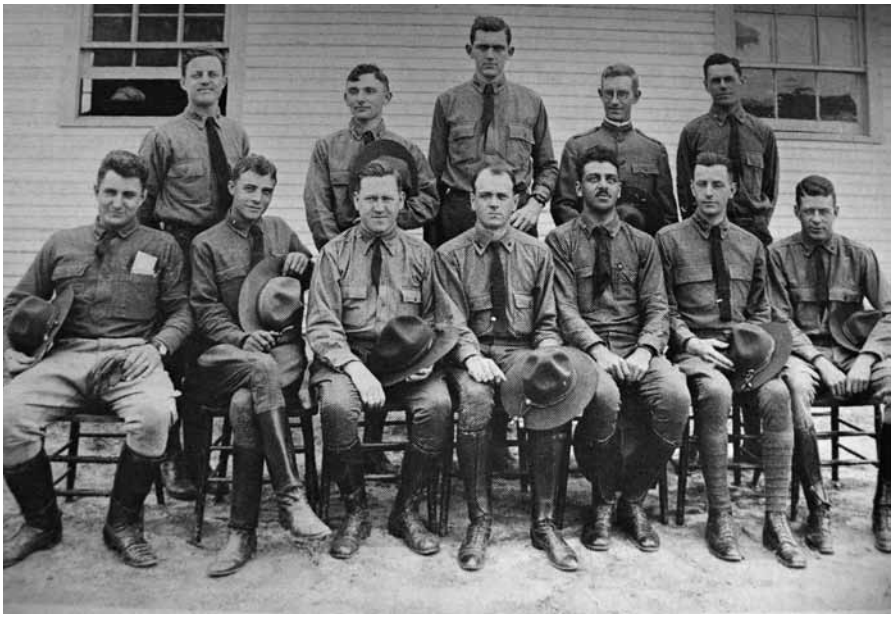


Fig.4. Tuska's Texas Air Service radio class; he is third from right, looking well tanned, and Elmo Pickerill is to his right. From 1 AWA Review.

> "The amateurs have come across in the case of the Army. … I have turned out a whole lot of operators for the Air Service and have become pretty well acquainted with the type of human it takes to make a first-class radio operator… The very first sort of student we looked for is an ex-Amateur. He seems to have had all the experience and all we have to do is acquaint him with a few special facts and he is ready for his Army job. They've surely done their bit and I am mighty proud I was one."[31]

In Tuska's Aviation Section, the SCR 65 with its BC-15A spark set flew in the spotter aircraft. Figure 5. On the ground, the SCR 54 with its BC 14 receiver and VT-1 vacuum tube detector received the signals from the aircraft. Figure 6. Tuska explained the process:

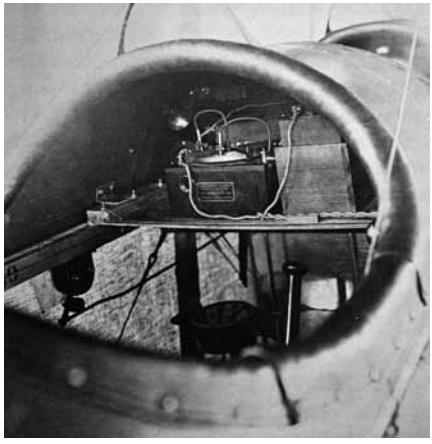


Fig.5. The SCR 65 airborne spark set. From 1 AWA Review.

Fig.6. The SCR 54 ground receiver. From 1 AWA Review.

> "Returning to the 1918 apparatus: its principal purpose was to send signals from an airplane to a ground station to direct artillery fire. The ground station signaled an observer in the airplane by a visual code … Generally the plane was flown toward the artillery battery, radioing the battery to fire just as the plane made a turn toward the target. An the observer in the plane watched for the shells to burst around the target; then the plane was turned promptly toward the battery, indicating if the shells fell long or short, and about how far off target. The necessary gun correction having been made, the progress continued until the target was hit. A well-trained crew with good teamwork was a must. We simulated battlefield conditions and trained men to install equipment and operate under abnormal conditions, such as bad interference, weak or fading signals, faulty gear, and to quickly make any necessary adjustments or repairs"[32]

Marconi himself, Chief of Signals for the allied Italian Army, praised the amateurs of the sort Tuska worked with in the U.S. Army and at ARRL:

> "America is fortunate in having perfected its organization in the amateur field…. American Wireless men are exceptionally

well qualified to take an active part in important signaling work."[33]

The Siren Call of Commerce and Invention

Out of the Army after the Armistice, it was time for Lt. Tuska to make his own way, and to make a living for himself. The exploding radio field in 1919, which he had foreseen, called him to commerce. True to his personal ethics, "… by reason of commercial connections, since he was entering the radio manufacturing business"[34] Tuska resigned as ARRL Secretary at a meeting on March 16, 1919.

In June 1919, he spoke for ARRL before a U.S. Senate Committee in testimony objecting to a proposed U.S. Navy takeover of the airwaves. [35] He was at most 24 years old at the time. Maxim had made prior Washington appearances on behalf of the League. Tuska's Senate testimony shows Maxim's continuing confidence in him.

At the time, the local A.C. Gilbert Company of Hartford made all sorts of toys and things of interest to young men. Tuska went to work for it as "designing engineer," promoted its crystal sets and radio supplies, and wrote an article for the company entitled: *The General Theory of Wireless Telegraphy*.[36] Next he made similar crystal sets[37] as his own radio parts company.

Tuska elected to forego radio broadcasting, despite holding the commercial land station license WQB as of September 1921, perhaps in connection with A.C. Gilbert. [38] He did, however, form "The C.D. Tuska Company [of] Hartford, Conn." initially to make radio apparatus of his own design. In mid-1919 Tuska placed a signed advertisement[39] in *QST* for "Radio Instruments at Amateur Prices" saying: "Our Aim: To sell good but inexpensive apparatus." Figure 7. His product line soon filled out,[40] including a coaxial tubular variable condenser he invented. In November 1919 he advertised[41] his "New Hi-Volt Storage Battery"—24 volts and built-in recharger from the AC mains.

Tuska Creates the Elegant *Superdyne* of the 1920s

The regenerative detectors of the receivers of the early 1920s earned themselves the sobriquet "bloopers" because their radiated squealing interfered with other sets. This much annoyed the neighbors. Several designers isolated the detector from the antenna with a radio frequency amplifier ahead of it. Stray capacitances in the triodes of the day nonetheless enabled a sort of

Fig.7. Tuska's signed July & September 1919 *QST* advertisement.

regeneration in radio frequency amplifiers. This was especially so in high-gain, multi-stage tuned radio frequency circuits (TRFs). The sets all too often defaulted to squealing oscillation.

The TRF circuit could provide outstanding sensitivity because, as Tuska wrote, the tuned radio frequency stages

> "… amplify the radio frequency before it gets to the detector. If this can be done, it is very much worthwhile because the response of the detector increases approximately as the square of the voltage applied to the grid."[42]

Tuska's briefly well-known Superdyne (Figure 8) circuit solved the problem (the "dyne" suffix for so many early circuits comes from the Greek word for power or force). He made and sold, nationally, several models of broadcast receivers for the home, between 1922 and 1925.[43] The first editor of this AWA Review, Robert M. Morris, wrote: "The Tuska Co. … designed and produced some excellent radio receivers, now prized in any collection of early radio equipment."[44]

As his 1916 article had shown, Tuska thoroughly understood Armstrong's regenerative circuit that used inductive positive feedback to enhance receiver sensitivity. But it was too much unintentional and unregulated capacitive feedback that caused the squeals and whistles. The process of invention ne'r runs smooth:

Fig.8. The C.D. Tuska Company Superdyne, circa 1924. From the Steve Johannessen (AWA) collection, his photo.

> "It was evident that we *must* use resonant circuits and it was further apparent that the minute we did use resonant circuits, the tubes would start to oscillate and spoil everything."[45]

Tuska solved the problem with an inventor's insight: use negative inductive feedback to stabilize the circuits:[46] "All that is necessary is to put in the conventional Armstrong feedback *but to feed the energy back in the reverse direction or negatively.*" (Tuska's emphasis; see Figures 9 & 10). He coupled a coil from the plate to the grid in opposite polarity. Figure 11. This inductive negative feedback canceled the stray capacity positive feedback if adjusted carefully by rotation. However, if adjusted even more delicately, some residual-capacity positive regenerative feedback remained. This provided " … astounding degrees of amplification" wrote Tuska.

Tuska had managed the technical problem of the triodes of the day. (See Figure 12, the Tuska Company logo). He took advantage of the necessary adjustment to make it his sets' volume

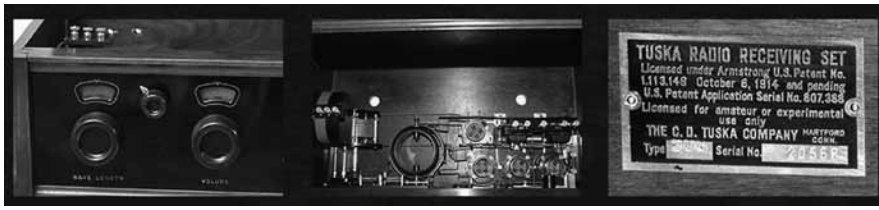


Fig.9. A triptych of the Superdyne with details of Tuska's patent application no. 807,388 at the right. From the Steve Johannessen (AWA) collection, his photo. This appears to be a model 305. Radiomuseum.org notes additional Superdyne models. 228, 301, & Superdyne Jr., and there may have been other models.

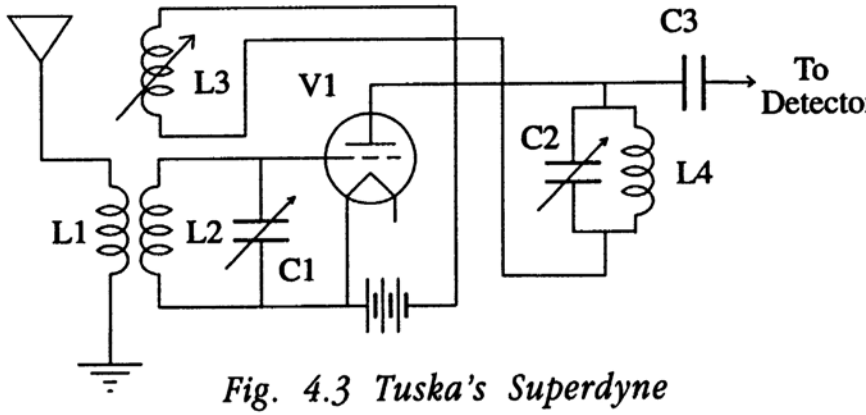


Fig.10. A schematic diagram of the Superdyne circuit, from David Rutland, Behind The Front Panel, *supra* n. 46 his Fig.4.3 at 35.

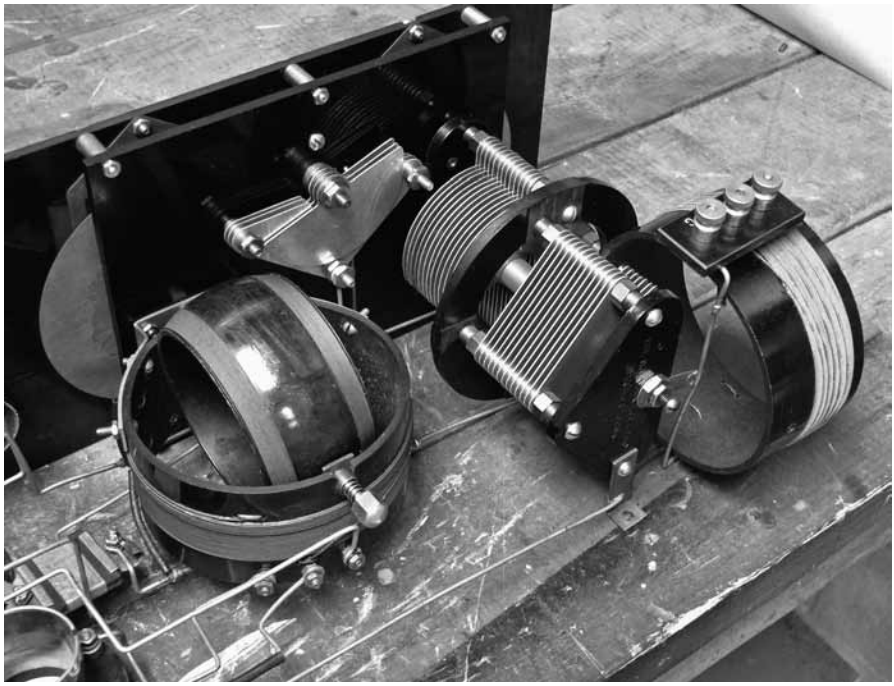


Fig.11. The adjustable inductive negative feedback device in the Superdyne. From the Steve Johannessen (AWA) collection, his photo.

Fig.12. The Tuska Company logo (a detail from an AWA photo).

control. But the adjustments, alas, tended to require more than consumer level skill and dedication, because retuning to a new frequency required readjustment of the feedback. Judging from the newspapers of the day, most listeners, at least during the day, were women who were not technically inclined. Only hobbyists wanted to fool with the knobs. (In general, people just wanted to turn their radios on, tune them in to a nearby station, and turn up the volume, while doing housework during the day, relaxing at night, or partying on the weekends at home during Prohibition, to the music of the local hotel orchestra.)

The Superdyne circuit soon fell to the capacitive neutralization of Professor L.A. Hazeltine.[47] This Neutrodyne circuit required no adjustment because it used factory installed insulated wires in a small cylinder to provide the needed counter-capacity, the "Neutrodon" condenser. In due course, a quite short course, the Neutrodyne in turn bowed to the screen grid tube, the tetrode. Its second grid eliminated the capacitive feedback that haunted triodes. The popularity of Armstrong's Superheterodyne circuit soon followed, as did pentodes. This stable universal

circuit dominated for decades until the advent of direct heterodyne detection in software defined radios—a reversion to Fessenden's original circuit.

After his own run at radio manufacturing, Tuska took his technical and commercial experience to Atwater Kent.[48] This company is now famous for its 1920s multi-dial breadboard receivers. The company made them to look like laboratory equipment as a marketing ploy. Atwater Kent soon moved on to the familiar metal boxes that were so much easier to operate.[49]

RCA Gets the Inventors' Inventor

In the midst of the Depression (1935), Tuska moved on to R.C.A.'s patent department,[50] as one of David Sarnoff's pool of talented executives who had individually pioneered radio in its earliest days, two decades or more before. R.C.A's distinguished hires included Elmer T. Cunningham, Arthur I. Isbell, Harold Beverage, and Elmo Pickerill, as well as Tuska. A high federal court in 1956 called Tuska "R.C.A.'s patent lawyer."

The court's opinion in that case provides insight into the operations—and challenges—of a busy industrial patent department.[51] With respect to the wartime RADAR patent at issue, the court noted:

> "There was considerable delay in filing the application for [this RADAR] patent. This is explained by R.C.A.'s patent lawyer, Mr. Clarence D. Tuska, by the fact that there were many applications in this general field to be made by him and they could not all be made simultaneously.... The veil of secrecy had been put over the results of experiments in the radar field for reasons of national security."

Tuska himself patented a wartime improvement to radio direction finding in 1942,[52] and continued to invent for several more years. [53]

Tuska did not train as a lawyer and did not practice law, but he did the work of senior patent counsel. He long acted as Director of Patent Operations at the R.C.A. Laboratories in Princeton, New Jersey. Tuska also continued to write prolifically on patents.[54]

Conclusion

Clarence D. Tuska enjoyed many adventures in early wireless telegraphy, in the early days of ARRL, in the Army, and in invention and commerce. His varied experience made Tuska a sympathetic and effective manager of electronics engineers and inventors. His reputation as a manager and a man was outstanding. His books about inventions and inventing, written in a down-to-earth tone and approach, encouraged inventors and honored the creative process. They are deeply historical and humane, with references to objects of art as well as technical matters.

Clarence D. Tuska was born in 1896 and died in 1985. This brilliant youth of 1914 advanced for his whole life one of the leading technologies of the 20th Century.[55]

Endnotes

1. C.D. Tuska, Inventors and Inventions (New York, 1957—hereinafter sometimes Inventors), Preface at vi.
2. This quote comes from the advertisement for his Patent Notes For Engineers (R.C.A., 1947) at the back inner dust jacket of his An Introduction To Patents For Inventors And Engineers (1957).
3. C.D. Tuska, *So You Want to be an Inventor,* Journal of the Franklin Institute, Vol. 255, No. 3, pp. 177–188 (March 1953); *Increasing Inventive Creativeness*, Vol. 260, No. 2, pp. 93–98 (August 1955).
4. Patent Notes For Engineers (R.C.A., 1947, multiple editions at RCA); Inventors and Inventions (New York, 1957); An Introduction To Patents For Inventors And Engineers (seven editions through 1964); and at age 76, Patents, And How To Get One For An Invention, two editions, 1972. His articles on invention are cited in the note above.
5. CellStream History of Telecommunication Timeline Wiki, http://www.cellstream.com/wiki/1900-1910, for 1907.
6. C.D. Tuska, *A Memorable Meeting* [with Maxim] in Fifty Years of ARRL, ARRL (Newington, 1965) at 5. Much of Fifty Years is attributed text from DeSoto, Clinton B., 200 Meters and Down, *supra.*
7. See generally, Clinton B. DeSoto, 200 Meters and Down (ARRL, Newington, CT, 1936 and reprinted).
8. The International Telecommunications Union (ITU) and the U.S. Federal Communications Commission define amateur radio:

   "A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is by duly authorized persons interested in radio technique solely with a personal aim and without a pecuniary interest" (ITU Regulations, Section III Radio services 1.56 amateur service; F.C.C. Regulations, C.F.R. Part 97 at 97.3(a)(4)).
9. ARRL, The National Association for Amateur Radio® celebrates its 100 year anniversary in 2014, in part by a series of historical articles in its magazine, *QST*. These articles include: Michael Marinaro, *In the Beginning*, *QST*, January 2014 at 69; Chris Codella, *Hiram Percy Maxim*, *QST*, February 2014 at 72; and Lee, [working title] *Clarence D. Tuska, Radio Pioneer, ARRL Founder*, [forthcoming] 2014. (This last is an earlier approach to some of the story of the present article). *QST* has been the primary publication of ARRL since 1915.
10. *A Memorable Meeting* at 5-6. Before 1912, amateurs selected their callsigns for themselves, often with some local cooperation among themselves.
11. *QST*, April 1936, in Fifty Years.
12. Fifty Years at 15.
13. Fifty Years at 26. League members raised money by bonds to pay off the debt that Tuska had taken on to publish *QST*. Some kept the bonds uncashed as souvenirs thereby making donations to the cause.
14. *Electrical World*, May 9, 1914 at 1057. Maxim seems to have avoided the publications of Hugo Gernsback (*e.g.*, *Modern Electrics*) who had sponsored the Wireless Association of America in 1909, which Gernsback could have seen as a rival to the nascent ARRL.
15. Fifty Years at 14; De Soto, *supra* at 41:

Maxim went to Washington in 1914 to get authorization for the special wavelength longer than 200 meters.

16. DeSoto, 200 Meters and Down, *supra* at 49. A message from the Seefred brothers, station 6AE in Los Angeles, reached Maxim and Tuska in Hartford at 1ZM by relay of half a dozen stations. By 1933, amateur radio handled 1.5 million messages, "20 per cent. of which were for the general public." *Ibid.* at 180; that comes to 300,000 free messages transmitted for a public suffering the financial stresses of the Depression. At today's postcard rate of 34 cents, that comes to something over $100,000; telegrams would be at least ten times more costly.
17. DeSoto, 200 Meters and Down, *supra* at 37 & 174.
18. *Ibid*. at 54.
19. Radio Service Bulletin, Bureau of Navigation, Department of Commerce, reports in issues 5 and 42, May 1915 and October 1920, and Fifty Years at 5 for 1WD; other sources as well, not all of which are consistent as to old call letters.
20. *QST*, April 1936 in Fifty Years; these included 1WH and later the special call 1ZM. (Perhaps "M" for Maxim by the courtesy of a friendly Radio Inspector, inasmuch as Tuska held 1ZT assigned at the same time).
21. His membership in the Institute of Radio Engineers as of 1915 is noted in his *QST* article *Pictured Electro-Magnetic Waves*, (December 1915) Issue No. 1 at 9.
22. *QST*, January 1916, accessible at http://en.wikisource.org/wiki/QST/January_1916/ The_Oscillating_Audion.
23. See, *e.g.*, Radio's First Two Decades at 49 (1987) reprinting part of Radio From Start to Finish (1942); Gleason L. Archer, History of Radio to 1926, at 112–113 & 189 (reprint Arno, 1971). But the first record of the suggestion is 1920; see, *e.g.*, Tom Lewis, Empire of the Air at 149 (1991).
24. C.D. Tuska, Inventors at 118–19.
25. See nearby photo from *Wireless Age*, February 1917 at 352.
26. C.D. Tuska, *A Radio Amateur in World War I,* 1 AWA Review 49 (1986).
27. *QST*, June 1919, the "Re-Opening Number" of *QST* at "Personal Notes." Official records note his service at Camp McClellan, Alabama, his last duty station. Annual Reports of the War Department, Vol. 1, Part 4 (1918) at 5170 (accessible on Google Books).
28. Tuska, *A Radio Amateur in World War I, supra*.
29. *QST*, July 1919 at 14.
30. DeSoto, Two Hundred Meters and Down, *supra* at 53.
31. *Ibid.* at 53 quoting Tuska.
32. C.D. Tuska, *A Radio Amateur in World War I, supra* at 56. Along with radio adventures, Tuska, serving in the Aviation Section of the Signal Corps, enjoyed all the drama of early aircraft, including involvement in crashes, getting lost flying at night, fuel leaks in the air, and more.
33. DeSoto, Two Hundred Meters and Down, *supra* at 53
34. Fifty Years at 26; ARRL has no letter of resignation on file.
35. Use of Naval Radio Stations for Commercial Purposes: Hearings… September 4, 1919 (U.S. G. P. O., 1919) at 95 (accessible on Google Books).
36. *QST*, June 1919 at 22 "Personal Notes";

also noted in Maurice L. Sievers, Crystal Clear: Vintage Crystal Sets, … Vol. 1 at 35. A 1920 A.C. Gilbert company pamphlet contains the article by Tuska on *The General Theory of Wireless Telegraphy*: A.C. Gilbert Company, Boy Engineering (Hartford, 1920) at 31.

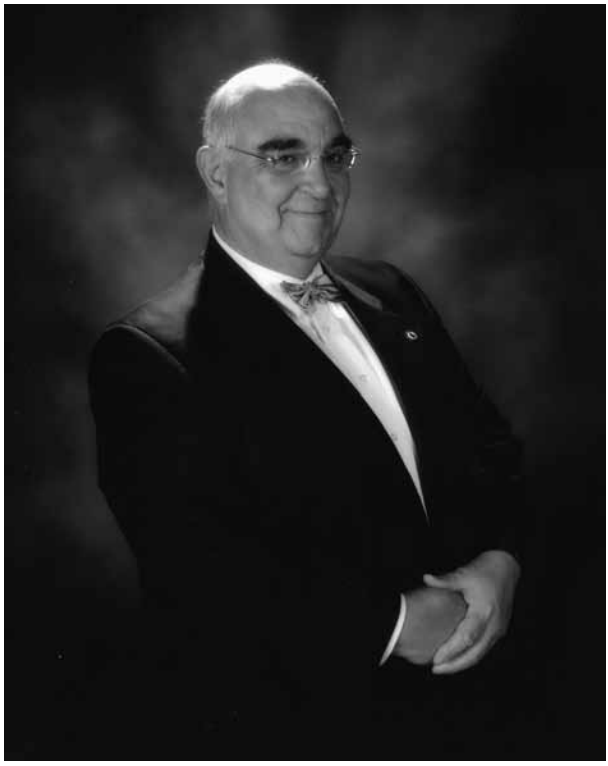
37. *E.g.*, Tuska model No. 4007; Crystal Clear at 35.
38. Ed Brouder of Hartford radio station WDRC, www.wdrcobg.com/ acgilbert3.html.
39. This advertisement appeared in *QST* in July 1919 at 25.
40. See, *e.g.*, C.D. Tuska Company, Experimental Radio Apparatus, Catalog No. 1 (Hartford, n.d. *circa* 1920 [reprint]) and *QST*, August & September 1919 at 25 & 38 respectively. In March of 1919 he had patented the coaxial tubular variable condenser, U. S. Patent 1,371,061, reported in *Electrical World* (1919, Vol. 77), reissued Sept. 23, 1923, No. Re.15689. This device would appear to be the Variable Condenser pictured in Tuska's 1919 *QST* advertisement.
41. *QST,* November 1919 at 51.
42. C.D. Tuska, *The Superdyne Receiver*, *QST*, November 1923, at 7–12.
43. Much information on Tuska's radios, and thousands of others may be found on Ernst Erb's www.radiomuseum.org, *e.g.*, search "Tuska."
44. Robert M. Morris, W2LV, in his Editor's Note to C.D. Tuska, *supra*, 1 AWA Review at 63. Morris inserted the Tuska Company battery advertisement at the end of his note at 64 his Figure 10.
45. Tuska, *The Superdyne Receiver*, *supra*.
46. This analysis comes from David Rutland, Behind The Front Panel—The Design & Development of 1920's Radios, (self-published 1994; reprinted by permission by the California Historical Radio Society in 2014) at 33ff, relying on C.D. Tuska, *The Superdyne Receiver*, *supra*.
47. See Mike Molnar, *Hazeltine, the Neutrodyne and the Hazeltine Corporation*, 26 AWA Review (2013) at 3, 9ff and its Figure 7. See also, Rutland, *supra* at 36ff and its plate 13.
48. He assigned a refrigeration patent to Atwater Kent as late as 1934: U.S. Patent 2,042,568, filed Sept. 29, 1934.
49. Ralph O. Williams, *The Atwater Kent Radios*, 12 AWA Review 5, 283–285 & 305–306, declares that radio design at the Atwater Kent company had become "hum-drum" by 1934–'35 and the company turned to refrigeration, but Atwater Kent closed it in 1936.
50. He assigned his patent on his Superdyne system, filed in 1923, but granted in 1933, to RCA: U.S. Patent 1,925,291A. This patent discusses in detail Tuska's solution to the neutralization problem. It is a fair inference that assignment of this patent related to his employment in 1935.
51. *Radio Corporation of America et al., vs. International Standard Electric Corporation*, 232 F. 2d 726, 731 (3rd Cir., 1956).
52. U.S. Patent 2,279,021, April 4, 1942.
53. In addition to the Superdyne patent, Tuska enjoyed at least six other patents dating from 1922 to 1969, according to Google patents.
54. *E.g.*, C.D. Tuska, Inventors and Inventions, *supra,* (New York, 1957; nine editions) at inner dust jacket biography. Tuska also wrote Patent Notes For Engineers for R.C.A. in 1947, which went through 22 editions. See notes 2–4 *supra.*

55. His son, James D. Tuska, continued the family tradition as an inventor for RCA; he died in 2013: http://www.seacoastonline.com/articles/[*etc.*]. Clarence Tuska's grandfather Morris immigrated from Hungary (1844) and was prominent in the New York Jewish Community, after working the California Gold Rush. He died in 1903. Tuska's father David died in 1909. Tuska was born on August 15, 1896 and died on July 1, 1985.

About the Author

Bartholomew (Bart) Lee, K6VK, xKV6LEE, WPE2DLT**,** is a long time member of AWA and a Fellow of the California Historical Radio Society (CHRS), for whom he serves as General Counsel Emeritus and Archivist.

He has enjoyed radio and radio-related activities in many parts of the world, most recently in East Africa. Radio technology and history have fascinated him since he made his first crystal set with a razor blade and pencil lead more than 50 years ago. He is especially fond of those sets of which it is said: 'Real Radios Glow in the Dark.' Bart is a published author on legal subjects and most recently on the history of radio. He has written about and lectured on early radio technology, radio intelligence activities ('episodes in the ether wars') from 1901 into the latter 20th Century, wireless telegraphy especially Marconi's early work, wireless developments on the West Coast since 1899, radio ephemera including radio stamps, and radio in emergency and disaster response. Since 1989 he has made some 20 presentations to the AWA conferences on his research interests including short wave radio and the development of television in San Francisco in the 1920s. The AWA presented its Houck



Bart Lee. Photo by Paula Carmody taken in Indonesia; copyright Bart Lee 2009.

Award for documentation to him in 2003 and CHRS made its 1991 'Doc' Herrold Award to him in connection with his work for the Perham Foundation Electronics Museum. In 2001, during disaster recovery operations in New York after the '9/11' terrorist enormity, he served as the Red Cross deputy communications lead from September 12 to September 21, (the 'night shift trick chief'). He has served in RACES as the Liaison Officer for the San Francisco Auxiliary Communications System, and as an ARRL ARES Emergency Coordinator.

He presently serves as an ARRL Government Liaison and Volunteer Counsel, and holds an FCC Commercial licence (General with RADAR) as well as an Amateur Extra Class licence. Bart has been a litigator by trade, prosecuting and defending civil cases in both state and federal court for 40 years. He also had taught Law & Economics for 20 years, including the economic history of telecommunications.

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Bart's son Christoffer Lee is also a licensed amateur radio operator and is now also a practicing lawyer. Bart invites correspondence at: KV6LEE@gmail.com .