

## ***The History of the Development of Electric Stringed Musical Instruments***

The history of the development of electric stringed musical instruments – in particular, the electric guitar and the electric bass is a fascinating one. It is a story of the interplay between man's discovery of the basic, fundamental laws of physics and new physical phenomena and the creative, constructive synthesis and assimilation of this new knowledge into our culture for the enhancement and evolution of our cultures' music, taking it in completely new directions.

The development of the electric guitar obviously occurred from the collective desire of musicians to electrify (and thereby amplify) the sound of their guitar, in order to better match the intrinsic volume levels of other instruments often used in bands. The historical path of how this occurred is a very interesting story!

Hawaiian music was initially introduced into America by U.S. servicemen returning from overseas tours of duty in the Hawaiian islands, in the aftermath the Spanish-American war (April 21-August 12, 1898), in which Cuba was liberated from Spanish rule, Puerto Rico and Guam were ceded by Spain to the United States, the Philippines were sold to the U.S. for \$20M, and the Hawaiian Islands were formally annexed by a resolution on July 7, 1898 from then-President William McKinley, which was rapidly approved by the U.S. House of Representatives and U.S. Senate, with a transfer of sovereignty on August 14, 1898.

American sailors, while stationed in Hawaii, upon hearing Hawaiian music, were completely enamored with it. Some of them also learned how to play it, and thus brought Hawaiian music back to the U.S. with them when they returned. Hawaiian music rapidly became extremely popular amongst the American public, at the turn of the 20<sup>th</sup> century.

The Spanish 6-string guitar was introduced to Hawaiian culture by Portuguese and other European sailors around the beginning of the 19<sup>th</sup> century. These gut-stringed musical instruments were also brought to Hawaii by Mexican and Spanish vaqueros (cowboys) around 1832, when King Kamehameha III hired them to teach Hawaiians how to handle an over-population of cattle. Likely in the evenings around their campfires, the vaqueros would play their guitars, often two together, one playing lead melody and the other bass and chords. This new kind of musical instrument intrigued the Hawaiian cowboys, or paniolo, as they were known. When the hired cowboys returned to the Mainland a few years later, some of them gave their guitars to the Hawaiians. The Hawaiian musicians incorporated what they had learned from the vaqueros' Mexican & Spanish music into their traditional chants, songs & rhythms, thus creating a new form of guitar music, known as Hawaiian slack-key guitar (ki ho'alu) which literally means "loosen the key". The standard E-A-D-G-B-E Spanish guitar tuning was changed to a D-G-D-G-B-D, a G-Major "Taro Patch" tuning, or sometimes tunings containing a Major 7<sup>th</sup> note ("Wahine" tuning), or tunings with the top two pitches tuned to a wide 5<sup>th</sup> interval apart ("Mauna Loa" tuning) and other interesting tunings. The open-G (and open-D) tunings in fact already existed in popular Spanish music – as the so-called scordatura (alternative) tunings. So it is possible that the vaqueros actually taught the Hawaiians these open tunings.

In the mid-1860's, steel guitar strings were developed, which Hawaiian musicians much preferred for their slack-key open tunings. The steel-stringed guitar, played lap-style was originally invented and popularized in Hawaii. Legend has it that an 11-year old Hawaiian schoolboy, Joseph Kekuku (1874-1932) discovered the sound while walking along a railroad track strumming his guitar. As one version of this story goes, he picked up a railroad spike lying by the side of the track and slid it along the strings of his guitar. Intrigued, he taught himself to play his guitar using the back of a knife blade.

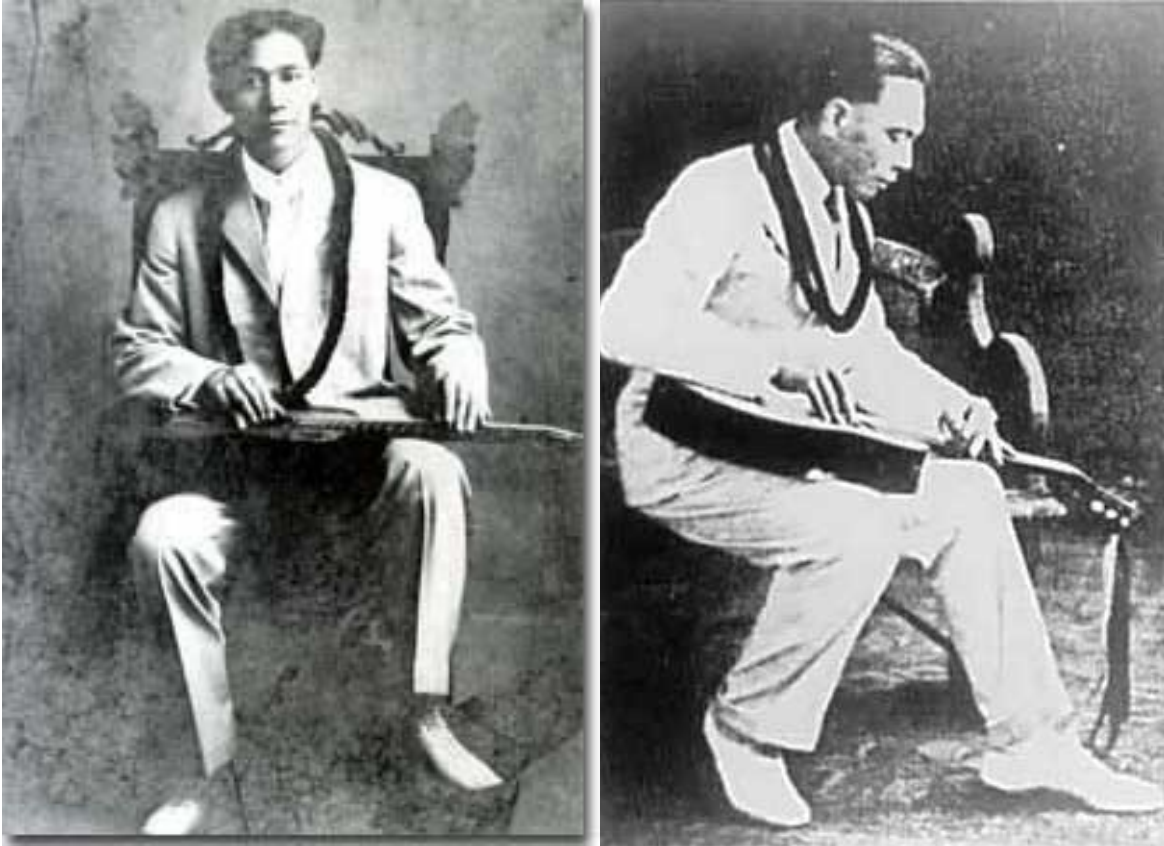


Figure 1: Photographs of Joseph Kekuku playing slack-key Hawaiian guitar.

Other people who are credited with the invention of the steel guitar are Gabriel Davion, an Indian sailor, around 1885 and James Hoa, a Hawaiian of Portugese ancestry. Joseph Kekuku toured the mainland U.S. in the very early 1900's and made some of the earliest recordings of Hawaiian music, subsequently heard by many Americans. Hawaiian music was a very definite influence on the subsequent development of blues – Mississippi delta blues – bottleneck/slide guitar in particular, as well as bluegrass music and so-called sacred steel music. It also had a significant impact on the development of Jazz music, and later on had further influence on the use of the steel guitar as often used in western swing and country music.

Hawaiian music was certainly a huge hit at the 1905 Lewis & Clark Exposition in Portland, Oregon, the 1909 Alaska-Yukon-Pacific Exposition, held in Seattle, Washington. Interest in Hawaiian music was further sparked by the success of Richard Walton Tully's 1912 Broadway play, "Bird of Paradise", starring Laurette Taylor. The Hawaiian Quintette recorded the play's incidental music for Victor. The 1915 Panama-Pacific International Exposition, held in San Francisco, California celebrated the opening of the Panama Canal (completed in August, 1914). More than 13 million people attended this world's fair, where the Hawaiian Pavilion showcased a great many Hawaiian musicians, e.g. Keoki Awai's Royal Hawaiian Quartette. During the period 1915-1930, a large number of recordings of Hawaiian music and publications of Hawaiian guitar methods and songs were made by the major music publishers.

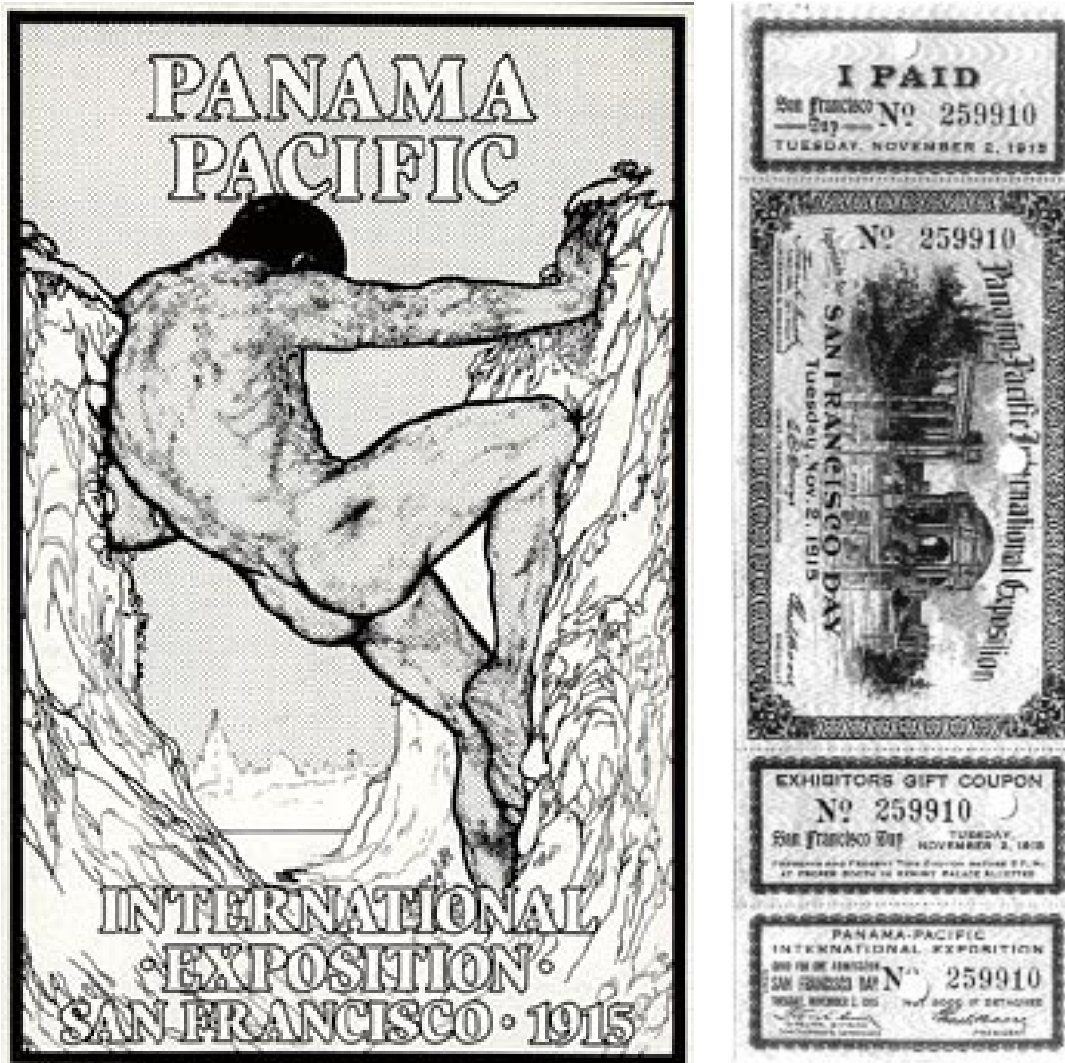


Figure 2: Poster and ticket for the 1915 Panama-Pacific International Exposition, San Francisco, California, celebrating the opening of the Panama Canal.

With the rapid rise of popularity of Hawaiian music in the United States, musicians who played this kind of music became regulars on the famous Vaudeville circuit. Their music was also available to the masses through early recordings of their music – Hawaiian guitar musicians including Joseph Kekuku, with Toots Paka’s Hawaiian troupe, W.K Kolumku, Frank (aka Palakiko) Ferreira and many others – played on the early Edison and/or the Victor Victrola phonograph players.

Many of the Royal Hawaiian Band members loved the concept of soloing, improvisation, variation and had a sense of strong group interaction and group dialog. The Hawaiian musicians on the Vaudeville circuit often shared the stage with jazz and blues musicians. Many of the great Hawaiian musicians of the post WW-I era - the 1920’s, such as Sol Ho’opi’i played blues, and were avid fans of e.g. the New Orleans Rhythm Kings and Louis Armstrong. Thus, much cross-pollination/influence of Hawaiian music with Jazz and Blues occurred during this time, and vice-versa.

A significant problem encountered with live Hawaiian music was that it was difficult to hear the Hawaiian guitar – since it was played horizontally, the sound from the guitar was projected vertically upward toward the ceiling, and not outward, horizontally toward the audience.

In the latter part of the 1920’s, some enterprising men, a Vaudeville Hawaiian guitarist, George Beauchamp (pronounced Beechum) and musical instrument repairmen, John and Rudy Dopyera, in Los Angeles, worked together on developing a mechanically-amplified acoustic guitar. They, along with others such as tool-and-die maker, Adolph Rickenbacker and John Dopyera’s 17-year old nephew, Paul Barth formed the National String Instrument Corporation in late 1925. Their first attempt at a mechanically-amplified guitar was inspired from the horn of an early type of phonograph player – their Hawaiian guitar sat on a stand and the horn was attached to the bottom of the guitar – it worked, amplification wise, but it sounded terrible. Next, inspired by the thin mica disc used in a Victrola phonograph player, they experimented with thin discs of mica, pressed fiber (bakelite), glass, tin and other metals, finally settling on a very thin, conical-shaped spun aluminum resonator. John Dopyera particularly liked the sound of this new kind of guitar, using three smaller-diameter aluminum resonator cones, mechanically connected to the bridge via a T-shaped bar inside the all-metal body of the guitar. He applied for a patent on this tri-cone resonator guitar design in 1927, which was finally granted in 1930.



George Beauchamp



Adolph Rickenbacker

Figure 3: George Beauchamp and Adolf Rickenbacker, ca. ~ 1925.



Figure 4: 1928 National Tricone Resonator Guitar.

However, John insisted on the development of a single resonator-coned instrument, because of cost. Only professional musicians could afford the more expensive tri-cone resonator guitar – thus the market for these was finite and limited. An inexpensive, single-cone version had a much bigger potential market, that of non-professional musicians and enthusiasts. John Dopyera left National in 1928 – starting a new company, The Dobro Corporation, and began making the more affordable single-cone resonator guitars. Shortly thereafter George Beauchamp, with his investors, also came out with a single-resonator guitar, from the then-named National Reso-Phonic Guitars company. Both companies wound up suing each other, John Dopyera ultimately winning.

Louis Dopyera, one of John's many brothers, became a majority stockholder at National in 1932, and Beauchamp left the company shortly thereafter. The two previously rival companies also merged shortly thereafter, becoming known as the National Dobro Corporation. This company put out guitars under both the National and Dobro names at this time. The corporation moved from Los Angeles to Chicago in the winter of 1936.

A wide variety of models and styles of single- and tri-cone resonator guitars, resonator mandolins and resonator banjos were made. The cost of single-cone resonator guitars in the early 1930's – the years of the Great Depression, typically ranged from ~ \$30 - \$65 from cheapest to top-of-the line, compared e.g. to a Martin D-18 acoustic guitar (~ \$55) whereas the tri-cones ranged from ~ \$125 - \$195, considerably more. Indeed, the sales of the less expensive, single-resonator guitar enabled National-Dobro to survive the Great Depression era.



Figure 5: 1933 National Style “O” Resonator Guitar – “Exploding Palm Tree” Engraving.

Lloyd Loar had been employed at the Gibson Mandolin-Guitar Company in Kalamazoo, Michigan since 1919. He was a gifted musician, and was also responsible for the development of the many “Master Series” instruments that Gibson made, including the venerable Gibson F-5 mandolin and L-5 guitar, in 1922. In 1923, Loar developed a very early, crude form of electrified guitar – using the physical vibrations of the guitar, as transmitted through the bridge, coupling these to a carbon-granule diaphragm-type microphone (as used in early telephones) and a crude form of early vacuum tube amplifier, which of necessity was battery driven, because there was no AC “wall power” present at this time in the country. The pickup was weak, finicky and quite sensitive to humidity. Using the same technology, Loar also developed an electric viola and electric bass. The Board of Gibson was not impressed with the new-fangled instruments, and Loar, for a number of reasons, left Gibson in 1924. Note that loudspeaker technology was also in its infancy at this time.

In 1929, the Stromberg-Voisinet Company (soon to become Kay) attempted to make a commercial success of Loar’s type of electric guitar, but it flopped.

Meanwhile, George Beauchamp, Paul Barth and Adolph Rickenbacker were hard at work on developing a solid-body, cast-aluminum electric Hawaiian guitar, utilizing a pickup with two horseshoe magnets and a coil of wire. It was nicknamed the “Frying Pan”, because of its appearance. A new company, Ro-Pat-In Corporation was formed – at the depths of the Great Depression – in 1931, to produce the instrument and its accompanying amplifier. Only ~ a dozen or so of these instruments were sold in 1932. The name of this company was soon changed to the Electro-String Corporation. The Electro-String Corporation would remain with its name until 1953, when it was purchased by Francis C. Hall, previously the exclusive distributor for Fender Electric Instruments. F.C. Hall renamed his newly-purchased company Rickenbacker Guitars....

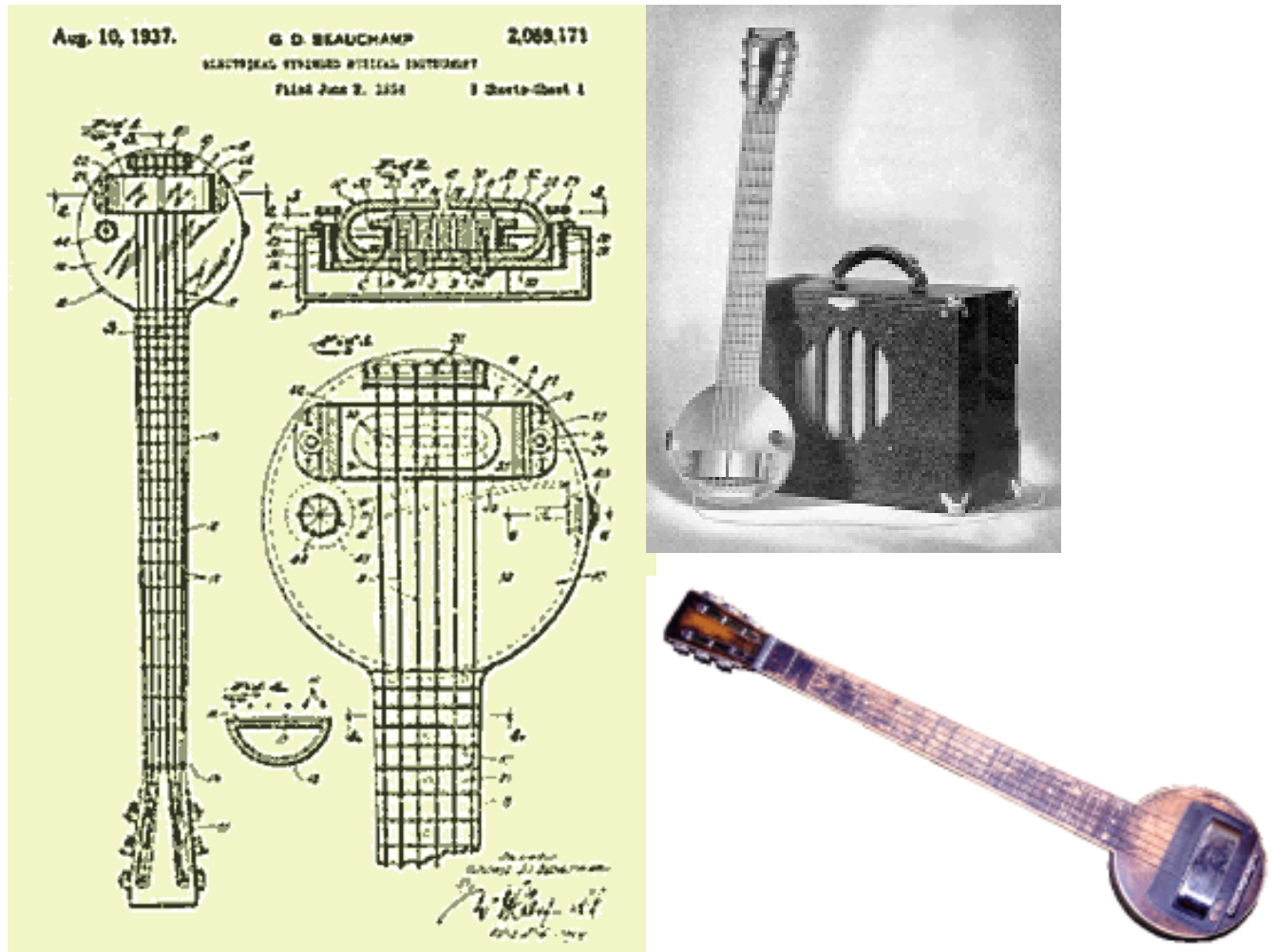


Figure 6: Ro-Pat-In/Electro-String “Frying-Pan” Electric Hawaiian Lap Steel Guitar and Amplifier, and Patent Application.

Lloyd Loar and former Gibson co-worker L.A. Williams formed their own company, ViViTone to market their own electric guitars in 1933 – ViViTone was also located in Kalamazoo, Michigan. However, for all their inventive genius in engineering and marketing, ViViTone’s efforts flopped by the end of the year, at least for guitars. They continued to work on developing other electrified stringed instruments, such as pianos.

In 1935, Gibson re-initiated development of electric musical instruments, initially with the help of an engineering firm – Lyon & Healy in 1935, and also with the help of notable musicians, such as Alvino Rey, who played an Electro-String “Frying Pan” electric Hawaiian guitar. However, it was a Gibson employee, Walter Fuller who ultimately succeeded in designing the pickup for Gibson’s new electric Hawaiian guitar – initially all-aluminum, named the EH-150, the guitar and matching amplifier (designed by Lyon & Healy) which sold for \$150. Shortly thereafter, Gibson also installed this pickup on one of their acoustic/Spanish guitars, and named it the ES-150. Gibson soon was building all-wood electric Hawaiian guitars. In 1936, Gibson also came out with the EM-150 electric mandolin, as well as a family of electric banjos!



Figure 7: Early Gibson EH-150, ES-150 and EM-150 electric Hawaiian and Spanish guitars, and electric mandolin.



The stylistic pickup characterizing these early Gibson electric stringed instruments is known today as the “Charlie Christian” pickup, because Christian was one of the first professional musicians to use the ES-150, immortalized in his pre-WWII jazz recordings with the Benny Goodman Band, which he joined in 1939.

July 13, 1937.

G. HART

2,087,106

ELECTRICAL MUSICAL INSTRUMENT

Filed Feb. 8, 1936

2 Sheets-Sheet 1

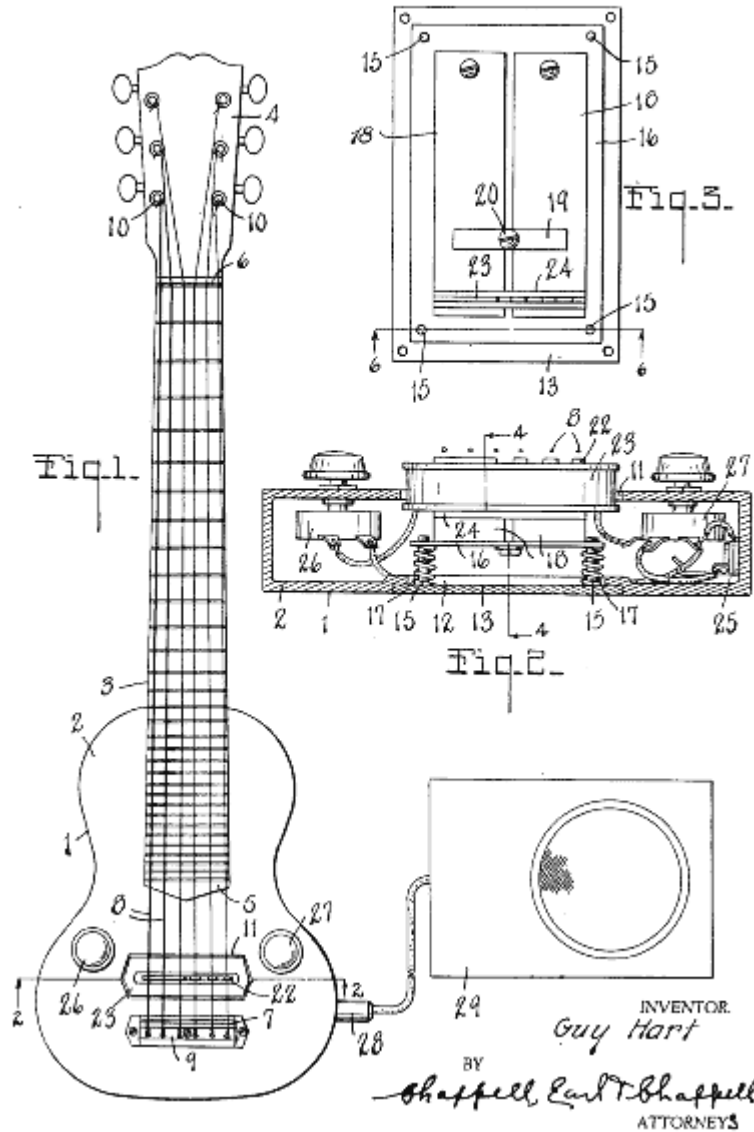


Figure 8: Patent filed in 1936 by Guy Hart (President of Gibson from 1924-48) for the design of the Gibson EH-150 electric Hawaiian guitar.

The Gibson EH-150 electric Hawaiian guitar was in fact hollow inside – in order to make room for the volume and tone controls, and more importantly, for the bulky pickup.



Figure 9: The Insides of a 1939 Gibson EH-150 Electric Hawaiian Guitar.



Figure 10: Charlie Christian & his Gibson ES-150 with Benny Goodman, Autumn, 1939.

National-Dobro also came out with a both an electric Hawaiian guitar and a good-looking electric Spanish guitar in 1935, and soon, Epiphone also followed suit. The birth of electric musical instruments had arrived – and all major musical instrument companies were scrambling to make more, to grab a piece of/dominate the market-share!

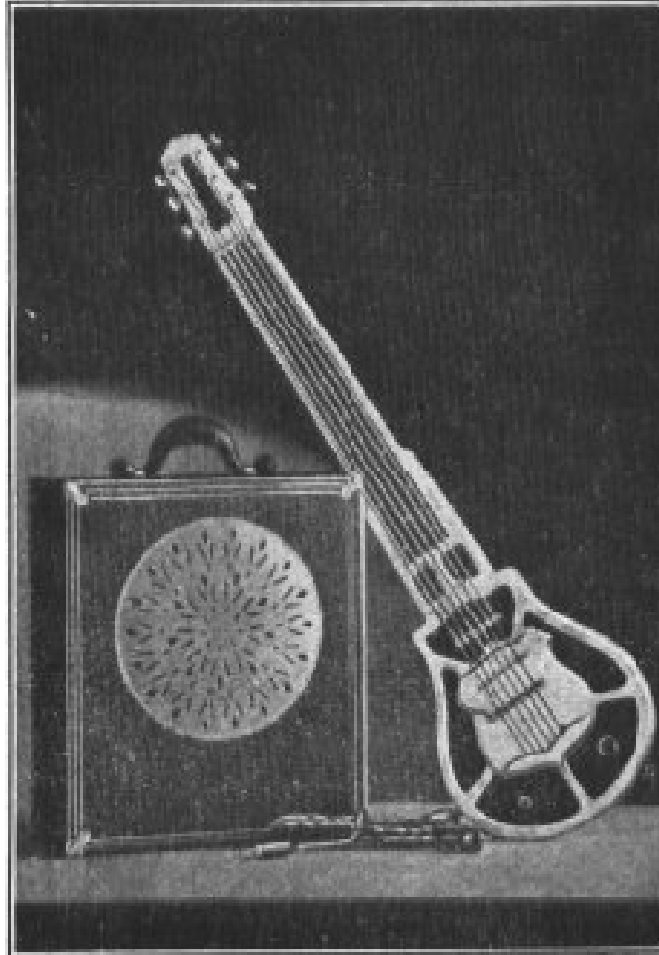


Figure 11: Early National electric Hawaiian guitar and amplifier.

By this time, much of the U.S. was beginning to be wired up/was already wired up for A.C. power distribution; there had been significant advances in vacuum tube technology (RCA began production of the metal-cased 6L6 beam power-pentode in 1936), electronics components in general – such as resistors, capacitors, power and output transformers, and also (electro-dynamic) loudspeaker technology. Thus, technologically, the time was also right for electrified musical instruments to be produced and mass-marketed, successfully. The nation was recovering from the depths of the Great Depression and people had more optimism for the future.

For musicians, the electric Hawaiian guitar – the very earliest examples were solidbody guitars – fulfilled a long-standing need for greater volume; the accompanying increased sustain of the solidbody Hawaiian guitar was a very appealing benefit for this particular genre of music!

One very famous musician, teacher and innovator of Hawaiian music of this era was Elbern “Eddie” Alkire (1907-1981). In 1929, he became a teacher and composer of Hawaiian music for the Oahu Music Company (Cleveland, OH). He was music director of the Oahu Serenaders, which performed more than 1000 nation-wide broadcasts via NBC and CBS during the early years of network radio. Alkire started his own company in 1934 in Easton, PA publishing and teaching Hawaiian music. Eddie Alkire was also knowledgeable of all things electronic, and developed the first 10-string electric Hawaiian guitar, designed and built his own tonally unique/versatile amplifiers. He used his musical expertise to create novel tunings of the 10-string electric Hawaiian guitar which enabled him to play four-part harmonies and rapid melodic passages that became the hallmark of his unique performance(s) of Hawaiian music.



Figure 12. Eddie Alkire, with one of his 10-string Alkire “E-harps”, circa ~ 1940 .

WW-II ended in August, 1945 Leo Fender, with his then co-partner, “Doc” Kaufman started up K&F Electric Instrument Company (for Kaufman and Fender) , producing a line of electric Hawaiian lap steels and matching amplifiers. Prior to this, Fender ran a small radio repair shop in Fullerton, California (now a suburb of south-east Los Angeles). Kaufman was a veteran of the Vaudeville circuit, and had earlier developed an electric motor-driven vibrato unit for use with electric Hawaiian guitars, for which he had obtained a patent. The K&F Hawaiian lap steels with their sweet-sounding “direct-string pickup” and amps were not fancily-made, like those of Gibson, however, while they were functionally well made, they were also frugally-made, in order to make them affordable to all.



Figure 12: 1945 K&F (Kaufman & Fender) Hawaiian Lap Steel Guitar & Matching Amp.

Apparently, because of the potential financial risk associated with scaling up production, and his own personal memories of the Great Depression era, Doc Kaufman opted out of his collaboration with Leo Fender, leaving Fender to make a go of it on his own in 1946. Thus, the Fender Electric Instrument Company was born.



Figure 13: 1946 Fender electric Hawaiian Deluxe "Organ Button" Lap Steel Guitar.

Fender initially developed a whole line of electric Hawaiian lap steel guitars – single, double and triple-necks, and an accompanying line of amplifiers. He developed the first solid-body electric guitar – the single-pickup Esquire, and the Broadcaster – a 2-pickup version, in 1950 (The Broadcaster name was chosen in reference to radio and TV broadcasts). The necks were bolt-on, and initially had no truss rod.



Figure 14: 1950 Fender Broadcaster.

Unfortunately, shortly after the debut of the Broadcaster, Fender received a telegram from the Fred Gretsch Musical Instrument Company, informing him that the name Broadcaster infringed on Gretsch's pre-existing (since 1937) BroadKaster name for one of their drum kit lines. Thus, Fender had to cease-and-desist on the use of this name for their guitar and come up with a new name. While this was in the works (~ from the end of February - Summer, 1951) employees at Fender clipped the "Broadcaster" name off of the headstock decals applied to these guitars – hence these no-name guitars are today referred to as "NoCasters". Soon the guitar was renamed the Telecaster, a direct reference to television broadcasts – telecasts. The first commercial TV broadcast occurred on July 1, 1941 by WNBT (now known as WNBC) – serving the NY, NJ and Connecticut areas.

In 1951, Leo Fender introduced a fretted electric bass guitar, known as the Precision Bass. It too had a replaceable (if necessary) bolt-on neck. The Fender Precision Bass was not the first electric bass guitar produced – that honor went to musician/teacher, instrument/amplifier-maker Paul H. Tutmark of Audiovox, of Seattle, Washington. Tutmark had an upright, solid-body electric bass on the market as early as February, 1935. This bass was refined and marketed by Audiovox as the radical new #736 Electronic Bass with matching model # 936 amp in early 1937. However, the Audiovox bass and amp never really took off, commercially speaking.

When the horizontally-played Fender Electric Precision Bass was introduced in November, 1951 and shortly thereafter, its companion 1x15" Bassman amp in early 1952, both listing for ~ \$200 each, they were a match made in heaven for musicians wanting to double their wages. The design of the Fender Precision Bass was such that it made it very easy for musicians to switch between playing a regular electric guitar and the new bass.



Figure 15: 1951 & 1952 Fender Precision Bases, and 1952 Fender Bassman Amp.

The Fender Precision Bass, with its pounding, ever-sustaining bottom end (compared to the anemic sound from a dog-house double-bass) set the stage for the creation of whole new genres of music – most notably rock and roll, and everything that followed after it – by enabling the sound(s) from the electric bass to simultaneously synergize with both the drums (rhythm) and with guitar(s) (melody) in a way never before possible, let alone dreamed of.

In 1952, Gibson, with Ted McCarty as president, was eager to answer Fender's challenge with a solid-body electric guitar of their own. Gibson enlisted the advice and help of Les Paul – then king of the electric guitar. Gibson named their new electric guitar in honor of Les Paul, which hit the streets in the summer of this same year, sporting a solid-body made of mahogany and set mahogany neck, with a carved maple top and two P-90 single-coil pickups. These guitars had amazing tone and sustain.



Figure 16: 1952 Gibson Les Paul Goldtop with P-90 Single-Coil Pickups.



In late 1952/early 1953, Gibson came out with their answer to the Fender Precision Bass, the Gibson EB-1 Bass, which was a shorter-scale bass than the Fender, and shaped like a violin, complete with faux f-holes painted on the carved solid mahogany body and set mahogany neck. It weighed a ton! It had a removable/replaceable telescoping end-pin, so that it could be played either as an upright bass, or horizontally, like the Fender Precision Bass. It had an enormous, highly-overwound pickup, and banjo-style tuners.



Figure 17: 1953 Gibson EB-1 Bass.

In 1954, Fender upped the ante with the release of their ultra-modern Stratocaster guitar, sporting three single-coil pickups and new-fangled tremolo bridge. This guitar was “as new as tomorrow” and stunning in its looks and ergonomic design, with fore-arm contour on the front and belly contour on the back. It was way too cool in looks and tones!



Figure 18: 1954 Fender Stratocaster.

At the end of the 1950's – hot on the heels of the Sputnik satellite/cold-war era, Ted McCarty and co-workers at Gibson introduced the ultra-futuristic Flying V, Explorer, Moderne and Futura solid-body guitars to the buying public. However, even with the new-fangled, patent-applied-for humbucking pickups (designed by Set Lover, Gibson engineer) and exotic korina wood used for the guitar bodies, the public did not buy into these guitars, until much, much later. Apparently they were just too far out there, at least at the time. Today, these classic solid-body guitars are much revered and highly sought after – they were produced in very limited quantities!



Figure 19: 1958 Gibson Flying V and Explorer.

In the 1960's, with the onset of rock-and-roll/rock music, there was a veritable explosion of electric guitars and ever-increasingly powerful amplifiers to play them through. Musicians such as The Beatles, The Rolling Stones, Jimi Hendrix, the Cream, The Who, The Yardbirds, Jeff Beck, Led Zeppelin, Traffic, The Doors and many, many others pushed their music to an all-time high. The Marshall Stack was born – along with it, the new sound of rock – Jimi Hendrix was one of the most potent ambassadors for Marshall (and the Fender Strat). Some famous pictures from this era are shown below.



Figure 20: Jimi Hendrix at Woolsey Hall, Yale University, Connecticut, 1968, and Woodstock Festival, New York, 1969



Figure 21: The Cream's Farewell Concert, Albert Hall, London, 1968.

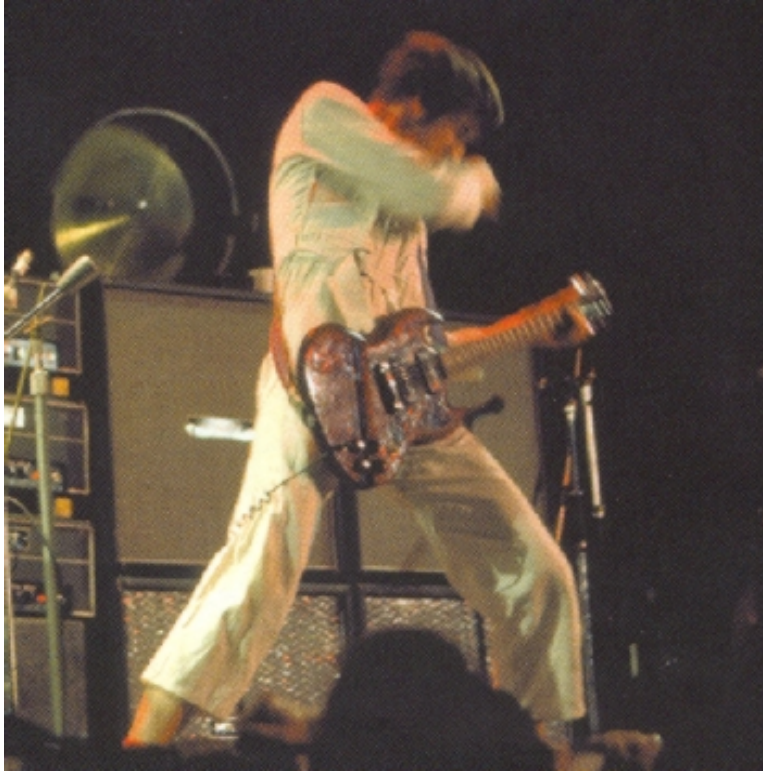


Figure 22: Pete Townsend of the Who at the Isle of Wight Festival, England, 1970.

Basic science R&D and the subsequent integration of this knowledge into our human culture enabled the development of electric stringed instruments and the genres of music that were created. Extending upon Michael Faraday's theories of electricity and magnetism, James Clark Maxwell's 1873 achievement of unifying these two phenomena into a single phenomena – electromagnetism, set the stage for all that followed. Maxwell's theory predicted the existence of electromagnetic waves. Such waves were experimentally discovered in 1888 by Heinrich Hertz, confirming the validity of Maxwell's theory. Guglielmo Marconi repeated Hertz's experiments, increasing the distance over which electromagnetic waves could be detected – from a few meters to a few kilometers. In 1897, Marconi obtained a patent and established the Marconi Wireless Telegraph and Signal Company, Limited, which opened the world's first radio "factory" in Chelmsford, England, in 1898. Marconi successfully transmitted wireless signals across the Atlantic on December 12, 1901, stunning the entire world. The age of radio had begun!

At about this same time, the world's first vacuum tubes were being developed. Thomas Alva Edison had accidentally discovered vacuum rectification in 1880, in the process of attempting to improve his electric light bulb technology. While he didn't then understand the basis of the phenomenon, he did patent it, because he recognized it might be useful – someday. Note that the electron wasn't discovered until 1897 by J.J. Thompson. Today, thermionic emission of electrons from a heated filament (cathode) is understood as the basis for the so-called Edison Effect.

In 1899, John Ambrose Fleming, working for the Marconi Wireless Company, was seeking a more sensitive detector for wireless reception to improve upon Marconi's original "coherer" tube (which was filled with finely-ground iron filings – which in the presence of radio frequency energy, the iron filings cling together – cohere – and allow current to pass). Fleming tried the Edison Effect bulb for this purpose, and found that it worked very well. Thus, the vacuum diode was born – the Fleming valve, as it soon came to be known.

In 1906, Lee DeForest added a third electrode element – a grid between cathode and plate (anode) of Fleming's diode. DeForest called his device an "audion" tube – an early form of triode vacuum tube, which was capable of both rectification and (voltage) amplification. Not only did this device have applications for world-wide wireless telegraphy, but also radio broadcast of e.g. the human voice! The first extended radio broadcast of the human voice and music occurred on December 24, 1906 from Brant Rock, Massachusetts – by Reginald Fessenden, a Canadian chemist, who had also previously worked for Edison.

The public world-wide was totally enraptured by radio – the notion of voice communication without any physical wires, via electromagnetic waves just blew many people's minds at that time! It was *the* high-tech of that era! Radio technology and radio broadcasting and reception soon took off commercially. Initially, commercially-made radio receivers for home use utilizing vacuum tube technology were battery-powered, because no infrastructure then existed for widespread electrical power distribution. Thomas Edison, and George Westinghouse (backed by physicist Nicola Tesla), were both very interested in bringing electrical power to the masses, however Edison firmly believed DC electrical power to be the answer, whereas Westinghouse equally firmly believed AC electrical power to be the way. A titanic struggle between the two ensued, but Westinghouse/Tesla ultimately prevailed because of the physics. AC power was soon being supplied to the masses, and as rapidly as communities were wired up for consumption of such power, consumer demand for all things electrical skyrocketed exponentially, including AC-powered radios, phonograph players and yes, electric musical instruments!

**References/Further Reading: History of the Development of Electric Stringed Instruments:**

1. Bob Brozman, *The History and Artistry of National Resonator Instruments*, Centerstream Publishing, Fullerton, CA, 1993.
2. Tom Wheeler, *American Guitars – An Illustrated History*, Harper Perennial, 1990.
3. Walter Carter, *Gibson Guitars: 100 Years of An American Icon*, General Publishing Group, 1994.
4. J.W. Black and Albert Molinaro, *The Fender Bass: An Illustrated History*, Hal Leonard Publishing Co., 2002.
5. Eddie Alkire – the UIUC Sousa Archives:  
<http://www.library.uiuc.edu/archives/archon/index.php?p=collections/controlcard&id=3554>

**Legal Disclaimer and Copyright Notice:**

**Legal Disclaimer:**

The author specifically disclaims legal responsibility for any loss of profit, or any consequential, incidental, and/or other damages resulting from the mis-use of information contained in this document. The author has made every effort possible to ensure that the information contained in this document is factually and technically accurate and correct.

**Copyright Notice:**

The contents of this document are protected under both United States of America and International Copyright Laws. No portion of this document may be reproduced in any manner for commercial use without prior *written* permission from the author of this document. The author grants permission for the use of information contained in this document for *private, non-commercial* purposes only.