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GEORGE BEAUCHAMP AND THE RISE OF THE ELECTRIC GUITAR UP TO 1939

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Declaration

I declare that this thesis is entirely my own work.

Matthew William Hill

ABSTRACT

This thesis examines the rise of the electric guitar in the United States – arguably the most iconic and successful musical instrument of the 20th century – and the role of George Beauchamp in its invention and development. It focuses on Beauchamp's invention of the electromagnetic pickup, which is the component that makes an electric guitar an electric guitar. The research is based on examination of surviving instruments as well as archival research. An extensive contextual background is given regarding the historical development of electrical musical instruments in general and electric and electrified stringed instruments in particular. The instruments manufactured by Beauchamp's company, the Electro String Instrument Corporation are discussed as well as difficulties and litigation Beauchamp and his company were faced with while trying to bring the instruments to market. The thesis focuses on the period between the first electrification of a fretted string instrument in 1890, and the conclusion of "the Miessner matter" (a period of prolonged threatened legal action against Electro String and other electric guitar manufacturers) in 1939. The thesis also considers competing pickup systems that emerged in the wake of Beauchamp's invention.

Brother musician listen to a MIRACLE!

Electro String Instrument Corporation
sales brochure, 1933

"When everybody began to make them,

everybody began to play them."

Adolph Rickenbacher, 1972

"The electric guitar is here to stay."

Al Frost, president of
National-Dobro Corporation,
in a letter to the Dopyera brothers,
December 22, 1939

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. Electric and Electrified Stringed Instruments before 1931

2. "The Mysterious Mr Beauchamp"

3. George Beauchamp and the Development of the "Frying Pan"

4. The Early Ro-Pat-In and Electro String Instrument Corporations

5. Guitar Family Instruments of the Ro-Pat-In and Electro String Instrument Corporations

6. Non-Guitar Family Instruments of the Ro-Pat-In and Electro String Instrument Corporations

7. Patenting the Horseshoe Pickup

8. Bringing Electric Instruments to Market

9. The "Miessner Matter"

10. Competitors of the Ro-Pat-In and Electro String Instrument Corporations

Summary and Conclusion

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For allowing me to examine instruments, or providing me with information from their own examination of various instruments, or giving me information or assistance of an incidental nature, I would like to thank: Silke Berdux, Kuratorin für Musikinstrumente, Deutsches Museum, Munich, Susana Caldeira, Conservator, Metropolitan Museum of Art, New York, New York, Eric Cale, director of the Wichita-Sedgwick County Historical Museum, Wichita, Kansas, Gail Davidson, Dr. Brian Flynn, University of Edinburgh, Carolyn Grant, Executive Director of the Museum of Making Music, Carlsbad, California, Graham Griffiths, John Hall, CEO of Rickenbacker International Corporation, Santa Ana, California, Marshal Hill, Doug Kensrue, CEO of MK Products, Irvine, California, Dr. Darryl Martin, University of Edinburgh, Dr. Jeffrey Noonan, Southeast Missouri State University, the library staff of Purdue University, West Lafayette, Indiana, Stephanie J. Richmond, National Archives and Records Administration, Washington DC, Arian Sheets, Curator of Stringed Instruments at the National Music Museum, Vermillion, South Dakota, and Lynn Wheelwright.

Any omission in the above list is accidental, and I must apologise to anyone whose contribution has not been given the credit it deserves.

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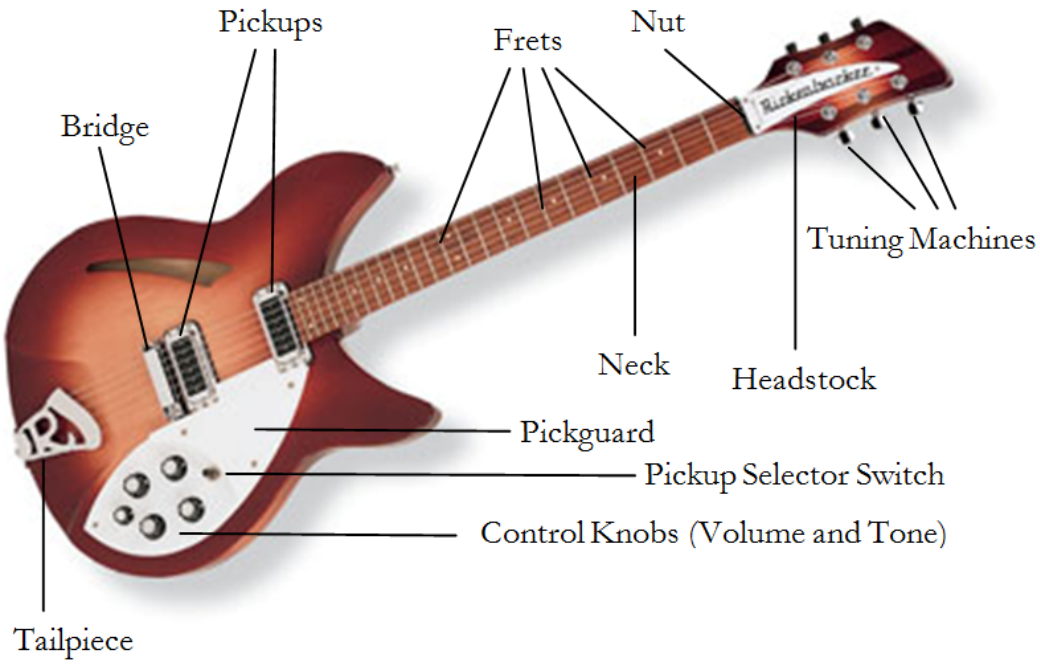
1890 guitar design. His friendship and encouragement over a period of 30 years have been instrumental (pun intended) in both the inception and completion of this thesis. My late father, Marshal Hill, in addition to offering much encouragement and support, was an important source of information and terminology of early 20th century radio and audio electronics and associated technology. His insight and familiarity with the amateur electronics milieu of the 1920s and 30s was vital to my understanding the technological context of the early electric guitar. Arian Sheets, Curator of Stringed Instruments at the National Music Museum, Vermillion, South Dakota, was unfailing with encouragement, constructive criticism, and a contrarian viewpoint during the research and writing of this thesis. Dr Christina Linsenmeyer, Finnish Cultural Foundation, Helsinki, was a sounding board for many of the ideas expressed within these pages. Lynn Wheelwright provided encouragement, spirited debate, and practical assistance on multiple levels, without which it is no exaggeration to say this thesis would not have been completed. Fiona Young not only proof-read the manuscript repeatedly (any errors remaining, of course, are my own), but provided valuable comments and feedback on the text. And finally, but probably most importantly, my mother, Dorothea Hill, to whom I dedicate this thesis, was the *sine qua non* of its completion.

Good night, Olga.

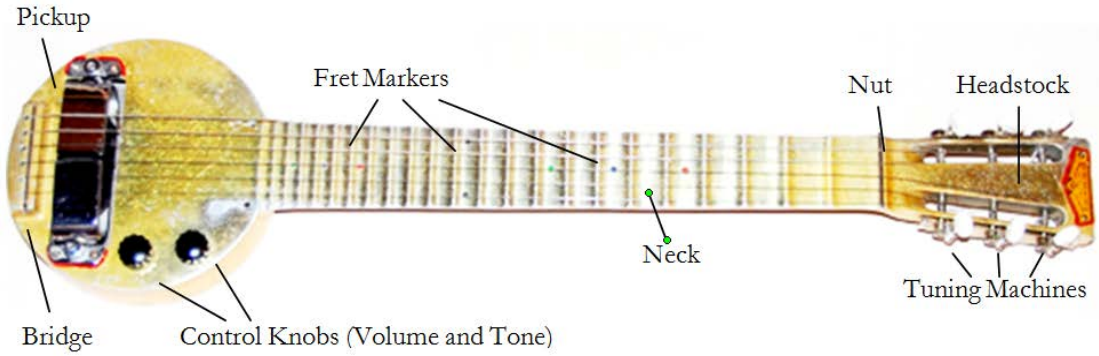
TERMINOLOGY AND CONVENTIONS

THE PARTS OF AN ELECTRIC GUITAR

Spanish-Style



Hawaiian-Style



DEFINITION OF SPECIAL TERMS

Electric / Electrical / Electrified

Even amongst musicians and organologists, there is much confusion about the terms electric/electrical/electrified as applied to musical instruments. For the purposes of this thesis, "electric" refers to stringed instruments that primarily function non-acoustically and whose primary means of sound reproduction is an electromagnetic pickup based on, or similar to, the type developed by George Beauchamp in 1931. Although such instruments can often appear to have an acoustic function, due to their primary use as electromagnetically amplified instruments they are typically referred to as electric guitars. "Electrified" refers to musical instruments (stringed or not) that employ electricity, but are not electrically amplified, such as the 1890 guitar design of George Breed discussed in the text. "Electrical" is used with the common meaning of any device that employs electricity in any capacity. Thus, while all "electric" guitars are "electrical" guitars, the reverse is not true. It should also be noted that the term "electrical guitar", whilst technically correct, has never been commonly used by musicians.

"Frying Pan" vs. "frying pan"

In order to prevent confusion, the term "Frying Pan" (capitalised) is used in this thesis when referring to the wooden-bodied prototype electric guitar made by George Beauchamp and Harry Watson in 1931, and "frying pan" (all lowercase) is used when referring to any of the aluminium-bodied production model electric guitars made by Rickenbacker/Electro String Instrument Corporation.

Hawaiian-Style Guitar/Steel Guitar

There is much confusion between the terms "Hawaiian-style guitar" and "steel guitar". A steel guitar is any guitar that is played with a "guitar steel" – a metal bar the player presses against the strings to set the pitch to be played. These guitars almost always have a greatly raised string height compared to a Spanish-style guitar (described below). Confusingly, the actual instrument utilised as a Hawaiian- style guitar can range from a conventional Spanish guitar adapted to be played horizontally in Hawaiian style, to specially made instruments with fretless integrated hollow necks. As a playing style, steel guitar playing is the essentially the same as Hawaiian-style guitar playing, but it

should be noted that (again, confusingly) Hawaiian-style guitar playing does not necessarily denote Hawaiian-style music; for example, Hawaiian-style guitar playing is commonly employed in American country music. So whilst all Hawaiian-style playing is steel playing, not all steel playing is Hawaiian-style playing. Even more confusingly, Spanish-style guitars can be played with a bottleneck or slide used on a finger of the left hand (a technique commonly found in blues) in a manner that is not Hawaiian-style playing, but which can have a sound reminiscent of Hawaiian-style technique.

"Rickenbacker" vs. "Rickenbacher"

The spelling "Rickenbacker" is used to refer to things regarding the company, except for the case of a few early instruments where the spelling "Rickenbacher" was used. The spelling "Rickenbacher" is used to refer to the person of Adolph Rickenbacher, who, with a few exceptions in his later years, consistently used that spelling in his personal life.

Spanish-Style

Although it might be thought that the term "Spanish-style guitar" would apply only to "classical"-style guitars derived from the designs of Spanish guitar maker Antonio de Torres Jurado (1817 – 1892), in common usage – especially in the musical instrument manufacturing industry – the term simply means any guitar, electric or acoustic, that is not a "Hawaiian-style" instrument. Especially during the first half of the 20th century, the term "Spanish-style" was commonly used in advertisements in catalogues when distinguishing a guitar from the equally popular Hawaiian-style instrument. A remnant of this practice can be found today in the names of many instruments made by the Gibson guitar company, which uses the designation "ES" (for "electric Spanish") in many of their models, such as the ES 150 and the ES 175.

Solenoid

A coil of insulated wire wrapped around an iron core which becomes an electromagnet when current is passed through the coil.

CONVENTIONS

Quotations

All quotations are given exactly as they appear in the original text, with the original spelling and syntax. Quotations that have been separated from the text are printed in a smaller font size and have been indented both right and left.

Synecdoches

The following synecdoches are commonly used in this thesis:

- "Electric guitar" to mean any electric stringed instrument of the same general configuration as an electric guitar.
- "National" to refer to the National Stringed Instrument Corporation.
- "Rickenbacker" to mean the Ro-Pat-In/Electro String Instrument Corporations.

Italics

Italics serve several purposes in this thesis. They are used for:-

- Titles of books or journals.
- Titles of songs or other musical works.
- Titles of films.
- Foreign words.
- Words or phrases that require special emphasis in the text.

Font and size

The thesis has been printed using the Garamond typeface with a 12-point font size. Quotations and footnotes are in Garamond 10-point. Captions are in Garamond bold 12-point.

LIST OF ABBREVIATIONS

c.	circa
ed.	edition (in Bibliography)
eg.	for example
ie.	as in the case of
l	left
mm	millimetres (preceded by the number of millimetres and then a space)
N.B.	*nota bene*; please note
r	right
1st	first (preceding ed. in Bibliography)
2nd	second (preceding ed. in Bibliography)
3rd	third (preceding ed. in Bibliography)
4th	forth (preceding ed. in Bibliography)
’	foot / feet
”	inch / inches

INTRODUCTION

Almost without question, the invention of the electric guitar is the most important development in musical instruments during the last century. No other musical instrument can claim to have had the impact on 20th century music – and society – since 1900 that the electric guitar and its variants have. The electric guitar's widespread popularity has given it an iconic status in recent years, both in musical importance and as a graphic realisation of the concept of "music", which almost certainly exceeds that of any other musical instrument, including the violin and the piano. Like the violin and piano, the electric guitar's origins and early history have been the subject of much heated debate and the source of much mythology. However, it is now generally acknowledged that the first commercially successful electric guitar was the Electro "Frying Pan", invented by George Beauchamp and manufactured in collaboration and corporate partnership with Adolph Rickenbacher by the Ro-Pat-In Corporation (later known as Electro String Corporation and known today as Rickenbacker International Corporation). The technology that Beauchamp developed for the Frying Pan is the basis for the overwhelming majority of electric stringed instruments[1] that have come after. Although others had key roles, especially in regards to commercial aspects, Beauchamp's work is the *sine qua non* in the story of the development of the electric guitar. However, George Beauchamp is the forgotten man in this story – most likely because he left the musical instrument business in 1940, a little more than ten years after entering it, and died within months of doing so. Unlike some of the other important figures of 20th century guitar manufacturing (many of whom, as will be shown, had connections with Beauchamp) he did not live to see the immense expansion in popularity of the electric guitar during the 1950s and 1960s, and thus claim a more prominent place in the public's consciousness.

[1] In this thesis the term "electric guitar" will often be used as a synecdoche to refer to all electric stringed instruments. It should be noted (as will be shown in chapters one and six) that from the very earliest stages, the technology behind the electric guitar was applied to other stringed instruments.

This thesis will examine Beauchamp's invention and its development, manufacture and marketing, placing it within the context of its precursors and competitors before and during the 1930s. It will also look at the activities of the Ro-Pat-In/Electro String Instrument Corporation in applying the technology to other stringed instruments and their attempts to market these. The research has been carried out by both archival investigation and examination of the instruments themselves. It should be noted that the key archive consulted for this thesis, the archive of the early Ro-Pat-In/Electro String Instrument Corporation, now at the Rickenbacker International Corporation company headquarters in Santa Ana, California, has never been thoroughly organised, so it has been impossible to reference the specific location of individual documents.

This thesis will show that the key aspect of Beauchamp's invention was not the use of electromagnetism to amplify the guitar (which had been attempted before, with varying degrees of mechanical and financial success), but rather a particular configuration of electromagnetic components, the key design feature being the use of the ferrous string as the armature (the moving/vibrating part of the instrument being directly amplified). It is this configuration which has ultimately become the most commercially and aesthetically successful amongst guitarists, continuing to the present day.

While the physical form of Beauchamp's guitar was radically different than any previous stringed instrument, its distinguishing feature was not its construction but its technology. Beauchamp's design was the first instrument to utilise the defining element of the electric guitar, as the instrument is generally understood today; the electromagnetic pickup.

WHAT MAKES AN ELECTRIC GUITAR AN ELECTRIC GUITAR?

In order to fully examine the history of the development of the electric guitar, it is necessary to first define the term; what makes a guitar "electric"? As some of the examples that are given the first chapter show, the application of electricity to a musical instrument does not necessarily make an instrument "electric" in common parlance. It is also generally agreed that simply amplifying the strings of a guitar does not make it an "electric guitar". If this were the case, an acoustic guitar amplified by a microphone could be considered an electric

guitar.[2] What defines an electric guitar as it is generally understood by modern musicians is the particular way in which the vibrations of its strings are amplified, and for almost all modern electric guitars (and other electric stringed instruments) that is by means of a device known as an electromagnetic pickup.[3] The electromagnetic pickup is the heart of an electric guitar's circuitry. Like its name suggests, a pickup "picks up" the vibration of a guitar string which is then amplified. Physically, an electromagnetic pickup consists of a magnet, in the form of either a single bar or individual slugs for each string, or a combination of both, surrounded by a copper wire-wrapped coil. Vibration from iron or steel strings creates electrical impulses in the pickup; these are then transferred from the instrument to an amplified loudspeaker. Although the physical configuration of this setup can vary slightly (in the configuration of the coils or placement of the magnet, for example), almost all modern electric guitar pickups work on this principle. Although, as will be shown, other methods of electromagnetically amplifying strings were developed and commercially produced in the period under discussion in this thesis, none ultimately proved technologically and commercially successful.

THE HAWAIIAN-STYLE GUITAR VS. THE SPANISH-STYLE GUITAR

Since both Spanish-style and Hawaiian-style guitars are germane to the discussion of the development of the electric guitar, it may be helpful at this juncture to explain and elaborate on the relationship between the two.[4] Although these can be viewed from an organological view as completely different instruments, from a cultural and contextual prospective, especially that of the 20th century, the differences between the instruments can be blurred and murky, both from a construction and a playing point of view. The Spanish-style guitar is

[2] An example of this is Fred C. Hammond's US patent no. 1,510,476 of 1922 (discussed more fully in chapter one), which concerns this very idea.
[3] It should be noted that since the 1970s, other pickup systems, such as piezoelectric pickups, have had some commercial success. Piezoelectric pickups have been typically used to amplify otherwise fully acoustic guitars, and only rarely arched-top, semi-hollow or solid body guitars, which are usually fitted with electromagnetic pickups. Often when piezoelectric pickups are used on guitars of these latter types, it is in conjunction with conventional electromagnetic pickups. The National "Glenwood 99" model of the early 1960s and the Parker "Fly" of the turn of the 20th century are both examples of this.
[4] Further information on Spanish-style and Hawaiian-style guitars is to be found in the list of terminology, conventions and abbreviations.

the more popularly known of the two; indeed the Spanish-style is what most people visualise when hearing the word "guitar".

Figure 0.1 –Spanish-style (Rickenbacker model 330) (l) and Hawaiian-style (Rickenbacker model B6) (r) electric guitars.

N.B. Instruments shown approximately to scale.

Although many people today might associate the term "Spanish guitar" with the style of instrument developed by Torres in the 1860s and popularised by Andre Segovia in the early 20th century, players and manufacturers, particularly in the United States, commonly used the term to designate any guitar, acoustic or electric, that was designed to be played in the Spanish-style (with the fingers of the left hand [for a right-handed player] fretting the stings against the neck), that is to say, not the Hawaiian style. It is not overstating the case that most guitarists would understand the terms "Spanish style guitar" and "conventional guitar" to be synonymous.

Although the Hawaiian-style guitar originated as a Spanish-style instrument with an altered tuning (typically tuned to a major chord and known as "slack key") and playing position, alterations soon began to be made in the instrument to accommodate the particular needs of Hawaiian style players. The most fundamental of these were changes in the guitar's nut and bridge saddle. These were raised high off of the fingerboard to facilitate playing, which kept the

playing bar from hitting the instrument's frets or fingerboard and allowed for the smooth glissando playing typical of the Hawaiian style. Another change was that the bridge saddle typically lacked "compensation" – a slanting of the bridge saddle which very slightly lengthens the instrument strings by varying amounts according to the strings thicknesses, which allows the thicker strings of a Spanish-style guitar to sound in tune when played higher up on the neck. Since the pressure of the playing bar is even across the strings, Hawaiian-style instruments have no need for string compensation. Another physical change was the square neck – this was used by various makers both as a means to simplify construction (a squared off neck being much easier and quicker to construct than the rounded neck of the Spanish-style instrument and having the added advantage of being much more physically stable, due to the square neck's greater mass, without the need for reinforcement such as truss rods) and increase resonance.

Although the current popularity of the Spanish-style guitar does not need to be restated, it should be remembered that in the United States during the early 20th century, the Hawaiian-style guitar had such a burst of popularity that most makers and players differentiated between the two. Indeed, electric instruments made by the Gibson company often used model designations that began with "ES" or "EH" meaning "Electric Spanish" or "Electric Hawaiian" respectively.[5]

As can be seen by the previous, the organological relationship between Spanish-style and Hawaiian-style guitars can be somewhat confusing, even for players familiar with both types. Indeed, it is this very confusion that has , in part, led to George Beauchamp's contributions to the development of the electric guitar not being fully recognised in the past, since the electric version of the Hawaiian-style instrument was sometimes perceived by earlier writers on electric guitar history as somehow being technically different than the now more familiar electric Spanish-style guitar. Although these two types of instruments were often perceived as very different from each other, it was not unusual in the

[5] The "ES" or "EH" model designations used by Gibson they were typically followed by a three digit number that was often the original list price of the instrument; for example the popular "ES150" model (often associated with the famous jazz musician Charlie Christian) indicated that the instrument was an electric Spanish guitar that originally cost $150 US.

early 20th century (and indeed even today) for a musician to play both instruments.

The time period and geographic area covered by this thesis is the United States of America from 1890 to about 1939. Although other nascent efforts at electrifying stringed instruments were attempted outside the United States, the first significant commercial attempts at manufacturing electric stringed instruments were American, and the U.S. would continue to dominate electric guitar production well into the 1970s. While this thesis focuses on American-made stringed instruments, it will examine the German-made Neo-Bechstein piano due to that instrument's apparent use of a similar technology and its possible dissemination in the United States just prior to the commercial launch of the "frying pan".

The dates covered are from the first known attempt in the United States to apply electricity to a fretted stringed instrument, to the conclusion of the threatened legal action by Miessner Inventions, Inc (in which Benjamin Franklin Miessner attempted to effectively monopolise the manufacture of electric string instruments by enforcing his patent claims on manufacturers) which opened the floodgates for electric guitar manufacture. Although for the most part electronically similar,[6] electric stringed instruments made up until this time differ significantly from their post-war counterparts in their physical design and thus can be considered "incunabula" in relation to their modern counterparts.

While the electric guitar has been the subject of much popular writing and amateur study, there has been no large-scale scholarly study of the subject until now.[7] Most of the popular writing on the subject has covered the post-war history of the instrument and had a tendency to be more concerned with the guitar as a collector's item or *objet d'art*,[8] rather than as an article of organological

[6] Exceptions, such as instruments made by ViViTone and Volutone, are discussed in Chapter Eleven.
[7] A search of the Worldcat catalogue (http://www.worldcat.org) shows well over 600 electric guitar and amplifier related books (not including tutors and method books and books on repair, construction, and modification) published since 1975, the bulk of these being published after 1990. Well-known author Tony Bacon has over 40 books on 20th century guitar history-related topics to his credit. Depending on one's perspective, this plethora of popular writing on the electric guitar either makes the lack of scholarly attention to the subject puzzling or completely understandable.
[8] The somewhat rude, but commonly used, collective term for such writing in books and magazines, which typically features attractively staged photographs of rare, desirable and/or expensive instruments, is "guitar porn".

investigation. What organological research has been done focuses mainly on the instruments made by the larger US manufacturers such as Gibson and Fender and is concentrated on instruments made after the Second World War. In contrast, the subject of early electric stringed instruments has remained almost completely unstudied. This study is the first to examine the pre-war development of the electric guitar in an in-depth manner.

The lack of previous scholarly attention to the subject of the early electric guitar has created some unusual research considerations for the production of this thesis. Because the extant writings on electric guitar history have been for the most part tailored for a popular audience, certain elements that are expected in academic writing, such as source citation and a neutrality of tone, are often lacking. This is not to imply that the "popular" sources are generally inaccurate – like much popular writing, the accuracy varies from factual to fictional. It does mean, though, that the narrative of the story of the development of the electric guitar has been framed in a particular way that implies a historical trajectory and inevitability about the electric guitar's development that, as will be shown throughout this thesis, is not borne out by the facts. Another significant aspect of this "conventional wisdom" accepted and promulgated by the majority of writers on the electric guitar is that the opinions and value judgements of these authors have been generally accepted as "canon" and elevated to the level of historical fact. This, in turn, has led to many elements of the electric guitar's story being misunderstood, conflated, or reported inaccurately. It should also be noted that the first published accounts of the early history of the electric guitar were journalistic and not surprisingly, tended to rely heavily on interviews with surviving participants. It is clear, nevertheless, that even more than usual, the common caveats of research based on collecting personal recollections particularly apply here; people's memories, too, are often subject to confusion, conflation, subjectivity and/or having a particular axe to grind. It is the purpose of this thesis to re-evaluate and correct some of these assumptions and assertions as they apply to the early electric guitar.

Although the electric guitar's impact on twentieth-century music has been considerable, this thesis is not concerned (except in the most general way) with

the music performed on these instruments. The musicians who played these instruments, likewise, are outwith the study, except for their interactions with instrument makers as employees, associates, designers and promoters.

While researched and written as part of this thesis, the author has previously presented the section on George Breed (in expanded form) in the Galpin Society Journal LXI. This work has been revised in part where it has been included in the thesis.

This thesis examines the electrification of stringed instruments, especially the guitar, and the development and dissemination in the United States during the period 1890 to about 1939. This range covers the time from the first application of electricity to a fretted string instrument, to the cessation of threatened legal action against electric guitar makers by Miessner Inventions, Inc, which set the stage for the unfettered mass manufacture of electric guitars in the post-war period. It is divided into chapters as follows:

Chapter one is a contextualised discussion of electric stringed instruments up until 1931. It examines the guitar designs of George Breed, an officer in the U.S. Navy, who, in 1890, patented the (almost certainly) first known application of electricity to a fretted stringed instrument. Like the modern electric guitar, Breed's patent was based on a vibrating string in an electromagnetic field. However, Breed's design worked on very different electrical and musical principles, resulting in a guitar with an unconventional playing technique that produced an exceptionally unusual, and un-guitar-like, continuously sustained sound. In addition, the probable reasons for, and the driving forces behind, the development of electric stringed instruments will be examined, including the significance and influence of nascent radio technology on the instruments. Also discussed are the electric stringed instruments made by the Stromberg-Voisinet company, which, in 1928, marketed the first known commercially available amplified guitar, and an electric banjo made by the Vega company in the late 1920s.

Chapter two examines George Beauchamp's life and his pre-electric guitar activities and inventions, especially his involvement with The National String Instrument Corporation, prior to 1931.

Chapters three through eight form the main argument of the thesis. Chapter three traces the George Beauchamp's development of his electric guitar design, including a detailed description of the wood-bodied Frying Pan prototype, as well as descriptions of the aluminium-bodied production models. Chapter four examines the activities of the early Ro-Pat-In/Electro String Instrument Corporation, including its legal actions and first sales. Chapter five examines Ro-Pat-In/Electro String's guitar family instruments, while chapter six discusses its non-guitar family instruments, including a fretted, *berda*-style double bass and an electric harp made for Harpo Marx. Chapter seven explores the difficulty the Electro String Corporation had in patenting the horseshoe pickup. Chapter eight examines the spread of the early electric guitar, including promotion by manufacturers and the role of jobbers (wholesalers) in popularising the new instruments. Also discussed is the earliest professional use of the instrument by players such as Gage Brewer, Jack Miller, and Alvino Rey.

Chapter nine examines how one company, Miessner Inventions, Inc., tried to impose a cartel on the manufacture of electric musical instruments by attempting to enforce claims of patent infringement against their makers. The company itself produced no actual instruments, but rather developed musical instrument technologies that it then licensed to others. Miessner Inventions became as well known for its litigation as its innovations by waging an aggressive campaign to intimidate companies making electric instruments. The threat of litigation by Miessner and the subsequent repudiation of the company's claims by electric instrument makers was a major (yet generally unrecognised) milestone in the manufacture, development and dissemination of electronic musical instruments, and the electric guitar in particular.

Chapter ten examines competitors and competing technologies of the Rickenbacker electric guitar during the 1930s, including instruments made by Epiphone, Gibson, National Stringed Instrument Corporation, Vega, Audiovox, Volutone, and ViViTone, as well as amateur-made "homebrew" instruments.

Following these chapters a Summary and Conclusion briefly reiterates each chapter in turn, underscoring the main points, and while no new arguments will be given, presents a précis of the thesis as a whole and makes some

contextual observations on the subsequent story of the electric guitar. An appendix of the whole of Beauchamp's 1937 patent follows, as well as an appendix discussing the mechanics and physics the electromagnetic pickup which goes into greater depth than the brief description given in this introduction. A general bibliography concludes the thesis.

Preceding the thesis is a list of terminology, conventions and abbreviations.

ELECTRIC AND ELECTRIFIED STRINGED INSTRUMENTS BEFORE 1931

THE EARLIEST ELECTRIFIED MUSICAL INSTRUMENTS

Although electric and electronic musical instruments are ubiquitous today, they are not often well understood, both in the way that they function and, especially, their history. This is not only true for the general public, but for musicians and musical historians as well. In particular, it is not well-recognised that the application of electricity to musical instruments dates back more than 250 years. What the first electrified instrument was has been the subject of some speculation, but it is most often identified as the *Denis d'or* ('golden Dionysus') a keyboard instrument constructed c. 1748 by the Czech priest Václav Prokop Diviš (pronounced 'Deevish') (1698 – 1765), sometimes known in the West as Procopius Devisch. Diviš was an early electrical experimenter; in 1754 he erected an early type of lightning rod (possibly invented independently of Benjamin Franklin) on church property near his home in Přímětice, near Znojmo, in the South Moravian region, close to the Austrian border of what is now the Czech Republic.[1]

Around 1748, but possibly earlier, Diviš created the *Denis d'or* and named it for himself (the "Denis" in the name is the French equivalent of the Czech surname "Diviš", both of which derive from the Greek god Dionysius). It was a stringed instrument, operated by a keyboard, approximately 150 cm long by 90 cm wide by 120 cm high (roughly the size of a modern spinet-style upright piano). The mechanism was extremely complicated, having over 790 strings arranged into 14 stops or registers, and the instrument was said to be able to imitate the sounds of the harpsichord, harp, lute and even wind instruments by various combinations of stops. A description of the instrument written in 1753 indicates that the strings were struck rather than plucked.[2] However, the most unusual feature of the instrument was that it employed electricity,

[1] Peer Sitter, "Das Denis D'or: Urahn Der 'Elektroakustischen' Musikinstrumente?," *Perspektiven und Methoden einer systemischen Musikwissenschaft: Bericht über das Kolloquium im Musikwissenschaftlichen Institut der Universität zu Köln 1998* Band 6 von Systemische Musikwissenschaft (2003). p. 303.
[2] *Tübingische Berichte von gelehrten Sachen*, XXX, July 1754, p. 395.

supplied by means of batteries or Leiden jars. The electricity was used for two purposes; the first was to somehow "energise" the iron strings of the instrument, which in turn enhanced the sound produced, and the second was to enable Diviš to give the unsuspecting player of the *Denis d'or* an electric shock. The second function is not as strange as it first might appear; some of the first practical applications of electricity[3] were in the creation of novelties which buzzed or shocked the unwary recipient. It is not clear how either of these electrical features functioned, but it is clear that the author of the 1753 description considered the *Denis d'or* to be a *"Electrisch-Musicalische Instrument"*, that is, an "electric musical instrument", the earliest known use of the term.[4]

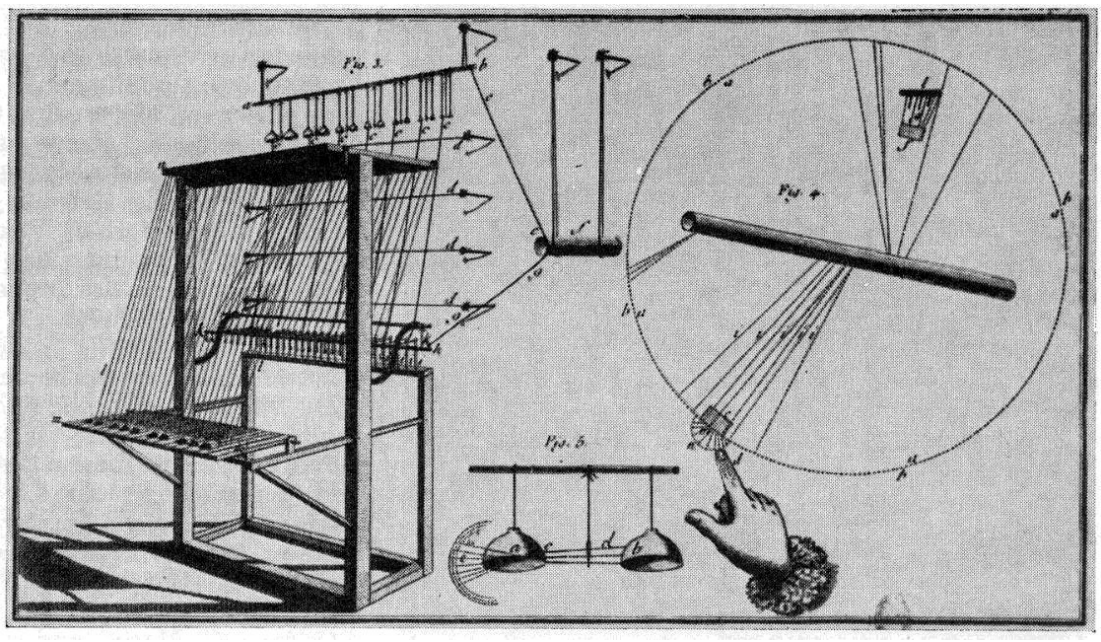


Figure 1.1 – Delaborde's *clavecin électrique*, 1759.

The next known musical instrument to employ electricity was the *clavecin électrique* invented by Jean-Baptiste Thillais Delaborde in 1759. Delaborde, like Diviš, was also a priest. Played by means of a conventional keyboard, the instrument's mechanism was activated electrostatically using a glass globe-type generator which produced electricity by way of friction. The static electricity thus generated is simultaneously of low, continuous flowing current and high voltage. In essence, the *clavecin électrique* was an

[3] If indeed, a practical joke can be considered a practical application.
[4] *Tübingische Berichte von gelehrten Sachen*, XXX, July 1754, p. 395. After Diviš's death in 1765, the *Denis d'or* was sold and taken to Vienna; its eventual fate is unknown. It should be noted that there is no clear description of the acoustic effect the use of electricity had on the strings, making it difficult to determine or even speculate on any possible circuitry of the instrument.

electrically activated carillon, using bells as the sound producers, with the main difference being that two bells were employed for each pitch. Both bells were electrically charged with a metal clapper suspended between them. When the key lever is depressed, one of the bells is earthed, which causes the metal clapper to violently swing back and forth between the earthed and un-earthed bells, producing the pitch – sounding not unlike a mid-20th century mechanical alarm clock. It should be noted that Delaborde did not discover the electric principle used in the device's mechanism, which was based on a existing alarm bell-type device. Delaborde published his description and account of the *clavecin électrique* in 1761[5], noting that the instrument was particularly effective when played in the dark, due to the brilliant sparks produced by the instrument while it was played. Unlike the *Denis d'or*, which appears to have utilised electricity mostly as a novelty or gimmick that was adjunct to the instrument's musical functions, the *clavecin électrique*'s utilisation of electricity was an essential part of its mechanism, making Delaborde's invention the first fully electrically-powered musical instrument.

THE 19TH CENTURY

An in-depth discussion of the application of electricity to musical instruments during the 19th century is not germane to this thesis; with the exception of George Breed's electrified guitar design of 1890, discussed below, none of the instruments concerned are fretted-type stringed instruments. Nonetheless, a few salient observations should be made. Broadly speaking, electrical musical instruments of the 19th century fall into two categories; those that used electricity as a motive force for a more conventional acoustic instrument (such as powering a player piano) and, much less commonly, those that used electricity as part of the sound source itself. However, even the division of electric musical instruments into these two broad categories can be somewhat misleading, since the degree to which electricity was intrinsic to the functioning of the instrument could vary significantly. For example, George Breed's electrified guitar of 1890, whilst producing a sound quite different from a conventional guitar, was fully acoustic, with a conventional soundboard and bridge. On the other hand, William Duddell's "Singing Arc" of 1899 was fully electric, using fluctuations in the direct current (DC) to power a carbon arc lamp (using technology similar to a modern arc

[5] Jean-Baptiste Thillais Delaborde, *Le Clavessin Électrique; Avec Une Nouvelle Théorie Du Mécanisme Et Des Phénomènes De L'électricité (the Electric Harpsichord with a New Theory of the Mechanism and Phenomena of Electricity)*, (Reprint of Paris edition of 1761) ed. (Geneva: Éditions Minkoff, 1997).

welder) to produce sound.[6] It is noteworthy that this was done without the aid of a loudspeaker or any conventional acoustical amplification; the sound was generated by the burning electric arc itself. This gives the Singing Arc the distinction of being the first known fully electric musical instrument as well as the first electropyrophone.[7]

GEORGE BREED AND THE FIRST ELECTRIFIED FRETTED STRINGED INSTRUMENT

In 1890, a United States Naval Officer, named George Breed, patented a design for an electrified guitar which appears to be the first application of electricity to a fretted string instrument. Like the modern electric guitar, Breed's patent was based on a vibrating string in an electro-magnetic field. Breed's design, though, worked on very different electrical and musical principles, resulting in a guitar with an unconventional playing technique that produced an exceptionally unusual, and un-guitar-like, continuously sustained sound. Breed is now almost completely unknown as an instrument maker/designer; the significance of this instrument has remained underappreciated, and the circuitry unexamined.

George Breed was born in Pittsburgh, Pennsylvania on 19 July 1864. He came from a wealthy and locally prominent family; his grandfather, also named George Breed, had a successful glass and china importing business in Pittsburgh, and was one of the founders of Western Pennsylvania Hospital. Invention seems to have run in the family; George Breed the elder's son Richard had at least two patents to his name.[8] Prior to the granting of his 1890 patent, Breed's career was in the US Navy. On 17 June 1882 Breed entered the United States Naval Academy in Annapolis, Maryland as a Cadet Midshipman, graduating from there on 10 June 1886.[9]

Breed shows a working knowledge of both electricity and metallurgy in the execution of his musical instrument design. As the study of electricity and metallurgy at

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[6] Thomas LaMar Rhea, "The Evolution of Electronic Musical Instruments in the United States" (Thesis (Ph D), George Peabody College for Teachers, 1972). p. 3. Although Rhea shows no awareness of the 18th century *Denis d'or* or *clavecin électrique*, the first chapter of his thesis remains the most comprehensive scholarly overview of electrical musical instruments during the 19th century.

[7] Although rare, there have been attempts in recent years to use fire in place of air as a sound conducting medium.

[8] US Patent No 252176, for a mechanical rotary movement, and US Patent No 408336 for a tool socket.

[9] Callahan, Edward W., *List of Officers of the Navy of the United States and of the Marine Corps from 1775 to 1900*, (New York, 1901), p.74.

the Academy was not prescribed until 1887 - a year after Breed graduated,[10] it must be questioned where he might have gained his knowledge. Although Breed may have not been formally trained at the Academy in these disciplines, it is highly plausible that he was exposed to them during his Navy training. Electric lights were first installed on a US navy ship, the *USS Trenton*, in the summer of 1883.[11] In 1884, at least three other ships, the *Atlanta*, *Boston* and *Omaha* were authorised to be outfitted with electric lights.[12] The Annual Report of the Secretary of the Navy for the year 1886 recorded that the bureau of navigation was pleased with the results,

> …owing to the small amount of heat given off, the absence of disagreeable odors, and the more perfect illumination, (which) adds much to the health and comfort of the officers and men, tends to make them contented and happy during their long absences from home and friends promotes discipline and prevents crime.[13]

It is also possible that Breed could have acquired the technical knowledge needed to create his design during the summer of 1888 while receiving ordnance instruction at the Navy Yard in Washington DC, his first assignment after graduation from the Academy.[14] The Navy's Bureau of Ordnance was also responsible for the Navy's research laboratories which conducted electrical as well as weapons research. It is not unreasonable to suppose that Breed might have received electrical training during his time there as well.

Breed's next assignment offers a further clue to the gestation of his design. On 12 October 1888, he was sent to the West Point Foundry in Cold Springs, New York on temporary inspection duty, where he remained until 4 January the following year.[15] The West Point Foundry specialised in the making of large-scale weaponry and armaments for the US Military. Here Breed would almost certainly have had access to the expertise and materials for creating the large electromagnet used in the design of his instrument.

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[10] United States Department of the Navy, United States Naval Academy website www.usna.edu/VirtualTour/150years/1880.htm

[11] United States Department of the Navy, *Annual Report of the Secretary of the Navy for the Year 1883*. vol.1 (Washington DC: Government Printing Office, 1883) p. 244.

[12] United States Department of the Navy, *Annual Report of the Secretary of the Navy for the Year 1884*. vol.1 (Washington DC: Government Printing Office, 1884) p. 137.

[13] United States Department of the Navy, *Annual Report of the Secretary of the Navy for the Year 1886*. vol.1 (Washington DC: Government Printing Office, 1886) p. 152.

[14] United States Department of the Navy, *Records of Officers*. Microfilm M330, Roll 17 (Washington DC: Government Printing Office).

[15] United States Department of the Navy, *Records of Officers*. Microfilm M330, Roll 16 (Washington DC: Government Printing Office).

After his tour of duty at West Point, Breed was attached to newly-commissioned cruiser *USS Baltimore*, the flagship of the North Atlantic fleet.[16]

Within four weeks of joining the crew of the *Baltimore*, Breed had filed his guitar patent application. Six months later, on 5 July 1890, Breed resigned from the Navy, to take effect from 7 January 1891, with leave given until that date.[17] On 2 September 1890 Breed was granted US Patent No. 435679 for his 'Method of and Apparatus for Producing Musical Sounds by Electricity', less than two months after his effective resignation from the Navy. Whether these two events are related is not known, but it is tempting to speculate that the reason George Breed left the Navy was to make and market his musical instrument designs.

Breed's patent is in the standard form of United States patent documents of the time. It is nine pages long, comprised of five pages of technical drawings followed by a further four pages describing the patent's specification. The first page shows two illustrations of the basic principle of the invention; the first drawing showing the basic elements of the design and the second showing how the circuitry can be applied to two or more strings simultaneously. On the second page Breed shows how the design's ability to activate multiple strings via the same electrical circuit enables it to be adapted for use as a signalling device. The third page shows an overhead view with a partial circuit diagram of a keyboard instrument. The fourth page shows a more complete diagram of the keyboard's circuitry. The fifth page shows the most remarkable application of Breed's design; an electrified guitar. While the technologies depicted in Breed's patent as a whole are both innovative and unusual, there are several aspects of Breed's application of his design to the guitar which make it particularly striking. In considering Breed's patent it is it important to remember that Breed was not patenting so much a specific musical instrument design as he was a method of setting a string in constant vibration. In Breed's patent, musical instruments are not the only application depicted; the patent shows the principle applied to a keyboard, a guitar, and as a signalling device.

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[16] United States Department of the Navy, *Records of Officers*. Microfilm M330, Roll 17 (Washington DC: Government Printing Office).
[17] United States Department of the Navy, *Records of Officers*. Microfilm M330, Roll 17 (Washington DC: Government Printing Office).

To set the string in motion, Breed's design makes use of an electromagnetic principle known as the *Lorentz Force*. In essence, the Lorentz Force principle states that when an electrically charged particle moves through a magnetic field, there is a force on it that is perpendicular to its direction of movement and to the North-South axis of the magnetic field.

In Breed's patent, a metal string is stretched through a strong magnetic field, provided by an electromagnet which encircles the string. It should be noted that the electromagnet does not share the same circuitry as the string, each having independent circuits; in fact it is not necessary that the magnet be an electromagnet at all, a fact that Breed indirectly acknowledges by depicting a non-electrified horseshoe-type magnet in his initial illustration showing the principle of the design. However in Breed's day permanent magnets were incapable of producing a magnetic field of the strength required and strong permanent magnets (such as the 'alnico' type) were a number of years into the future.[18]

The string, in addition to its conventional function as an acoustic source, is also an integral part of the design's circuitry, as a direct current (DC) passes through it. This electric current is intermittently interrupted at rapid yet irregular intervals, producing a pulsed DC, which sets the string in motion by the rapid engaging and disengaging of the Lorentz Force created when current is flowing through the string. This pulsed DC, which is created by the rapid interruption of the string's circuit, mimics some of the properties of (but is not the same as) alternating current (AC), which in 1890 was yet to be widely used. Breed likens this rapid making and breaking of the circuit to the effect of a metal pin being drawn across a file; his analogy is quite vivid, stating that a softer tone is produced with a finely cut file, while a coarser file generates a rougher sound. This suggests that the use of files as part of the circuitry may have been based on Breed's personal experience, and perhaps formed part of the initial discovery process. In the patent Breed creates the rapid making and breaking of the electrical circuit by the use of a rotating wheel with randomly spaced contact points on its outer edge which he calls a 'break wheel'. Breed recommends that this break wheel should either be turned by clockwork or alternatively, powered by a small electric motor attached to the same battery as the electromagnet. Although not explained in the patent, the non-regularity of

[18] Vermuelen, R., 'Forty Years of Acoustics', *GRT Monitor*, Vol. 3, No. 3, (June, 1962), p. 74.

the pulsations in the string's electrical circuit is an important factor in the performance of the instrument. Pulsations that are too regular would cause the instrument body to resonate in a much more pronounced manner at those frequencies that matched the rate of pulsation, thus producing prominent wolf tones and making the instrument acoustically imbalanced.

The first use of the method that Breed describes in his patent is as a signalling device. In fact, Breed suggests that the circuitry of his design lends itself particularly well to telegraphy, in that it allows simultaneous transmission of multiple signals on the same wire. The circuit described in this part of the patent differs from the patent's musical applications in several respects. The most noteworthy of these is the use of two separate sets of strings, one as transmitters and the other as receivers, tuned to the same set of pitches. Unlike the other applications described in the patent, the signalling device makes no use of a break wheel; instead, a flexible platinum contact point is used, which is connected to the main circuit at the transmitting strings. A telegraph key-like device is connected to the same part of the circuit which, as long as it remains closed, creates the rapid pulsations of current created by the break wheel in Breed's other applications. The pulsations thus created are registered on the corresponding string at the receiving end by a telegraph sounder[19] activated by a circuit triggered by a key-like device which is set in motion by the vibration of the receiving string. The transmitted signal only registers on the receiving string of corresponding pitch, having no effect on the other strings. It should be noted, for each pair of matched-pitch signalling strings, there are four independent circuits: one each for the electromagnets on the sending and receiving end, the circuit connecting the sending and receiving strings and the circuit powering the telegraph sounder. However, an obvious drawback to the system is the need to maintain the same pitch (which, as will be shown, could be problematic due the heat-generated detuning of the strings) on the corresponding sending and receiving strings.

The greater part of the patent concerns the application of Breed's method to musical instruments, and he gives examples of its application to the piano and the guitar. The design for the piano shown in the patent is more of an example of the possibilities of the circuit as applied to the keyboard instrument rather than a fully-realised instrument design. It is immediately apparent that keyboard instrument aspect of the

[19] A telegraph sounder essentially consists of an electromagnet which when engaged triggers an armature, making an audible click.

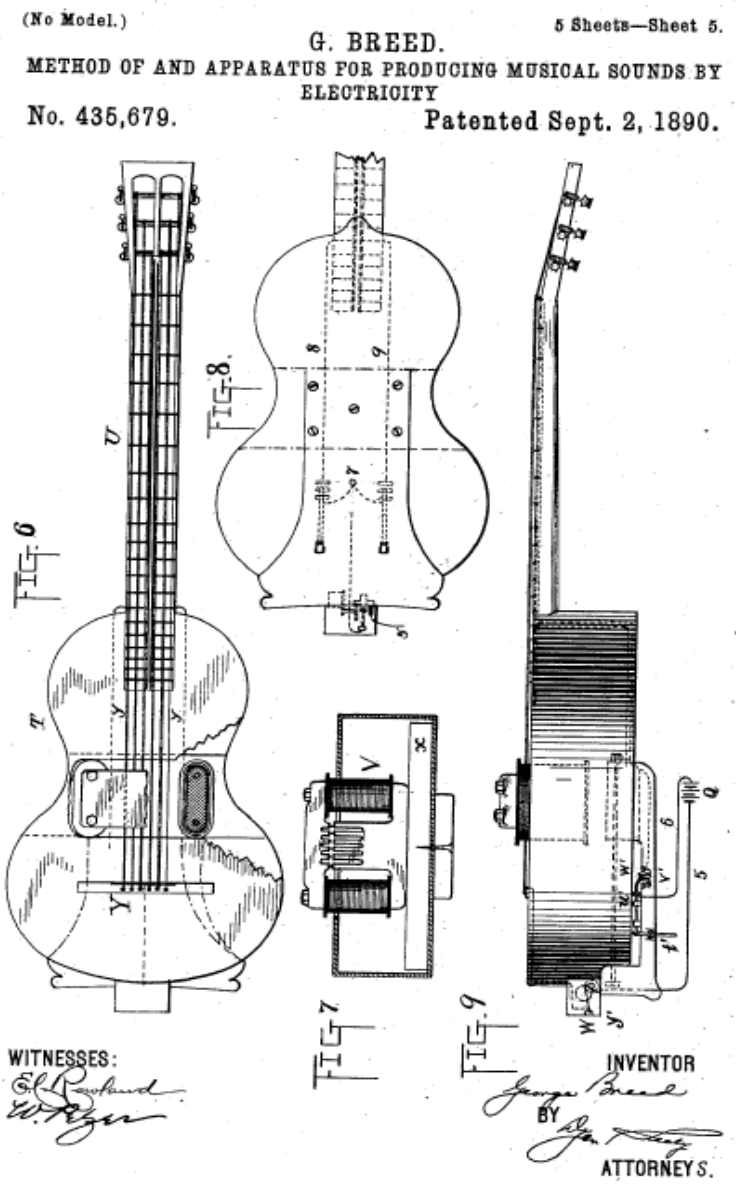
patent is not nearly as developed as those of the signalling device and guitar. There are two drawings in the patent that relate to the piano circuitry; an overhead view of the proposed instrument and a drawing detailing its circuit. (As noted above, the implausibility of this instrument as shown is readily apparent: while the instrument illustrated has a keyboard with well over one hundred keys, strings are only depicted for about 40 keys. A single large electromagnet is shown through which the strings pass. Interestingly, unlike the electromagnet shown for the guitar (see below), this electromagnet does not appear to have any pole pieces for concentrating the magnetic field on the strings. The design includes multiple break wheels with different contact surfaces (smooth, medium and rough) that can be controlled in combination in the manner of organ stops. In addition to the break wheel tone controls, a pair of pedal-operated rheostats are shown, which would adjust the level of volume produced by the keyboard by restricting the amount of current to the strings. No details of the keyboard action are shown, only a simple key-lever with a small metal contact piece opposite the key end which rises when the key is depressed to make contact with the electrical switch, thus completing the circuit. The mechanism resembles that of a clavichord;[20] however, unlike a clavichord, the key velocity has no impact on volume and the sound of the each note is produced by a single vibrating string.

Breed's guitar, depicted on the fifth and final page of the patent's drawings, is shown with far more realism and detail than the piano. Breed was probably not a trained luthier; he uses unusual nomenclature for the parts of the guitar, including 'head' for the body, 'stem' for the guitar neck and 'sounding-wires' for the strings.[21] Although the drawings and description of the guitar in Breed's patent appear to be quite comprehensive, closer examination shows that the patent conceals as much as it reveals about the guitar's circuitry and physical construction. It should be made clear at this point that this instrument, although powered by electricity, is not an electric guitar in the way that the term is generally understood. With an electric guitar, sound is created by the interaction of a vibrating ferrous metal string with an electromagnetic pickup which

[20] The clavichord is a stringed keyboard instrument, popular in Europe from the late 15th to early 19th centuries. It has probably the simplest action of all keyboard instruments. When a key is pressed, a small metal wedge called a tangent strikes the string which produces a sound. Unlike a piano hammer, the tangent remains in contact with the string for as long as the key is depressed. A more forceful keystroke creates a louder sound, a softer stroke a quieter one. Before the invention of the piano, the clavichord was the only stringed keyboard instrument to have key-articulated dynamics. Ed Ripin, et al, "Clavichord" *Grove Music Online*, *Oxford Music Online*, Oxford University Press. Accessed September 21, 2013.

[21] Throughout the document, Breed uses the terms 'sounding-wires' and 'strings' interchangeably.

produces a signal that is then amplified through a loudspeaker.[22] Although there is a superficial physical resemblance between the electromagnet in Breed's design and an electromagnetic pickup,[23] the employment of electromagnetism in the circuitry of Breed's guitar is not to amplify its volume, but rather to create its timbre. While the strings in Breed's guitar (and the other applications in his patent) are set into motion by an electromagnetic means, it is still an acoustic instrument.


(No Model.) 5 Sheets—Sheet 5.

G. BREED.

METHOD OF AND APPARATUS FOR PRODUCING MUSICAL SOUNDS BY ELECTRICITY

No. 435,679. Patented Sept. 2, 1890.

FIG. 6

FIG. 8.

FIG. 7

FIG. 9

WITNESSES:

INVENTOR

BY

ATTORNEYS.

Figure 1.2 – George Breed's 1890 guitar design.

[22] While some guitars use other pickup systems, such as the piezoelectric (the Parker Fly for example), the vast majority of modern electric guitars, especially solid body types, employ electromagnetic pickups.

[23] This resemblance is especially striking between Breed's electromagnet and George Beauchamp's electromagnetic pickup on the 1931 Rickenbacker 'Frying Pan' electric guitar.

While the circuitry of the guitar is the same in principle as that shown in the signalling device and piano, Breed's application of his patent to the guitar results in an instrument with several noteworthy playing and construction characteristics. One notable aspect is Breed's specification of metal strings. Although commonly used on mandolins of the time, this appears to be the earliest application of metal strings to an American guitar, predating their mid-1890s use by Orville Gibson and the Larson brothers.[24] Conductive metal strings are required because the guitar's strings form part of the electrical circuit. Interestingly Breed does not specify what type of metal should be used for the strings; since the strings help to create resistance in the circuit, their composition is a significant factor. Strings made of copper, a highly conductive metal, would have a low resistance, enabling the string to function in the circuit the same way as an electrical wire. Strings of iron or steel, which is not nearly as conductive as copper, have a much higher resistance and would function in the circuit much less efficiently, effectively adding a resistor to the circuit, and creating much more heat than the copper wire. Breed also suggests the possibility employing of non-metal strings wrapped with a conductive material.

Another distinctive feature is the method of completing the circuit and setting the string in motion. On the keyboard, the key lever essentially acts as an old-fashioned blade switch, completing the circuit. As on the other two applications described in the patent, the strings of the guitar pass through an electromagnet which is on a separate circuit, and possibly a second power source. Unlike the design of the signalling device and the piano, the guitar's electromagnet has six pole pieces which focus the electromagnetic field on each string as well as decreasing the magnet's weight. The electrically charged strings are attached to a metal bridge that is connected to the clockwork break wheel mechanism which is then connected to one terminal of the battery. The other terminal of the battery is connected to one of two three-position rheostats (high, medium, and low power), which regulates and limits the flow of current in the string circuit. However, other than showing the rheostats' (which Breed calls 'resistance coils') placement on the guitar and their operation by toggle switches connected to a sliding bar, Breed gives no details of their specifications. Experimentation with the string circuit suggests that the circuit would require a

[24] Martin, Darryl, 'Innovation and the Development of the Modern Six-String Guitar', *The Galpin Society Journal* 51, (1998), pp. 86-109.

resistance of at least 1 ohm at the rheostat's setting of least resistance/maximum volume. Even allowing for the use of heavy gauge resistance wire, this would create a rheostat of much greater size than that depicted in Breed's drawing.

The rheostats in turn are connected to the frets, which in effect become multiple contact points. The string is set in vibration by pressing the string against one of the frets, thus completing the electrical circuit. The frets do not completely span the fingerboard but are divided between the third and fourth strings. This allows the treble and bass strings to be on two different circuits, each one controlled by one of the two rheostats and allowing for differing volumes between the two groups of strings. It should be noted that Breed states that the function of the rheostats is to equalise the volume between the different groups of strings and not to raise and lower the volume of the instrument as whole as with the volume control of a modern electrified instrument.

Since this guitar can only be sounded in the manner intended when a string is pressed against a fret, it follows that, unlike a conventional guitar, open strings cannot be used in playing. Breed, however, seems to have accounted for this in his design by the use of a neck which meets the body at the 13th fret rather than the 12th fret as was more typical of the guitars of his day. This 13-fret neck seems to imply an E-flat tuning which would allow the pitches that would normally be open strings on the guitar to be played by playing the first fret. [25]

One of the implications of Breed's method is that, unlike on a conventional guitar, the right hand is not used for setting the string in motion. This allows both hands to be used in playing the instrument, a feature that Breed acknowledges. Two-handed fingerboard techniques would become popular by the second half of the twentieth century,[26] but this appears to be one of the earliest mentions of the technique, if not the first.

As might be expected, the unusual electrical design of the guitar has had a noteworthy effect on its physical configuration. In addition to the 13-fret neck, there are other features where Breed's design differs greatly from a typical late nineteenth-century

[25] There are modern acoustic guitars with 13-fret necks (but without a specifically E-flat tuning), such as the H15 model made by the Santa Cruz guitar company, which aim to create a compromise between the tonal quality of the 12-fret neck and the utility of the 14-fret neck. Interestingly, the Santa Cruz instrument's body is based on the same type of small-bodied American guitars as Breed's design.

[26] The playing of such guitarists as Eddie VanHalen and Stanley Jordan, or instruments such as the Chapman Stick are notable examples of contemporary two-handed playing.

guitar. Perhaps the most noticeable is the thick wooden panel attached to the guitar's back. Besides providing a support for the electromagnet, the panel also houses the rheostats and switches. Another notable aspect is the guitar's extremely small size, even by the standards of the day.

From the time of Breed's invention until the mid 1920s this guitar almost certainly would have been powered from wet-cell batteries. As with the electromagnets of Breed's day, so, too, the batteries available to Breed would have been large, cumbersome, and not particularly efficient, especially when compared to those available in Europe during the same period.[27] The inability of the batteries of the time to provide large amounts of current economically would have severely limited the guitar's electrical efficiency and the length of time it could be played for without recharging, which may have been as short as a few minutes.[28]

Irrespective of the problems with electromagnets and the power supply, the electrical circuit of Breed's design offers some additional quirks that contribute to its impracticality as a performer's instrument. The most noteworthy of these is the tendency for the guitar to go out of tune. A current in the string that is strong enough to react to the magnetic field also tends to heat the string, which in turn causes the metal of the string to expand, making the string go flat; this effect can be quite pronounced.[29] This tendency to detune would have also limited Breed's invention's usefulness as the signalling device previously discussed. Another idiosyncrasy inherent in the circuitry is that playing two or more strings on the same circuit (either the bass or treble) simultaneously results in an overall decrease in volume since the energy in the circuit is then divided between them. It is possible that the division of the strings into two circuits was an attempt to minimise this problem.

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[27] Schallenberg, R., 'The Anomalous Storage Battery: An American Lag in Early Electrical Engineering', *Technology and Culture*, Vol. 22, No. 4 (Oct., 1981), pp. 725-752.

[28] An Edison battery catalogue of the time gives the price of a rechargeable type "A" wet cell battery (the smallest standard size, weighing 1 ¾ lbs. when filled, and which was typically used for powering telephones) as $0.75 with the price of the consumable materials used for each charge (Zinc and copper plates, caustic potash and paraffin oil) as $0.18. This is equivalent to $17.14 and $4.11 respectively in 2006 prices. For context, the average weekly wage of an American worker in manufacturing in 1890 was $8.56. More powerful batteries were, of course, proportionally larger, heavier and more expensive. Edison Mfg. Co., *The Edison-Lalande Battery*, (New York: c1891). Lawrence H. Officer and Samuel H. Williamson, "Purchasing Power of Money in the United States from 1774 to 2006", MeasuringWorth.Com, August 2007. Long, C. D., *Wages and Earnings in the United States*, 1860-1890. (Cambridge, Massachusetts: 1975) p. 42.

[29] On a reproduction of the circuitry made by the author, the strings were found to go flat within a matter of seconds.

The on-off, back and forth motion produced by the Lorentz Force and a break wheel creates a sound not dissimilar to a cross between a traditionally played Neapolitan-style mandolin (but with a much more rapid repetition and softer attack) and the scraping of a plectrum along an electric guitar string, in the manner of a rock guitarist. The break wheel adds a fair amount of noise to the sound, both from the clicking and sparking of the contact blade against the wheel and the noise from the clockwork mechanism. If an electric motor, especially of the type available in the 1890s, were substituted for the clockwork mechanism (Breed suggests this possibility in his patent), it would likely only replace one kind of added noise with another. It should also be noted that, even under optimal conditions, the constantly varying temperature of the strings due to the flow of the electricity through them makes a constant pitch difficult to maintain, creating a slow, semi-measured, almost vibrato-like effect.

From the foregoing, one should not assume that the science behind Breed's design is unsound. The reason that Breed's design was not commercially successful was probably not poor science but the inability of the nascent electrical technology of the day to fully exploit his ideas.

As previously noted, the coincidental timing of Breed's resignation from the Navy and the granting of his patent makes it tempting to suggest a relationship between the two events. However, it is not known with any certainty what Breed's activities were immediately after leaving the Navy or whether he attempted to exploit his patent commercially.

Given all its problems, one has to wonder what was Breed was trying to achieve with his design. Unlike later attempts at guitar electrification, Breed's design was not aimed at making a louder instrument. Nowhere in the patent does he claim that his design produces greater volume. In fact, it is doubtful that Breed was able to make his instrument anywhere near as loud as a conventional guitar. What Breed had developed was a stringed instrument that was capable of sustaining notes indefinitely while being fingered, a kind of electromagnetic hurdy-gurdy.[30]

[30] A hurdy-gurdy is a "mechanically bowed chordophone with three basic elements: a set of melody and drone (or bourdon) strings, a resin-coated wooden wheel which when made to rotate by a crank acts as a bow, and a keyboard with tangents that bear on the melody string or strings when depressed." Francis Baines, et al. "Hurdy-gurdy." *Grove Music Online*, *Oxford Music Online*, Oxford University Press. Accessed September 21, 2013.

Although generally not appreciated as such, George Breed's guitar represents an important step towards the electric guitar. While not amplified, Breed's design uses the Lorentz force like a modern electric guitar, only in reverse; Breed uses the Lorentz force to drive the string while Beauchamp's design uses the Lorentz force created by the vibrating string to create the electric guitar's signal. The ultimate significance of Breed's guitar inheres less in its functionality as a musical instrument than its importance both as the earliest known application of electricity to a fretted stringed instrument and in foreshadowing the electrical technology that would be applied, although in a very different manner, to stringed instruments, especially the guitar, forty years later.

THE CONTEXT AND DRIVING FORCES BEHIND THE ELECTRIC GUITAR

The one thing that all the preceding instruments discussed have in common is that they lack the one feature that most today would consider the defining characteristic of electric musical instrument; that is the employment of electromagnetic technology (i.e. an electrically-powered amplifier and loudspeaker) for the amplification (as opposed to mechanical activation) of the instrument. In other words, for many people the entire point of an electrical musical instrument is that it is able to be louder than a non-electric one. This may be obvious, but it still needs to be pointed out that to create an electric musical instrument in the modern sense, three things are necessary: 1) a sound source to be amplified, 2) a means of a amplifying the sound source (pickup and amplifier), and 3) a method of acoustic reproduction of the amplified sound source (speaker). This change in the essential conception of electric musical instruments begins around the turn of the 20th century and was driven mostly by the invention and spread of telephone technology. Indeed, it will be shown that telephone technology would continue to be the main driving force electric musical instruments until the late 1920s. It should also be noted that in contrast to more modern times, during this nascent period "amplified" was not synonymous with "louder". Indeed, due to the low power of many early amplifiers, it could be questioned whether some of these early amplified instruments were even as loud as their fully acoustic counterparts.

In order to understand the context of the invention of the electric guitar, the nature of the inventing process itself must first be examined. The popular concept of invention and the inventor in most people's minds is someone in the mould of Thomas Edison; the often eccentric genius creating contraptions from scratch in answer to a

pressing need of society. Most, if not all, of the popular writers on the history of the electric guitar have stated that a need for greater volume, especially to compete with louder brass and percussion instruments in the dance orchestras of the early 20th century, was the primary impetus for the development of the electric guitar. While it is true that it was soon recognised and advertised that increased volume was a benefit available to players of the instrument, examination of the historical record does not bear out the suggestion that making the instrument louder was the primary motivation behind its invention. This is not as contradictory as it first might appear; Jared Diamond, in his book *Guns, Germs and Steel*,[31] notes that it is actually very common that an invention precedes its practical application.[32] In the case of the development of the electric guitar, the historical assertion that it was due to an increased need for a volume can be easily and empirically disproved.

The contention is typically made that, in the quest for greater volume, the sound box of the guitar was gradually increased in size until it became physically impractical to play. Then in turn, inventors turned to mechanical amplification to increase the volume of the instrument, before turning to electrical amplification, which became the final and most widely used solution to this "problem".[33] However, a critical examination of these assertions shows that they are wrong or, at best, extremely misleading. There are a number of factors that determine the volume of a stringed instrument; string material, construction, instrument tessitura, playing technique, et cetera, and none of these can be considered in isolation. Regarding the first contention, after a certain, rather small, size, making the sound box of a stringed instrument bigger does not make it louder; no one would argue that a double bass is significantly louder than the much smaller violin or that a *bajo sexto* (a Mexican 12 string/6 course baritone guitar) is louder than a

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[31] Jared M. Diamond, *Guns, Germs, and Steel : The Fates of Human Societies* (New York: Norton, 2005). pp. 242-244.

[32] One of the best-known modern examples of this is the ever-so-slightly tacky glue used on post-it notes. Created in 1968 by Dr Spencer Silver, a senior scientist at 3M's corporate research lab, it was originally developed to be a super-strong adhesive and was a complete failure for its original intended use. Dr Silver spent several years trying to find a practical application for his invention and it was not until 1974 that Arthur Fry, a 3M colleague of Dr Silver's, came up with the idea for the post-it note, (its first use being to mark the pages in a hymnal). It was not until 1980 that they were commercially mass-marketed. Http://www.post-it.com/wps/portal/3M/en_US/Post_It/Global/About/History/ (retrieved December 27, 2012).

[33] Michael Wright, *Guitar Stories* (Bismarck, ND: Vintage Guitar Books, 1995); Richard R. Smith, *The History of Rickenbacker Guitars*, 1st ed. (Fullerton, CA: Centerstream Pub. : Distributed by Hal Leonard Pub. Corp., 1987); Tom Evans and Mary Anne Evans, *Guitars : Music, History, Construction and Players from the Renaissance to Rock* (New York: Paddington Press : distributed by Grosset & Dunlap, 1977).

Neapolitan-style mandolin. What increasing the sound box of an instrument does do is change its timbre; it increases the lower frequencies of the instrument, which need more acoustic energy to sound comparable in volume to higher frequencies.[34] This has the effect of making the instrument sound deeper and fuller, but has only a slight effect, if any, on the overall volume produced. A noteworthy example of this phenomenon is found in the "dreadnought" style guitar, developed and made famous by the CF Martin Company; the large sound box of the instrument was specifically designed to provide a deep-sounding accompaniment for singing, rather than a loud instrument for solo playing.[35]

This is not to suggest, however, that increased volume was not a concern and goal of electrical experimenters and manufacturers of the time; contemporary magazine articles mention both recent advancements in sound reproduction and the need/desire for ever-greater sound clarity and volume in radios and phonograph players.[36] However, it is noteworthy that the same complaints are not made concerning stringed instruments; although the banjo was one of the first stringed instruments to be amplified (as will be discussed below), previously no one seemed to be complaining that banjos could not be heard over other instruments. It is clear, then, that before the 1930s, the quest for greater volume in stringed instruments was driven by novelty and electrical experimentation (both of which can be considered zeitgeists of the 1920s especially) rather than a perceived lack in the volume-producing capabilities of stringed instruments by musicians themselves.

THE AMPLFIER

The electric guitar could not be invented until there was an amplifier to play it through. Although an in-depth discussion of the historical and technical facets of amplification is outwith the scope of this thesis, an extremely brief overview of the development in the United States of the main aspects may be helpful. In order to make a guitar amplifier (or any type of an amplifier set up) three things are required: 1) the amplifier circuit itself, which makes the weak source signal, such as that from an electric

[34] It should be noted that the same is true regarding higher versus lower frequencies when electronically amplified; lower frequencies need much more powerful amplification to be heard at the same apparent volume as higher frequencies. This is why large public address systems used in rock/pop music concerts have much more powerful amplifiers for the bass speakers than for the high-frequency horns.
[35] Evans and Evans, *Guitars : Music, History, Construction and Players from the Renaissance to Rock*. p. 246.
[36] "Electric Amplifier Developed for Fretted Instruments," *The Crescendo*, January 1929. p. 20

guitar pickup, stronger, 2) a loudspeaker of some sort, which translates that stronger signal into audible sound, and 3) electricity to power the system.

In 1906 Lee DeForest invented the precursor to the amplifying valve, the "Audion" valve,[37] which was intended to efficiently detect (but was not capable of increasing the strength of) telegraph signals over long distances. A refinement of DeForest's invention, the triode vacuum valve, allowed for the amplification of signals, including audio signals fed into it. Interestingly, in 1915 DeForest evidently created and electronic instrument that used the Audion valves themselves as a means of generating the musical tones and then for the amplification of an existing signal.[38] By the early 1920s, the application of vacuum valve technology had paved the way for the first audio amplifiers. These were typically used for the amplification of radio broadcasts and phonographs. Large amplification systems could be used for public address.

As part of his 1876 patent for the telephone, Alexander Graham Bell included a design for a loudspeaker, the first capable of reproducing intelligible speech.[39] Although there were incremental improvements, Bell's horn-type speaker remained the standard design until the advent of the paper coned speaker. The horn-type speaker consists of a driver which is attached to a Victrola-type horn. An electrically activated diaphragm in the driver reproduces the amplified signal which is, in turn, acoustically amplified by the horn in the manner of a megaphone. In May 1921 Chester W. Rice of General Electric Corporation and Edward W. Kellogg of A.T. & T developed the first paper-coned speaker. They described their invention in "Notes on the Development of a New Type of Hornless Loudspeaker", the now well-known paper published in the *Transactions of the American Institute of Electrical Engineers* in 1925.[40] That same year Rice and Kellogg filed for a patent for their invention. It should be noted that the key feature of the paper-cone speaker design was not that it featured a paper cone, but rather that it had a moving coil-type design, in which the electrical signal from the amplifier was converted to sound by means of a suspension-mounted wire coil within a magnet. The magnet, in

[37] This was not the first vacuum valve, since the glass tube Audion was not a vacuum, but instead filled with gas.
[38] "Inventor Produces Music from Light; Lee Deforest Declares He Finds Surpassing Tones in Lamps," *The Philadelphia Public Ledger*, October 4, 1915.
[39] Alexander Graham Bell, "Improvement in Telegraphy,"(United States Patent Office 174465 filed February 14, 1876 issued March 7, 1876). N.B. There is much controversy and debate regarding the early history of the telephone concerning who invented what and when.
[40] Chester W. and Edward W. Kellogg Rice, "Notes on the Development of a New Type of Hornless Loudspeaker," *Transactions of the American Institute of Electrical Engineers* 44(1925).

common with most magnets used in speakers during the 1920s and 30s, was an electromagnet, since non-powered magnets were not powerful enough to drive the speaker coil.[41] This magnet/coil unit was in turn attached to a paper cone which, in conjunction with the speaker unit being mounted in a baffle (analogous to the sound box in a stringed instrument), acoustically radiated the sound. One of the first major commercial applications of the Rice-Kellogg speaker design was in the series of "Radiola" extension loudspeakers made by RCA from 1925. Once they became generally commercially available, paper cone-type loudspeakers quickly superseded the older horn type. This is reflected in the design of the electrical schematic symbol for a speaker, which in the early 1930s changed from a shape resembling a question mark-shaped speaker horn to the now-familiar abstract symbol resembling a paper-coned speaker. Paper-coned loudspeakers had a greater range of frequency reproduction, which was necessary when dealing with the much greater frequency range of early electric instruments in comparison to radio broadcasts and phonograph signals of the time.

The third aspect of amplification – the electrical power needed to run the device – though obvious, seems to be often overlooked. Before about 1927, most small electrical appliances in the United States would have been run on battery-supplied power. Even after that time, mains electricity tended to be found mostly in large cities on the east and west coasts. Indeed many rural sections of the country, especially in the Deep South, were not "on the grid" (that is, having a comprehensive system of power generating stations and substations capable of delivering electricity to end users in homes and businesses) until well after World War II. Although small petrol and gas powered electrical generators did exist during this period, they do not appear to have been widely used for directly powering electrical appliances, being used instead to charge batteries.[42] This meant that the most likely method of powering radios, phonographs and the public address systems in areas without mains power was a battery. Mains power allowed for the more efficient and convenient use of electrical appliances such as

[41] This would be the case until the development of the alnico magnet in the late 1940s.

[42] This is most likely because the appliances themselves were mostly designed to directly operate on the lower voltages produced by batteries rather than the higher voltages used in mains power (typically 110-120v in the United States and 220-240 in Europe, which are then stepped-down within the appliance). It should be noted that elsewhere, small thermoelectric generators were a common means of powering radios. They were particularly popular in the USSR until the 1960s, where they were powered by, and combined with, a kerosene lamp.

radios and amplifiers.[43] The combination of these three elements – the amplifier circuit, the paper-coned loudspeaker and mains power – allowed the creation of the first portable public address systems. At this stage, and throughout the early 1930s, there was very little difference, if any, both physically and conceptually, between instrument amplifiers and PA systems.[44] These portable amplifiers were simply electronic devices capable of a amplifying any input the user chose, whether radio, phonograph, microphone or musical instrument. However, there is evidence that during the late 1920s there was a small but growing industry of manufacturing public address systems, both portable and installed, for professional use. For example, there are no advertisements in the Philadelphia telephone directory for companies making public address systems in the mid-1920s, but by the end of the decade there are several.[45]

Radio, not only as a technology, but also as a medium, helped spur the development of the technologies that would enable the electric guitar. Radio is, by its nature, the most ephemeral of mediums. Even newspapers, which are designed to be read and thrown away, can be lingered over in a way a newscast cannot; a radio broadcast disappears at the moment it is experienced. The 1920s were a time of mass entertainment – films, recordings and radio broadcasts were being created in ever increasing numbers to satisfy a voracious public. The public that consumed these entertainments also had a keen hunger for novelty, and this meant that nascent broadcasters were always on the lookout for interesting content that would attract listeners. This, in turn, helped promote the development of experimental instruments and the revival of obscure or obsolete ones. In a reciprocal manner, developments in microphone technology were further driven by the need to accurately reproduce an ever widening array of musical sounds.[46]

AMPLFIED STRINGED INSTRUMENT EXPERIMENTORS OF THE 1920S

It is somewhat contradictory that the most direct precursors to the electric guitar were not guitars or another fretted instrument but rather violins. Upon reflection, however, this is not surprising; for well over 200 years previously, the violin had been

[43] It should be noted that this consideration applies to many other electrical appliances as well – a battery-powered steam iron is unlikely to be electrically viable.
[44] In fact, except for the cabinetry, which tended to be much more ornate on radios, there is little difference between radios and PA systems during this time.
[45] Philadelphia Classified Telephone Directory, Fall 1928, p. 14. Philadelphia Classified Telephone Directory, Fall 1929, p. 16.
[46] "Microphone Has Popularized Obscure Musical Instruments," *New York Times*, March 6 1927.

almost unquestionably the most well-known and important European string instrument and it is natural that inventors would use the violin as a readily available starting point for experimentation. During the 1920s, there were a number of United States patents relating to the electrical amplification of violins. Fred C. Hammond's 1922 patent describes mounting a microphone in a violin, and discusses similar mountings in other string and wind instruments, but does not specify a microphone design; it was apparently assumed that the user would be using an already available design.[47] While the greater part of the patent concerns the adaptation of the violin sound post to house a microphone, it also patents the idea of using a microphone permanently mounted to the instrument. This is a key concept in the development of the electric guitar since it established the concept of a stringed instrument specifically created or adapted for amplified playing as opposed to a musical instrument amplified simply by the use of a microphone. It should be noted that the most common type of microphone of the day was the carbon-button style, which uses the electrostatic properties of powered carbon to create the electrical signal. It should also be noted that the most common speaker of the day, the headphones used by radio operators, also worked on the same electrostatic carbon principle, only in reverse.

Frederick W. Dierdorff's 1924 patent for an amplified violin employed a membrane to better translate sound vibrations from the bridge to the instrument's pickup, but like Hammond's patent did not specify the actual design of the microphone to be used.[48] However, Dierdorff's patent does give some insight into the novelty value that the inventors of such instruments must have felt their creations had:

> "An instrument of this kind can be used to give entertainments such as vaudeville acts wherein its tones are reproduced through a loudspeaker to emanate at any desired part of the hall or theater."[49]

For the greater part, early electric stringed instruments were the province of experimenters, not working musicians. This was often reflected in their designs, which were commonly radical and minimalist – both ergonomically and aesthetically – compared to conventional musical instruments. Later electric string designs, especially

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[47] Fred C. Hammond, "Tone Amplifying Apparatus for Musical Instruments,"(United States Patent Office 1,510,476 filed July 6, 1922 issued October 7, 1924).
[48] Frederick W. Dierdorf, "Apparatus for Reproducing Musical Tones,"(United States Patent Office 1,707,115 filed January 18, 1924 issued March 26, 1929).
[49] This focus on the novelty and popular aspects of nascent electric instruments by both the inventors and the public seems to have been particularly strong in the United States; in Europe, especially Germany, the general tone as well as the audience for electric instruments was decidedly more serious and avant-garde.

those intended for commercial manufacture, were typically based more on traditional instruments – most likely to help in the appeal to musicians.[50] The vast majority of these early experimental amplified stringed instruments were based not on fretted stringed instruments, like the guitar, mandolin and banjo, but rather on violin family instruments, most often the violin and cello. However, these instruments often only bear a passing resemblance to their acoustic namesakes. For example, the October 1922 edition of *Popular Science* magazine depicts Joseph J McCrann of Lowell, Massachusetts, playing his newly invented "radio violin" (see figure 1.3).[51] A cursory examination of the instrument however, reveals it to have very little in common with its relatives made by Stradivari. Physically, the instrument consists of little more than a stick of wood – possibly a cut-down broomstick – with the addition of a pickup and a ukulele key as a tuning peg. The pickup appears to be repurposed from phonograph and seems also to function as the instrument's bridge. The brief article in *Popular Science* states that McCrann "transmits music by radio" but this is not to say that he was broadcasting this instrument by radio waves in the way that we would understand this today. Rather, it simply means that McCrann was using radio technology, that is to say the amplification stage of a radio, to reproduce the sounds of his instrument. McCrann's instrument is, in essence, an amplified diddley bow[52] played with a violin bow. It should be noted that this picture seems to have confused more than one later researcher who was unfamiliar with the confusion and conflation of the terms "radio" and "amplified" by both journalists and the general public during this nascent period. [53]

[50] It is almost axiomatic that musicians tend to be notoriously conservative when it comes to their taste in, and choice of, instruments. Witness that the vast majority of violins are based on a handful of models by three or four historical makers and a similar majority of electric guitars can trace their lineage two models made by the Gibson and Fender companies.

[51] "A Radio Violin," *Popular Science*, October 1922.

[52] A diddley bow is a one-stringed instrument, common to the American South, that is typically played Hawaiian-style with a glass jar in the left hand and a plectrum in the right hand. American musician Bo Diddley took his stage name from the instrument.

[53] Lorenzo F. Candelaria and Daniel Kingman, *American Music : A Panorama*, 4th concise ed. (Boston, Andover: Schirmer; Cengage Learning, 2012). p. 12.

Figure 1.3 – Joseph J. McCrann's "Radio Violin", ***Popular Science*****, Oct 1922.**

The cover of *Radio News* magazine for April 1927 depicts a violin player on stage playing an amplified violin through an amplifier and speaker to a huge audience. However, the actual setup depicted in the magazine is much more humble; a violin with a carbon-button pickup and a horn-type radio speaker. In the first paragraph of the article the author explains his motivation for the creation of his amplified "giant-tone" violin:

> A dance orchestra leader, who also plays a violin, asked the writer recently if the violin music could be amplified electrically, so that it could be heard all over a large dance hall above the music of a piano and the loud wind instruments. He thought this would be a profitable novelty and would, as well improve the quality the dance music by making the director's instrument dominate all the others.[54]

[54] R. F. Starzl, "The Giant-Tone Radio Violin," *Radio News*, April 1927.

Figure 1.4 – Cover of *Radio News*, April 1927.

At first it may seem that this contradicts the assertion made previously that it was not lack of volume driving the development of the electric guitar. However, it is clear from the passage that it was the novelty of the concept – as well as the notion of being able to more easily dominate the band – that was the real impetus behind the idea.[55] The

[55] The article also seems to suggest that the apparatus works because the violin is already capable of producing a significant volume.

carbon-button pickup was mounted on a long thin bolt (which possibly acted as a metal reed) that was attached to the violin's treble f hole – the author of the article noting that drilling a hole in the top of the instrument would make a better mounting, but that the instrument's owner was hesitant to have this done. The pickup mounting on the giant-tone violin left the carbon-button floating about an inch and a half to two inches above the soundboard. This positioning would have made it somewhat inconvenient for both bowing and pizzicato playing.

As a group, these early electrical stringed instruments routinely ignored playing considerations in favour of electrical and technological ones. Almost certainly this is due to the fact that the developers of these instruments were engineers and tinkerers, rather than traditional luthiers. It is significant that these early electric stringed instruments were much more likely to appear in the pages of *Popular Science* than the *Music Trades Review*; this suggests that the main appeal of these instruments was their technological innovation and novelty rather than the actual music created by them, this being true for both the instrument's inventors and the public who read about them in magazines.

STROMBERG-VOISINET "ELECTRO"

The first commercially available electrically amplified stringed instrument was the "Electro" made by the Stromberg-Voisinet company around 1928/1929. While some have asserted that these were the first electric guitars,[56] the Stromberg-Voisinet Electro does not meet the definition of an electric guitar in the way that is usually understood; while the pickup on these instruments was electromagnetic, they did not use the electromagnetic technology in the same fashion (that is, using the string as the armature) as George Beauchamp's design. The instruments were prominently featured in a full-page advertisement within the section featuring the Stromberg-Voisinet company's products in the 1929 Chicago Musical Instruments (CMI) catalogue (see figure 1.5). The catalogue advertisement shows the Electro's amplifier along with four different models of Electro amplified instruments; a guitar, a tenor guitar, a tenor banjo and a long-scale plectrum (four-stringed) banjo.[57] The text of the advert makes no mention of this last instrument, but does give prices for the others, as well as a

[56] Wright, *Guitar Stories*. p. 89.

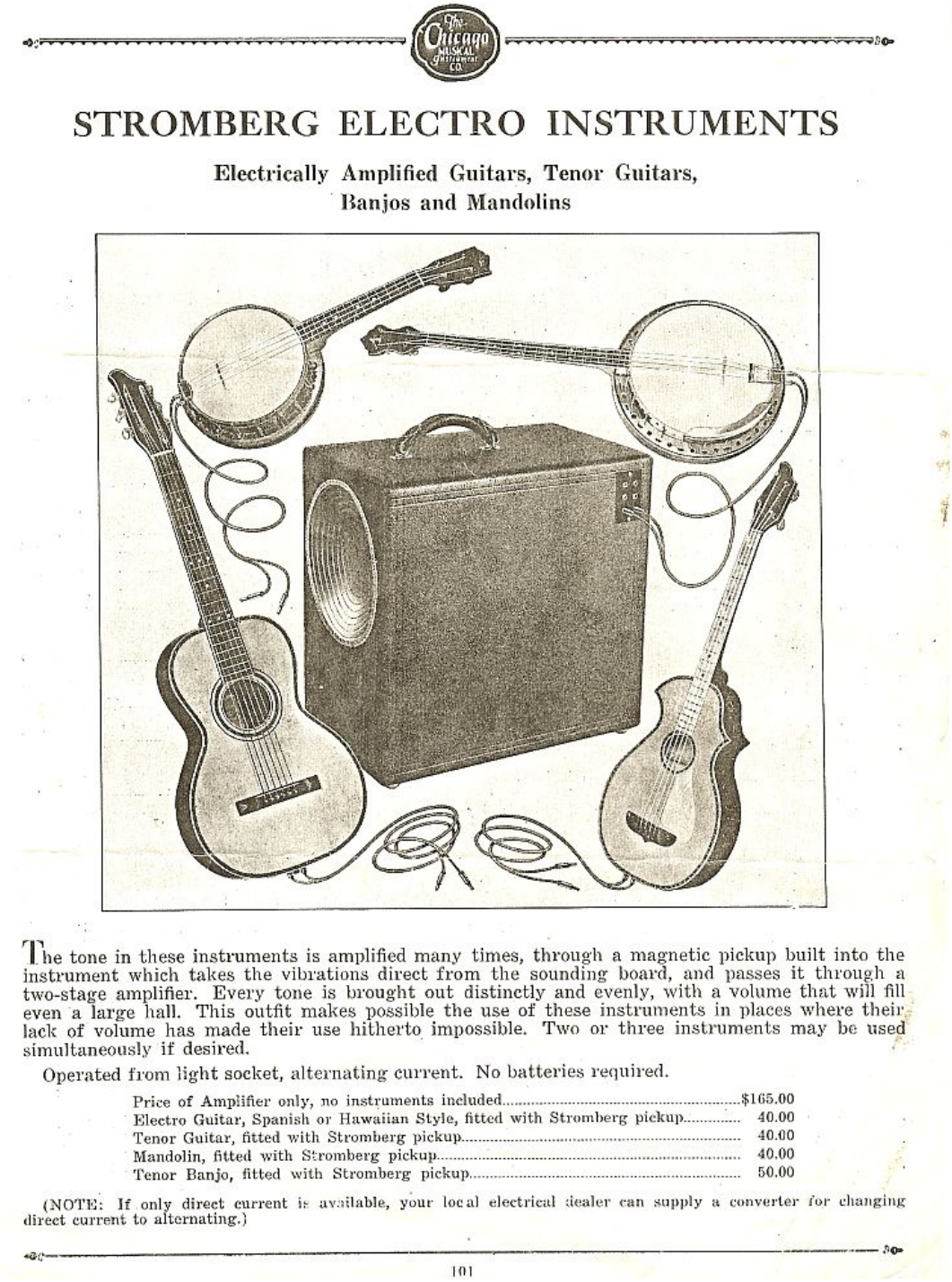
[57] The tenor banjo and the plectrum banjo are often confused; the plectrum banjo is essentially a five-string banjo with the short fifth string removed while the tenor banjo, which also has four strings, has a string length that is much shorter than the plectrum banjo, to facilitate the playing of chords.

mandolin model. The earliest known mention in print of the Stromberg-Voisinet Electro was in an article, "New Sales Avenue Opened with Tone Amplifier for Stringed Instruments" in the October 20, 1928, issue of *The Music Trades*.[58] The article gives a brief and somewhat unclear description of how the pickup system works and states that the new guitars would be valuable to orchestras due to their increased banjo-like volume.[59] It should be noted that this reinforces the point made earlier that, while increased volume did not appear to be the major factor behind the development of electric stringed instruments, manufacturers readily used increased volume of the new instruments as a marketing point.

The new line of Stromberg-Voisinet Electro instruments appears to have been fairly well publicised; half-page articles on the instruments appeared in *The Music Trades* appeared in both the October 20 and November 17, 1928, issues,[60] while the November 24, 1928, issue of the *Music Trade Review* gives the Electro a prominent position in its "Musical Merchandise" section.[61] The January 1929 issue of *The Crescendo* also has a short article on the Electro.[62] It should be noted that all three of these articles use much the same language, which makes it almost certain that they were written from the same source – most likely a press release given out by Stromberg-Voisinet. The October 20, 1928, *The Music Trades* article states that the instruments were developed by Stromberg-Voisinet company secretary H. C. Kuhrmeyer and were currently in production. The article further states that a prototype guitar and amplifier were being demonstrated in the Chicago banjo shop of Milton G. Wolf[63] and that the instruments had been used by Guy Lombardo's Orchestra at the Granada Cafe and with "singular success" by Brunswick recording artists "The Vagabonds".[64] The November 17, 1928, *The Music Trades* article has pictures of both the new instruments (the same illustration as in the

[58] "New Sales Avenue Opened with Tone Amplifier for Stringed Instruments," *The Music Trades*, October 20 1928.
[59] This assertion makes the presence of the Electro tenor banjo in the lineup somewhat confusing.
[60] "New Sales Avenue Opened with Tone Amplifier for Stringed Instruments."; "Draw Banjo Volume from Tinkling Guitar," *The Music Trades*, November 17 1928.
[61] "Electric Amplifier for Stringed Instruments," *Music Trade Review*, November 24 1928.
[62] "Electric Amplifier Developed for Fretted Instruments."
[63] Milton G. Wolf was a noted the banjo player of the 1920s who was featured in the 1926 promotional catalogue for Vega banjos.
[64] "New Sales Avenue Opened with Tone Amplifier for Stringed Instruments."

CMI catalogue) and a publicity photograph of The Vagabonds (playing a conventional guitar, rather than the Electro).[65]



STROMBERG ELECTRO INSTRUMENTS

Electrically Amplified Guitars, Tenor Guitars, Banjos and Mandolins

The tone in these instruments is amplified many times, through a magnetic pickup built into the instrument which takes the vibrations direct from the sounding board, and passes it through a two-stage amplifier. Every tone is brought out distinctly and evenly, with a volume that will fill even a large hall. This outfit makes possible the use of these instruments in places where their lack of volume has made their use hitherto impossible. Two or three instruments may be used simultaneously if desired.

Operated from light socket, alternating current. No batteries required.

Price of Amplifier only, no instruments included	$165.00
Electro Guitar, Spanish or Hawaiian Style, fitted with Stromberg pickup	40.00
Tenor Guitar, fitted with Stromberg pickup	40.00
Mandolin, fitted with Stromberg pickup	40.00
Tenor Banjo, fitted with Stromberg pickup	50.00

(NOTE: If only direct current is available, your local electrical dealer can supply a converter for changing direct current to alternating.)

101

Figure 1.5 – Stromberg-Voisinet "Electro" instruments and amplifier as depicted in the Chicago Musical Instruments wholesale catalogue, 1929.

[65] "Draw Banjo Volume from Tinkling Guitar." The photograph in the microfilm source is too dark for positive identification, but it is almost certainly not an instrument made by Stromberg-Voisinet.

While no Stromberg-Voisinet Electro instrument is known to survive, an instrument made by Kay (the same company as Stromberg-Voisinet, renamed around 1930) does exist, in the collection of Lynn Wheelwright, which has a pickup installed on it that is extremely likely to be a Stromberg-Voisinet electro pickup.[66] While the instrument is a wooden-bodied resonator guitar, the mounting on the pickup is most likely the type of mounting used for the banjo.

Figure 1.6 – Probable Stromberg-Voisinet "Electro" pickup from the collection of Lynn Wheelwright.

[66] Lynn Wheelwright, "Stromberg Electro," *Vintage Guitar*, September 2008.

The pickup unit employs a metal rod attached perpendicularly to the top of the guitar. The rod is adjustable for height and/or tension. It is connected to a vibrating metal reed (called an actuator) that acts as the armature and is perpendicular to the rod and parallel to the top of the guitar. The vibrating end of the actuator is placed within the centre of a wire coil. Two horseshoe magnets provide a magnetic field that converts the actuator's vibrations into electrical current within the coil. While this sounds superficially similar to George Beauchamp's electromagnetic pickup, the two designs have a very different electromechanical signal path. While Beauchamp's pickup is directly driven by the string, the Stromberg-Voisinet has the vibration from the strings transferred to the saddle, then to the bridge, then to the top of the guitar (or in the instance of the existing exemplar, a wooden soundboard-like plate that was used in place of the metal resonator), to a vertical metal rod, which is connected to the horizontal metal actuator/reed, that then vibrates within the centre of a wire coil, which in turn generates an electrical signal that is then sent outside the guitar to an amplifier/speaker. Even with this likely exemplar, there are still many questions about how the Stromberg-Voisinet pickup worked. For example, there are three holes in the top of the existing resonator instrument for attaching the perpendicular rod and adjusting the mechanism. It is not known if these would have been employed on the guitar and banjo versions of the Stromberg-Voisinet Electro. Also it is not clear how the pickup was attached to the bridge of the banjo version, since this would have necessitated piercing the banjo head. It is possible that a wooden block may have been attached to the underside of the head, but this would have possibly dampened the instrument's tone and reduced its acoustic functionality.

The article in the October 30, 1928, *The Music Trades* announcing the Stromberg-Voisinet Electro describes its accompanying amplifier as having "carrying case design" and gives its dimensions as 18" x 15" x 19".[67] Judging from the depictions of the amplifier given in *The Music Trades*, this means that almost certainly the amplifier employed a 12 inch speaker. It is notable that the depictions of the amplifier show no grill cloth or metal grill protecting the paper cone of the speaker, as is usual on later guitar amplifiers. John Teagle speculates that the amplifier's speaker had a metal cone in the manner of resonator guitars rather than a paper cone, but this is almost certainly not

[67] "New Sales Avenue Opened with Tone Amplifier for Stringed Instruments."

the case.[68] The amplifier's box housing was covered in leather.[69] Nothing is known about the amplification stage of the unit, but a few particulars may be surmised from statements made in *The Music Trades* and the amplifier's description and depiction in the 1929 Chicago Musical Instruments catalogue. The total weight of the unit was approximately 25 lbs.[70] The amplifier's electronics weighed less than its companion loudspeaker since the carrying handle (which it is assumed was placed at the centre of balance) is well forward of the middle of the amplifier box. The amplifier was capable of having three instruments connected to it simultaneously, by means of separate banana-pin jacks.[71] It is unknown if the amplifier had a volume control, but it is likely that it did not as was common with radio amplifiers of the time. The amplifier was capable of being used with radios and phonographs as well as the Stromberg-Voisinet Electro instruments.[72] It is noteworthy that the amplifier and speaker are contained in one unit – this was unusual for the time (although not completely unknown), as it was more typical for amplifiers and speakers still to be separate components. Thus by combining an amplifier with a speaker in a single unit specifically designed for the amplification of electric stringed instruments, the Stromberg-Voisinet company has a more than reasonable claim to being the originator of the "combo"-style guitar amplifier, the most common and popular moderate configuration of the device. The advertisement in the 1929 Chicago Musical Instruments catalogue specifically mentions that the amplifier was operated by mains power rather than batteries and connected to the mains by means of a light socket. Using a light socket as an electrical connection is not as strange as it first might appear since the first use of electricity in most homes and businesses up until World War II was for electric lighting and it did not necessarily follow during this period that establishments with electrical lighting would have wall sockets, that even today would have been typically on a separate circuit. While the *Music Trades* states that the amplifier could operate on either alternating current (AC) or direct current (DC) power,[73] the 1929 CMI catalogue states that the use of an adapter was necessary for DC

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[68] John Teagle, "Antique Guitar Amps 1924-1934; Which Came First – Electric Guitar or Amp?," *Vintage Guitar*, September 1997.
[69] "Electric Amplifier for Stringed Instruments."
[70] Ibid.
[71] See chapter 3 for more on the historical means of connecting electric guitars to amplifiers.
[72] "Draw Banjo Volume from Tinkling Guitar."
[73] Ibid. Although an in-depth discussion of history of AC versus DC is beyond the scope of this thesis, it should be noted that the competition in the United States between the two types of power delivery systems was vociferous and hard fought. Direct current (the same kind of current used in batteries) was

operation. The amplifier cost $165, which was more than three times the cost of the most expensive associated Electro instrument, the tenor banjo.

By the middle of 1929, the Stromberg-Voisinet Electro had essentially disappeared from the market; no further mentions of it are found in advertising or trade publications. It is very possible that, due to the lead time for the publication of wholesaler/jobber catalogues, the Stromberg-Voisinet Electro was no longer actively being made or promoted by the time the advertisement for the instrument appeared in the Chicago Musical Instruments wholesale catalogue in the spring of 1929. It is not known how many instruments were made in total; in response to a threatened lawsuit by Electro String Instrument Corporation/Rickenbacker in 1937, Stromberg-Voisinet (which since the early 1930s had been known as Kay) president Henry Kuhrmeyer – who, as company secretary in 1928, had developed the Electro – wrote in a letter "in fact, we put out several hundred electrical instruments as far back as 1927".[74] However, since Kuhrmeyer was slightly inaccurate on the date of introduction for the Electro (1928), it is also possible he was mistaken about the number of instruments produced.

VEGA ELECTRIC BANJO 1928

A final and enigmatic footnote to the account electric stringed instruments before 1931 is an "amplification unit" (pickup) for the banjo by the Vega company. No exemplars or photographs/drawings of the pickup or instrument are known to exist, and it is only known from a short article in the January 1929 issue of *The Crescendo* magazine.[75] Interestingly, the same article also concisely describes the electric stringed instruments being made concurrently by Stromberg-Voisinet. Although there is nothing in the article that suggests how the Vega amplification unit actually worked, it is stated that the pickup was attached to the banjo's head and that the unit had a separate amplifier and loudspeaker (this, as noted above, being the typical arrangement of the period). It is important to note that the article clearly states that the unit was an add-on device designed to be retrofitted to an acoustic banjo, rather than an organically-conceived electric instrument.

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common in the early days of mains power (being famously championed by Thomas Edison, who held public demonstrations in which he used AC power to electrocute animals), but by the late 1920s alternating current (promoted by the Westinghouse Corporation and Nikola Tesla) had become the de facto standard and remains so today.

[74] Quoted in Wright, *Guitar Stories*. p. 92

[75] "Electric Amplifier Developed for Fretted Instruments." p. 20.

It is been asserted by some authors that the Vega amplification unit represents a concerted effort to market an electric stringed instrument.[76] While the *Crescendo* article mentions the instrument being introduced by Vega at the Musical Instruments Manufacturers Convention in New York (which, due to the publication date and typical production lead time for magazines at the time, would indicate the 1928 convention, which was held at the Hotel Commodore on June 3-7 of that year), the convention issue of the *Music Trades Review* makes no mention of it in a short paragraph covering the Vega company's activities at the trade show. [77] It is almost certain that this unit remained at the prototype stage and was never commercially produced. It is not mentioned in the entry or advertisements for Vega in the *Purchaser's Guide to Musical Instruments* for 1929.[78] It should be noted that by 1936, Vega had an electric banjo on the market, with a pickup based on George Beauchamp's design.[79]

NEO-BECHSTEIN ELECTRIC PIANO

All of the precursors of the electric guitar previously examined here, whether they worked electrostatically or electromagnetically, all lack one of the defining features of Beauchamp's pickup design; using a ferrous-metal string as the armature that drives the pickup. However, there is one pre-1931 electric instrument that does use a ferrous string-driven pickup; the Neo-Bechstein piano of 1928.[80]

The Neo-Bechstein piano was designed by physicist and Nobel prize winner Walter Nernst, and was manufactured as a collaboration between Siemens & Halske AG, founded in 1847, and the C. Bechstein Pianofortefabrik AG, established in 1853. Utilising what is essentially a conventional grand piano action, the Neo-Bechstein piano had no soundboard, but instead had the strings mounted over a series of electromagnetic pickups, which are in turn connected to an amplifier and speaker. The pickups consist of a horseshoe magnet that is positioned over two coils of wire (see figure 1.7). The main controls for the Neo-Bechstein are located (rather inconveniently, from the perspective of the player) on the bent-side of the instrument, although there is what appears to be an on-off switch on the right side of the keyboard. The amplifier and

[76] Teagle, "Antique Guitar Amps 1924-1934; Which Came First – Electric Guitar or Amp?."
[77] "National Music Industries Annual Convention," *Music Trade Review*, May 26 1928. p. 35.
[78] *Purchaser's Guide to Musical Instruments* (Boston: Music Trades, 1929).
[79] See chapter 10.
[80] The most comprehensive modern account of the Neo-Bechstein piano is in Peter Donhauser, *Elektrische Klangmaschinen: Die Pionierziet in Deutschland Und Österreich* (Vienna: Böhlau, 2007).

speaker are housed in a separate unit, which could also contain a radio and phonograph player. While the instrument was designed in 1928, it does not appear to have been commercially manufactured until the around 1930. The Neo-Bechstein was promoted by Siemens in Germany and the United States until least the mid 1930s.

Figure 1.7 – Neo-Bechstein piano, c.1930.

Although the physical configuration of the Neo-Bechstein pickup is different than a modern electric guitar pickup, it appears to have functioned in a similar, if not identical, manner; a ferrous string acts as an armature that disturbs a magnetic field, which in turn generates an electrical signal within a coil wire. As previously noted, many inventors and experimenters were aware of the general physical principles involved, but Nernst's and Beauchamp's pickup designs appear to be the first to use the string as an armature. It is notable that electromagnetic pickups on the Neo-Bechstein are very similar in some ways to George Beauchamp's pickup, especially his earliest design of 1932, which also utilised the horseshoe magnet with the ends of the horseshoe closest to the strings.[81] However, in the Ro-Pat-In/Electro String Instrument Corporation's production models of Beauchamp's design, the fact that the strings had to pass between the arms of the horseshoe magnets most likely gave Beauchamp's pickup an advantage over the Neo-Bechstein in terms of sustain. It also should be noted that both the magnets and the coils in Beauchamp's design were much more massive and thus were probably both more efficient and louder than the pickups on the Neo-Bechstein.

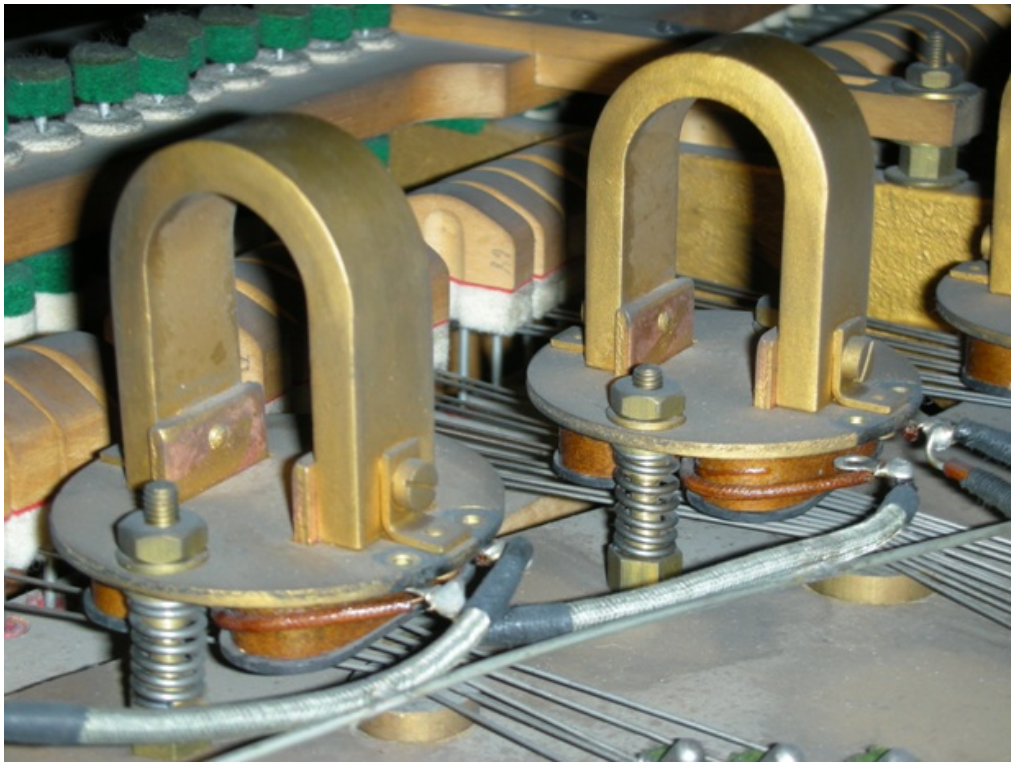

Figure 1.8 – Pickups on the Neo-Bechstein piano, c.1930.

[81] See chapter 3.

It is not clear if George Beauchamp was aware of the Neo-Bechstein piano. It is certainly possible; the instrument was well promoted in the eastern United States – several articles about the Neo-Bechstein appeared in the New York Times, particularly during the summer and autumn of 1931.[82] However, the archives of the Los Angeles Times and the Los Angeles Herald-Examiner do not appear to mention the instrument. Since it appears that the mentions of the Neo-Bechstein in the American press were somewhat light on technical details, it seems likely that, even if Beauchamp was aware of, or inspired by the Neo-Bechstein piano, Beauchamp invented his electric guitar pickup independently. Benjamin Franklin Miessner, the New Jersey inventor who was to later initiate lawsuits against many of the early makers of electric guitars including Electro String, was very aware of the Neo-Bechstein piano; clippings of articles about the instrument exist in scrapbooks found in his personal archive, and letters in his personal archive suggest that at some point Miessner may have owned one or had the significant access to one in the United States.[83] Although it is not known what influence the Neo-Bechstein piano had on the development of the electric guitar in the United States, it is clear that the Neo-Bechstein was the first electric string instrument to use a pickup that utilised a string driven armature – the same idea that George Beauchamp would later use in his pickup design.

[82] "Shows New-Style Piano: Instrument without Sounding Board Invented by Expert," *New York Times*, July 12 1931; "New German Piano Lacks Sounding Board: Electrical Amplifier Takes Its Place – Instrument Is Said to Have Superior Tone Quality," *New York Times*, August 30 1931; "A Versatile Instrument," *New York Times*, October 4 1931; "Radio Piano Offers New Tonal Effects," *New York Times*, October 29 1932.

[83] See chapter 9. Benjamin Franklin Miessner Archive, Purdue University, West Lafayette, IN.

"THE MYSTERIOUS MR BEAUCHAMP"

It can sometimes seem that the story of the electric guitar is as much about personality as technology. In order to understand the development of the electric guitar is not only important to place its technical development within a historical context, it is also necessary to place the life of its main developer, George Beauchamp, within an historical framework. Although now generally acknowledged as the inventor of the electric guitar as well as being a pivotal figure in the development of the resonator guitar, the name of George Beauchamp is not as well known as others important to the history of the American guitar, such as C.F. Martin, Leo Fender or Orville Gibson. Even the "frying pan" electric guitar he designed is much more associated with the name of Adolph Rickenbacher, the man primarily responsible for its commercial manufacture, than with Beauchamp, its inventor. Add to this the fact that the two principal accounts of Beauchamp's life, written more than 45 years after his death are primarily based on interviews marked by strong partisanship – both for and against Beauchamp[1] – and it is easy to see why National String Instrument Corporation employee Al Frost once described him as "the mysterious Mr. Beauchamp".[2] This chapter will examine the historical background leading up to Beauchamp's development of the electric guitar, focusing on his involvement with the development of the resonator guitar and the creation of the National String Instrument Corporation. This will include a brief history of the National Stringed Instrument Company and some of the significant individuals involved. It will also examine briefly the events of Beauchamp's later life up to his early death in 1941.

George Delmetia Beauchamp was born in Texas on 18 March 1899, one of nine children of Saybird Jackson Beauchamp and Fanny Myrtle Beauchamp, nee Mitchell. In the Rickenbacker archives there exists a short and somewhat 'folksy' account of

[1] Smith, *The History of Rickenbacker Guitars*. Bob Brozman, *The History and Artistry of National Resonator Instruments* (Fullerton, CA: Centerstream Publishing, 1993). In both of these accounts, Richard Smith, author of the section on Beauchamp in *The History and Artistry of National Resonator Instruments*, is very aware of the lack of objectivity in his subject's recollections of Beauchamp. Conversation with Richard Smith, 20 January, 2012.

[2] Al Frost, quoted in Brozman, *The History and Artistry of National Resonator Instruments*, p. 19.

Beauchamp's life and inventions written by Adolph Rickenbacher around 1960, approximately 6 years after Rickenbacher's retirement and sale of the business to F.C. Hall. In his account, Rickenbacher says that Beauchamp himself told him 'his pappy gave him a mule and an old wagon and told him to "git", and that is about all he had with the exception of an old guitar.' Rustic vernacular aside, it appears likely that Beauchamp moved to California with his family rather than away from them, as the first mention of Beauchamp in the Los Angeles city directories in 1923 also includes listings for other family members, including his father. It is not clear exactly when he moved to Los Angeles, but it must have been some time before 1923 as the city directory of that year shows him living at 1245 W 88th Street, approximately two blocks away from his father. Although it has usually been assumed that Beauchamp was a full-time professional musician during the mid 1920s, the Los Angeles city directories for both 1923 and 1926 listed his profession as painter (not an artist, but a "decorator" in British parlance).[3]

Beauchamp took violin lessons as a child, and by the early 1920s began playing steel guitar and around 1923 began playing professionally. By the mid-1920s Beauchamp had a duo with his brother Alton (on Spanish-style guitar) called "Grasshopper and George" which also, with the addition of ukulele player Slim Harper, performed as a trio under the name "The Boys from Dixie."[4] It is extremely likely that Beauchamp and his groups played on the vaudeville circuit in 1924 and 1925. It is likely that he had some success with his groups; there exist professional photographs of both acts, most likely taken at the same session, dressed in matching shirts and trousers, and wearing artificial Hawaiian leis. The booking agent for Beauchamp's groups was the William Morris[5] agency, which at the time was still under the management of the founder, and had recently expanded to Los Angeles from the East Coast.[6]

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[3] George's brother Alton was also listed as a painter in the same directories. This is also confirmed by Emil Dopyera; ibid., p. 19.

[4] The group was possibly named after the World War I novelty song "When the Boys from Dixie Eat the Melon on the Rhine" by Ernest Breuer and Alfred Bryan, Maurice Richmond Music Co. (New York, N.Y.) 1918. The geographical term "Dixie" typically refers to those southern states east of Texas, but often not Texas itself, where George and Alton Beauchamp were from. However, not being a political entity, interpretation of what constitutes "Dixie" has varied greatly over the years and often includes East Texas. Strangely, the earliest uses of the term "Dixie" actually referred to a location in New York State.

[5] No relation to the famous designer, artist and leader of the English arts and crafts movement.

[6] The company still exists today, after many mergers and expansions, under the name WME (from the most recent merger, that of the William Morris and Endeavor agencies) and is the largest entertainment agency in the world.

Recollections of people who knew Beauchamp at the time suggest that he was generally regarded as likeable and articulate, as well as an excellent musician.[7] It is not clear exactly what the repertoire of Beauchamp's musical acts were, but it seems likely, due to their instrumentation and photographic evidence, that they played a Hawaiian style of music known as *hapa haole* ("half white") which was a highly Westernised/Americanised version of traditional Hawaiian music, typically, but not always, with English lyrics. It is unknown whether any of Beauchamp's groups featured vocals, but the existence of similar groups operating on the West Coast at the same time that did suggests that this was probably the case.

THE RESONATOR GUITAR AND ITS DEVELOPMENT

At this juncture it may help to include a brief description of the resonator guitar. The term "resonator instrument" refers to a group of stringed instruments with varying construction details, but all having in common the concept that the sound-amplifying part of the instrument, rather than being a wooden soundboard, as on a conventional string instrument, is a dish-shaped diaphragm, most typically made out of spun aluminium. These metal diaphragms strongly resemble the paper speaker cones used in electric loudspeakers – which were invented in 1921 and first became generally commercially available about 1926, almost simultaneously with the development of the resonator guitar). Although sharing some superficial characteristics with membranophone-based stringed instruments such as the banjo, resonator instruments differ greatly; notwithstanding the obvious differences such as the materials of the primary resonating body, the most significant is probably that the membrane of a banjo is under tension by being attached to the shell in the manner of a drum, while the cone of a resonator instrument is only under pressure from the tension of the strings pressing down on it. While the guitar was by far the most successful iteration of the resonator concept, the idea has been applied to many other stringed instruments, including the mandolin, ukulele, and even violin family instruments.

There are three main configurations of the resonator guitar: the "Tricone", the single resonator, and "Dobro" style. All three of these instruments may be built in either Hawaiian-style (that is, with a square section neck designed to be played on the lap) or Spanish-style (with a rounded neck enabling it to be played in the conventional

[7] Brozman, *The History and Artistry of National Resonator Instruments*, p. 19.

manner).[8] The "Tricone", like its name implies, uses three spun aluminium cones, mounted with their widest aperture on the face of the instrument, to produce its sound, the bridge of the instrument having a "T" shape with each point of the T resting on top of one of the resonator cones. Typically having a body made out of metal, usually chrome or nickel-plated brass and often with engraving similar to that found on contemporary brass instruments, the Tricone is the style of resonator instrument most associated with Hawaiian music.[9]

Figure 2.1 – 1929 National "Style 2" Tricone resonator guitar.

[8] For a more thorough explanation of the differences between Spanish-style and Hawaiian-style instruments, please refer to Terminology and Conventions.
[9] It must be emphasised that Hawaiian-style music is not necessarily synonymous with Hawaiian-style playing; see Terminology and Conventions.

The single cone resonator, not surprisingly, uses one large resonator in place of the three smaller ones used on a Tricone instrument. Although the earliest single cone resonator instruments had metal bodies (either plated brass similar to the Tricones or painted steel), wood-bodied are also typical of the style. The timbre of a single cone resonator is generally agreed to be more piercing and strident when compared to Tricone instruments. Although there are exceptions, single cone instruments tend to be less complex, both in terms of construction and decoration, than Tricone instruments, and this has historically been reflected in their price. Single cone guitars are the style of resonator instruments most associated with blues musicians, though ironically, one of the models most identified with the genre, the National Style "O", is decorated with mock-Hawaiian scenes.

Figure 2.2 – 1930 National Style "O" resonator guitar.

The last type of resonator instrument that needs to be mentioned is the "Dobro" style, named after the company which first produced it.[10] Superficially similar

[10] More on the Dobro company and its relationship to National String Instrument Company and George Beauchamp will be presented at the end of the chapter.

to a single cone resonator instrument, the "Dobro" style instrument also has a single resonator cone, but the cone is mounted with its widest aperture pointing inward. The bridge of the instrument is structurally similar to that of the tri-cone, but with eight feet which rest on the outer edges of the cone, rather than individually on separate resonators. This "backwards mounting" of the resonating cone in effect projects the sound to the back of the instrument where it is then reflected back towards the player and the listener. The "Dobro" style was the last of the three types of resonator instrument to be developed and is particularly popular with country and bluegrass musicians.

Originally popular with 1920s and 30s musicians for their distinctive tone as well as their greater volume, since the 1970s resonator guitars have seen something of a revival in popular music, especially country and folk, with musicians rediscovering their unique tone quality and unusual looks. Although resonator instruments are particularly associated with the United States, since the expiration of the original patents, resonator instruments, often closely mimicking the original 1920s and 1930s designs, have been made by various companies around the world.

COLLABORATION WITH JOHN DOPYERA AND THE CREATION OF THE RESONATOR GUITAR

The resonator guitar is often seen as a direct antecedent of the electric guitar, with the reasoning that the instrument was developed to fill the same volume-increasing function that the electric guitar would later fulfill more effectively. The fact that one of the major participants in the resonator guitar's creation, Beauchamp, would later invent the electric guitar also seems to support this contention. While this line of thinking does have some validity, it oversimplifies and conflates the actual story.[11]

Although it has been hotly debated, both at the time of its invention and later, exactly what George Beauchamp's involvement with the development of the resonator guitar was, it is clear that had he not been involved with the creation and equally importantly, the marketing of the resonator guitar, it is highly unlikely that Beauchamp

[11] There are still many questions to be answered regarding the Dopyera brothers and the events surrounding the early years of the National Stringed Instrument Corporation. What is presented here, while thorough in its main points, deals mainly with those aspects that are pertinent to Beauchamp and his development of the electric guitar, and is not intended to a be comprehensive history of the National Stringed Instrument Corporation.

would have gone on to invent the electric guitar. As will be shown, it is through his experience with National that Beauchamp developed many of the skills, and personal and business contacts, needed. And so, Beauchamp's development of the electric guitar is probably best understood within the context of his previous experience with developing the resonator guitar. While it is clear that it was Beauchamp who instigated the creation of the resonator guitar, it is equally clear that most of the practical matters concerning its construction were attended to by John Dopyera.

One of 10 children (of whom at least four would be involved with instrument making), John Dopyera was born July 6, in 1893 in the village of Stráže (now known as Šaštín-Stráže) in Senica District, Trnava Region in western Slovakia.[12] At the age of three, he moved with his family to the village of Dolná Krupá, 30 miles away, where he would spend the rest of his youth until the family's move to the United States. Family folklore says that the move was prompted by Dopyera's father's wish for his sons to escape the possibility of serving as soldiers in the upcoming world war. It is not clear exactly when John Dopyera and his family settled in Los Angeles. A sister, Laura Dopjera (The spelling "Dopjera" was used by the family until about 1920) is listed as a waiter at the Leue & Wolfersberger Restaurant (528 W 6th St) in the 1909 L.A. City Directory. The first listing of John is as a cabinetmaker in the 1915 L.A. City Directory. Family history relates that this sojourn in Los Angeles was not permanent at first; John and some of his brothers appear to have also had a business in Taft, California (about 120 miles NW of Los Angeles) sometime in the late 1910s and early 1920s. This is confirmed by a patent of John Dopyera, filed in 1923, giving his city of residence as Taft.[13] John and his brother Rudy are listed in the 1926 L.A. City Directory as "Dopyera Bros. Banjo manufacturers" with a business address (which apparently doubled as their residence) of 5006 Moneta.[14] This is approximately 3½ miles from George Beauchamp's residence on 8836 Orchard Street.

Although the general story of the development of the resonator guitar is fairly well known, the recollections of John Dopyera and other family members having been

[12] John Dopyera Jr. gives the name of his father's birthplace as 'Stratzia'. Brozman, *The History and Artistry of National Resonator Instruments*, p. 5. Is

[13] John Dopyera, "Banjo,"(United States Patent Office 1,649,101 filed December 12, 1923 issued November 15, 1927).

[14] It appears that within a couple of years Moneta was renamed "South Broadway", however there are still institutions in the area with "Moneta" in their title.

published on several occasions,[15] pinning down specific dates, events and relationships has proven to be somewhat problematic. It is not known if Beauchamp and Dopyera had known each other before Beauchamp commissioned his guitar, but at some point in the first half of 1926 George Beauchamp went to the Dopyera brothers shop and commissioned an instrument from John Dopyera. According to the generally accepted story, Beauchamp felt the need for a louder instrument that could compete in volume with the instruments of the dance and vaudeville bands of his day. Although there is likely an element of truth to this, this reasoning has been unquestioningly accepted by later writers on the subject, most likely since it is viewed within the context of the generally much louder music of the subsequent decades. However, this is not necessarily the case and a slight digression on the subject of Beauchamp's likely need of greater volume is relevant here.

Although, as with the subsequently invented electric guitar, the advantages of the increased volume provided by resonator instruments would become readily apparent to musicians, it does not necessarily follow that the desire for increased volume was the principal impetus behind its invention. The reasons typically given by musical historians, that guitar players were actively seeking a louder instrument to enable them to be heard over competing brass and percussion instruments, seems to be not relevant in Beauchamp's case; there appears to be no evidence that, before commissioning the resonator guitar, Beauchamp ever played in a group larger than his guitar and ukulele trio. It is tempting to speculate that Beauchamp's primary purpose in commissioning instruments from Dopyera was not increased volume, but increased marketability. It is reasonable to surmise, similar to the way that vaudeville banjoists of the era often played visually striking instruments, which could include decorations of rhinestones, pearloid veneers, and elaborate inlay, and which not uncommonly included sound modifiers such as the knee-damper,[16] that Beauchamp felt a new variation on a Hawaiian-style guitar that was both a visually and sonically striking instrument would help set Beauchamp, and the acts he played with, apart from the crowd.

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[15] In addition to the accounts in Brozman, *The History and Artistry of National Resonator Instruments* and Smith, *The History of Rickenbacker Guitars*, there has been at least one magazine article (Guitar Player, 1974) as well as a museum exhibit (*Loud and Clear: Resophonic Guitars and The Dopyera Brothers' Legacy To American Music* Erie Art Museum December 31, 1997 - April 15, 1998).

[16] This is a knee-activated mute which created a muffled effect, similar to a snare drum's damper.

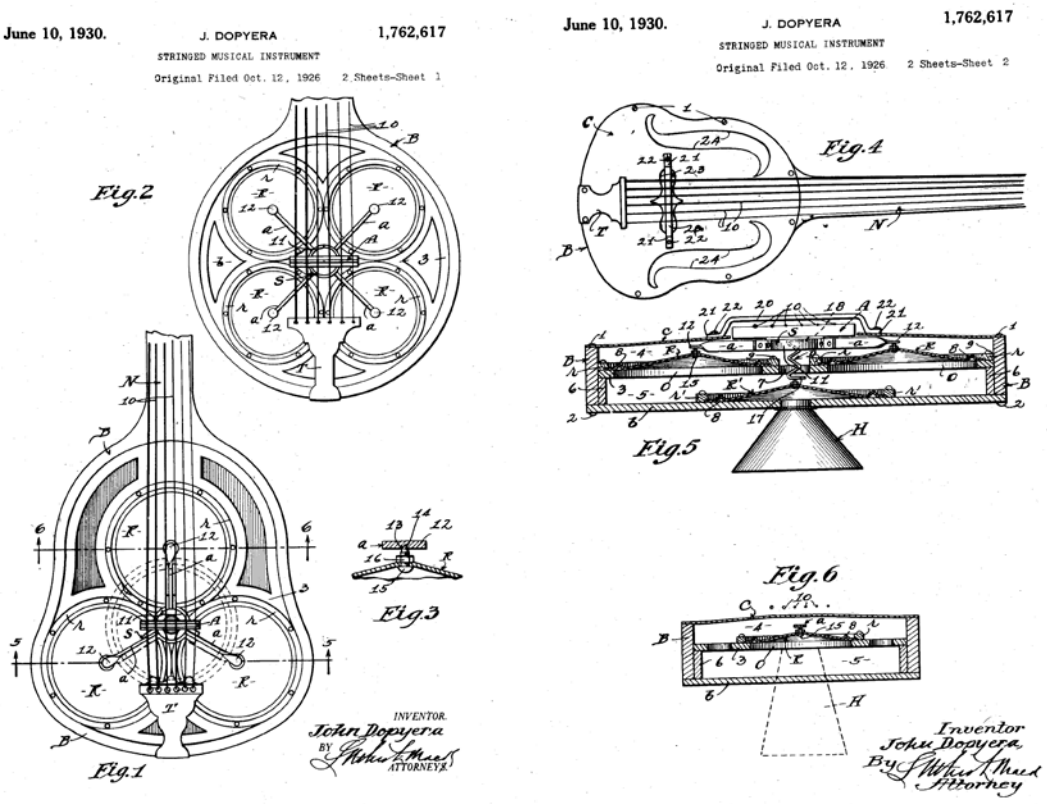

Figure 2.3 – John Dopyera, "Stringed Musical Instrument", U S Patent 1,762,617

Although it is not known for certain what the first instrument that John Dopyera made for Beauchamp looked like, there are some clues. Dopyera, later in his life, said that the instrument employed a Victrola-like horn to amplify the sound. He also said that this instrument did not work particularly well and that this lack of success is what led Dopyera to begin working on the instrument that would become the Tricone. Dopyera did patent an instrument which does incorporate a horn-like mechanism projecting towards the back of the guitar,[17] and it is likely that this instrument had much in common, if not everything, with the first instrument that Dopyera made for Beauchamp. This instrument seems to show some influence of the Stroh viol, an early 20th century violin which incorporated a Victrola-like horn.[18] It is known that a Hawaiian guitar version of the Stroh viol existed, although it is unlikely

[17] John Dopyera, "Stringed Musical Instrument 1,"(United States Patent Office 1,762,617 filed October 12, 1926 issued June 10, 1930).

[18] Stroh instruments used a small disc of mica that was vibrated by the bridge and amplified by the horn. These instruments were popular in the early recording industry since they produced a sound that was more easily picked up by the microphones of the time. Bart Hopkin, *Musical Instrument Design* (Tucson, AZ: See Sharp Press, 1996). p. 112.

that Dopyera had ever seen one, since extremely few were made.[19] Dopyera stated in later interviews that he was familiar with the Stroh viol and it seems reasonably certain that Stroh instruments had an influence on Dopyera's designs.

It is easy to see some possible design issues with the instrument illustrated in the patent. The amplifying horn which projects from the back of the instrument presents playing difficulties in both Spanish and Hawaiian position – the horn would tend to project into the player's stomach in the first case, thus potentially muffling the sound, and in the second instance, the horn would either balance on the player's leg, again potentially muffling the sound, or dangle on either side of the leg, creating a somewhat off-balance playing position.[20]

Soon after the completion of his first instrument for Beauchamp, Dopyera constructed a second instrument for him. While it is unknown exactly what this instrument looked like, it is almost certainly very similar, if not identical, to the instrument shown in US patent 1,741,453.[21] Although there would be slight modifications, notably to the shape of the bridge and the shape and number of the sound holes, this is the instrument that would be made, in both Spanish and Hawaiian variants by the National Stringed Instrument Corporation. While it is not known exactly to what extent Beauchamp influenced the design of the resonator guitar, it appears that most of the practical aspects of the final instrument were Dopyera's rather than Beauchamp's. It does seem clear in retrospect, though, that it is unlikely that Dopyera would have created the resonator guitar if it had not been for the instigation and influence of George Beauchamp.

John Dopyera began the process of patenting the resonator guitar soon after its development. This was not unusual for Dopyera; both he and his brother Rudy had been patenting various items of their invention for at least 10 years previously, and it appears that applying for a patent was a typical event in the invention process for the brothers.

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[19] There were possibly as few of these as 5 to 10. Interview with Lynn Wheelright 21/9/2008. The author has personally only come across three Stroh Hawaiian guitars, one of which is in the *Cité de la Musique* in Paris.

[20] In addition, the Stroh Hawaiian guitar had its amplifying horn mounted on the back (underside) of the instrument, in this case tilted forward so the resonating end of the horn jutted from between the player's legs, giving the musician a somewhat rude appearance.

[21] John Dopyera, "Stringed Musical Instrument 2,"(United States Patent Office 1,741,453 filed April 9, 1927 issued December 31, 1929).

JOHN, PAUL, GEORGE AND ADOLPH:

THE FORMATION OF THE NATIONAL STRINGED INSTRUMENT CORP.

It is not certain exactly when the first Tricone resonator instruments were produced; there is evidence that Sol Hoopii used a National-made Tricone resonator guitar on a recording he made on October 18, 1926 (Farewell Blues/Stack O'Lee Blues, Colombia 797 – D). It is known, though, that the first dies for stamping the Tricone bodies were made at Adolph Rickenbacher's tool and die shop around April 1927, about the same time that John Dopyera applied for the patent for the second and final Tricone design.[22] Although the incorporation of the National Stringed Instrument Corporation did not occur until early 1928, the company was up and running, and mass producing instruments by the summer of 1927. Things moved quickly for the nascent National company; soon after production began, the company began to promote their products in earnest, both with an advertisement in the August 1927 issue of the music trades and a performance by Sol Hoopii's Novelty Trio at the Western Music Trades Convention in San Francisco.[23]

Although National's product output was based on John Dopyera's instrument designs, George Beauchamp seems to have been the driving force behind the company from the business and money aspects. According to an often repeated story, Beauchamp approached his cousin-in-law, Ted E. Kleinmeyer, for a loan $12,500 to help establish the company, supposedly at a wild party at Kleinmeyer's house, which was around the corner from Beauchamp's.[24] The first Board of Directors meeting for the new company was held on February 29, 1928. George Beauchamp was appointed secretary/treasurer. This was moved by John Dopyera and seconded by Paul Barth. The trademarked "National" name was sold by the Dopyera brothers (which had first been used by them in 1926) to the new company in exchange for common stock.[25] It is not clear if any of the other Dopyera brothers were involved in the day-to-day operations of National at the beginning (although eventually all the brothers would be involved in some way in either the National, Dobro, or National Dobro companies). This possible lack of

[22] Brozman, *The History and Artistry of National Resonator Instruments*, p. 280.
Dopyera, "Stringed Musical Instrument 2."
[23] Brozman, *The History and Artistry of National Resonator Instruments*, p. 27.
[24] Much has been made the supposed size of the parties thrown by Kleinmeyer during this period, but it is doubtful that they were too outrageous in size, since his house was a fairly modest 1400 square feet.
[25]Al Frost Archive, NAMM, Carlsbad, California. NAMM ("National Association of Music Merchants") is the industry trade association. Brozman, *The History and Artistry of National Resonator Instruments*, p. 27.

involvement is especially surprising in the case of Rudy Dopyera, in that he was a partner with John in their banjo shop.[26] There were five directors appointed at this meeting: John Dopyera, John's nephew Paul Barth (who would go on to be associated with Electro String Corporation until the early 1960s), George Beauchamp, Murray Ferguson (manager of the local branch of the California Bank, and a neighbour of both Kleinmeyer and Beauchamp) and Ted E. Kleinmeyer.[27]

As the primary underwriter of the National Stringed Instrument venture (although he appears to have had little to do with the day-to-day operation of the company), Kleinmeyer's strange and scandalous story deserves some elaboration here. Many of the events of Kleinmeyer's life, particularly in his early years, were both tragic and titillating enough to be published in the local newspapers. Theodore E. Kleinmeyer, who almost always went by the name "Ted", was born in 1906 to Mr and Mrs Ernest F. Kleinmeyer of El Monte California. Kleinmeyer senior was a wealthy rancher and landowner and although he is listed as having an active cattle and horse breeding business, it appears that his real wealth was based on playing the stock market and owning oil-producing properties in the South Bay area of Los Angeles, particularly Wilmington.[28] While Kleinmeyer senior must have been considered both a wealthy and notable member of the community (almost every newspaper account appends the term "millionaire" to his name), his life was not untouched by scandal; a series of articles in the Los Angeles Times in 1914 describes a remarkable court case in which Ernest Kleinmeyer was accused (and cleared) of stealing back a horse he had sold.[29] When Theodore was a year old he lost his mother in a traffic accident. He was travelling with his mother and father in a horse-drawn buggy in Wilmington, California, when the vehicle was struck by a tram operated by the Pacific Electric Railway. Theodore was

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[26] Is not clear what happened to the banjo shop after the formation of National.

[27] Frost Archive.

[28] CALL RICH MAN A HORSE THIEF. Warrant Out for Millionaire Stock Financier; Sold Arabian and Stole Her Back, Is Assertion; Tail and Mane Cut, but There's a Photograph. Los Angeles Times (1886-1922) - Los Angeles, Calif. Date: Apr 23, 1914 Start Page: II1 Pages: 2 Section: Pictorial City/Editorial Section.

[29] Ibid.
WHOSE MARE IS IT? Millionaire Accused by Realty Man of Re-possessing Himself of Animal Once Sold. Los Angeles Times (1886-1922) - Los Angeles, Calif. Author: LOCAL CORRESPONDENCE. Date: May 2, 1914 Start Page: II8 Pages: 1 Section: Pictorial City/Editorial Section.
NAME IS CLEAR, FRIENDS CHEER. Millionaire Not Guilty of Larceny Charge; Now Lives for His Son, Who Inherits Everything; Tragic Life of a Stockman on Covina Ranch. Loves Horses But Not Enough to Steal. Los Angeles Times (1886-1922) - Los Angeles, Calif. Author: LOCAL CORRESPONDENCE. Date: May 5, 1914 Start Page: II8 Pages: 1 Section: Pictorial City/Editorial Section

hurt in the crash, although this was not immediately apparent. Both his mother and father were also injured and while his father eventually recovered, his mother died soon after from complications of her injuries.[30] Although it is unknown exactly what the nature of young Kleinmeyer's injuries were, they were evidently both severe and long-term; a newspaper article written six years later refers to him as an "invalid".[31] However, Kleinmeyer must have eventually made a good recovery, since his contemporaries in the late 1920s appear to make no mention of any disability.

Just over a week after Ernest Kleinmeyer cleared his name of horse thievery, he died at one of his ranches having been killed by some of his horses, which, strangely, was how *his* father had died.[32] This was not, however, the end of Theodore Kleinmeyer's troubles; almost immediately there was both a lawsuit against Ernest Kleinmeyer's estate – variously reported to be worth between $750,000.00 and $1.6 million and of which Theodore Kleinmeyer was the sole legatee – and a legal battle for Theodore's guardianship between his maternal grandparents and Nels Pederson, a man who was appointed guardian in his father's will.[33] Kleinmeyer senior's will specified that Theodore was to inherit one third of the estate when he reached 21 in 1927 and the balance when he turned 30. The estate increased significantly in value by the time he reached the age of majority and his first payment was $600,000.00.[34] While this made Ted E. Kleinmeyer extremely rich, it did not make him the millionaire that has been often claimed. It also suggests that George Beauchamp must have approached his cousin-in-law for financing soon after Kleinmeyer inherited his money.

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[30] ENTIRE FAMILY STRUCK BY CAR. Woman's Shoulder Is Broken and Man Is Bruised and Cut, but Little Baby Escapes Injury. Los Angeles Herald, Volume 35, Number 186, 5 April 1908
ASKS $95,000 DAMAGES FOR INJURIES FROM STREET CAR. Wife Killed, Child and Self Hurt, Los Angeles Man Sues Interurban Company on Three Claims. Los Angeles Herald, Volume 36, Number 61, 1 December 1908

[31] LIFE STEEPED IN TRAGEDY ENDS IN TRAGIC MANNER. Covina Stockman Shares Same Fate as Father Who Was Killed by Horses--Wife Died as Result of Railroad Accident and Son Has Been an Invalid for Years from Injuries Received at Time of Mother's Death. Los Angeles Times (1886-1922) - Los Angeles, Calif. Author: LOCAL CORRESPONDENCE. Date: May 13, 1914 Start Page: II:8 Pages: 1 Section: Pictorial City/Editorial Section

[32] Ibid.

[33] INVOLVES BIG ESTATE BY PECULIAR CLAIM. Los Angeles Times (1886-1922) - Los Angeles, Calif. Author: LOCAL CORRESPONDENCE. Date: May 30, 1914 Start Page: II:7 Pages: 1 Section: Pictorial City/Editorial Section
STRUGGLE FOR GUARDIANSHIP. ASSAILS GRAND PARENTS' RIGHT TO WEALTHY HEIR; Santa Ana Man Named in Will by El Monte Ranchman Files Counter Petition--Will Bequeaths Estate of Seven Hundred and Fifty Thousand Dollars to Boy. Los Angeles Times (1886-1922) - Los Angeles, Calif. Date: Jun 2, 1914 Start Page: II:10 Pages: 1 Section: Pictorial City/Editorial Section

[34] HEIR TO MILLION GETS SENTENCE Los Angeles Times (1923-Current File); May 6, 1933; ProQuest Historical Newspapers Los Angeles Times (1881 - 1987) pg. A:2

Kleinmeyer's story did not have been happy ending; he soon ran through his money and by the late 1920s was borrowing money from his cousin-in-law George. In 1933 Kleinmeyer was arrested for writing a bad check for $400 and was sentenced to a chain gang.[35] Three years later, he inherited the balance of his father's estate, but this seems not to have improved his fortunes; his ex-wife (with whom he had two daughters) received a significant percentage of this and he apparently ran through this money like he had his first inheritance. According to George Beauchamp's son Nolan, Ted E. Kleinmeyer, eventually became a school janitor in Temple City, California and died impoverished sometime in the 1960s.[36]

Although things appeared to start off well at National, it is clear that they quickly turned sour. A comprehensive examination of the company's internal and external conflicts is beyond the scope of this thesis (indeed, the story would provide much material for a large and somewhat scandalous novel), but the main source of National's problem can be boiled down to the conflicting and contrasting personalities, and the various business decisions and complications arising from them, of John Dopyera (and later, the other Dopyera brothers) and George Beauchamp.

Although one must rely on second-hand accounts to create a portrait of the personality of George Beauchamp, it is abundantly clear that his personality must have stood in sharp contrast to John Dopyera's. Beauchamp was very much a man of his time – the Roaring Twenties – and like the general perception of that decade, was gregarious and ebullient. It is also readily apparent that Beauchamp had excellent social skills that enabled him to work well with most people and get them excited and involved in his projects.[37] He must have had some financial sense as well, or it would have been unlikely that he was able to convince Murray Ferguson, his bank manager neighbour, to have become involved in the National project. However, Beauchamp was not without his faults; he was known to be something of a soft touch and found it hard to say no to his friends, especially when it came to money. Harry Watson, National foreman and future woodcarver of the Frying Pan prototype, would leave National in 1930 under something of a cloud due to an unpaid $200 debt that involved Beauchamp (it is not clear whether the money was loaned by George Beauchamp or the National Stringed

[35] Ibid.
[36] Brozman, *The History and Artistry of National Resonator Instruments*, p. 36.
[37] Ibid., p. 19.

Instrument Corporation).[38] It has also been asserted that Beauchamp made loans to Ted E. Kleinmeyer from company funds.[39]

John Dopyera, on the other hand, was as sober and buttoned-down as Beauchamp was happy-go-lucky. Where Beauchamp was known to indulge in a "businessman's lunch" (which would include alcohol), the teetotal Dopyera would have a banana and a glass of carrot juice.[40] While Beauchamp was a pushover making money, Dopyera was known for his practicality and frugality, complaining that the company wasted sandpaper.[41] However acerbic Dopyera may have appeared to Beauchamp, it is clear that John Dopyera was the only high-ranking person involved in the National venture who had any significant practical experience of either instrument making or running a workshop.

And yet, personality conflicts and dislike of Beauchamp's lifestyle does not completely explain Dopyera's bad blood with George Beauchamp. It is known that others who worked at National had a wild and alcohol-fuelled lifestyle that rivalled or excelled Beauchamp's (for example, foreman Harry Watson was renowned for his drinking and fighting exploits as well as a rather crude sense of humour[42], and Ted E. Kleinmeyer was alleged to have driven around town drunk in his car with a police siren blaring.[43] Even Paul Barth, who by all accounts was quite mild-mannered, was said to have kept a bottle of bootleg alcohol in the glove compartment of his car),[44] yet this does not appear to have affected Dopyera's working relationship with them. In fact, leaving National, Dopyera assigned his interest and title in his National stock to Ted E. Kleinmeyer, who had a much more dubious reputation and lifestyle than Beauchamp.

Part of the answer to Dopyera's animosity towards Beauchamp may lie in a series of escalating conflicts between John Dopyera and George Beauchamp, in which Beauchamp appeared to take undeserved credit for inventions that Dopyera had created. The first of these was a small article in the September 1927 issue of Popular

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[38] Frost Archive.
[39] Brozman, *The History and Artistry of National Resonator Instruments*, p. 36.
[40] Ibid., p. 12 & p. 29. After surviving a bout of Spanish Influenza around 1918, Dopyera was always particular about his diet. In the 1940s he would open what would now be termed a health food store.
[41] John Dopyera's frugality did not extend to the National product line; he resisted both making low end products and cutting corners on higher end ones.
[42] Brozman, *The History and Artistry of National Resonator Instruments*, p. 35.
[43] Ibid., p. 36.
[44] Ibid., p 35.

Mechanics magazine[45] (which must have been written some time before then, most likely as mass production was starting) in which the new Tricone resonator guitar was featured and Beauchamp was identified (although not by name, which appears to have been typically the case with these types of articles in Popular Mechanics) as its (apparently only) inventor. It has been reported that this greatly upset Dopyera; not only was Dopyera angry with Beauchamp for what Dopyera saw as wholesale theft of his idea, he was also dismissive of the idea that Beauchamp was capable of inventing anything on his own.[46] This, however, was patently untrue; on July 30, 1928, he applied for a patent for a type of metal plectrum that was later successfully made and marketed by National.[47] The patent detailed two different plectrum designs; one designed for the thumb and the other to be attached to the end of the fingers. While the thumb pick was very similar to existing designs made of tortoiseshell or celluloid,[48] differing only by being made of metal, the finger pick appears to be a wholly new design, with the plectrum part functioning as an extension of the player's fingernail. Both of these plectrum designs, especially the finger plectrum, would prove to be extremely popular with players of the five string banjo, especially in the fast-picking bluegrass style that would begin to develop during the 1930s. Despite their ubiquity today, the fact that these plectrums were developed by Beauchamp appears to remain generally unknown.

A second and greater conflict between Beauchamp and Dopyera had to do with the design of the single-cone resonator guitar. On March 11, 1929 George Beauchamp applied for a patent for a resonator guitar design that used a single large resonator rather than the three smaller resonators specified in Dopyera's patent.[49] Although Dopyera appears to have resisted the move, Beauchamp had wanted to produce a simplified

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[45] "All-Metal Guitar Produces Loud, Sweet Tone," *Popular Mechanics*, September 1927, p. 360. Interestingly, the same issue featured a number of musical instruments, including short articles on the serpent (as an example of a charmingly obsolete old instrument), a square-sectioned fife, a banjo with a damper effect, a flute made of gold, and a dual piano designed for teaching in which the keys played by the teacher lit up electric lights on the student's keyboard.

[46] Brozman, *The History and Artistry of National Resonator Instruments*, p. 30.

[47] George D. Beauchamp, "Pick for Stringed Musical Instruments,"(United States Patent Office 1,787,136 filed July 30, 1930 issued December 30, 1930).

[48] Plectrums of this type were particularly popular with zither players, which is where Beauchamp probably got the idea.

[49] George D. Beauchamp, "Stringed Musical Instrument 1,"(United States Patent Office 1,808,756 filed March 11, 1929 issued June 9, 1931). This instrument would form the basis of the style "O" guitar, although the resonator depicted in the patent is somewhat smaller than that used on the production model. Interestingly, Beauchamp would later file for a patent for another single cone design which would use an unusual cone design with three peaks that incorporated the T-shaped bridge from the Tricone guitar. George D. Beauchamp, "Stringed Musical Instrument 2,"(United States Patent Office 1,808,757 filed January 21, 1930 issued June 9, 1931).

version of Dopyera's design for several reasons. A single-resonator instrument that could be produced at a lower cost would be advantageous to the company in several ways – it would allow entry-level customers and it would be more competitively priced against other inexpensive instruments from other makers. Dopyera was against this as he believed that the single-resonator design was inferior in tone. In fact, his patent specifies no less than three resonators:

> Experiments have also determined that the best results can be obtained by using three of the resonators. The use of less than three resonators substantially decreases, and the use of four slightly decreases the volume. In some cases, four resonators may be used with good results, but it is preferable to use three and never less than three.[50]

Beauchamp took advantage of the weak wording in the patent and patented the single resonator design. Dopyera was outraged at this and considered it a personal attack. It is not known what Beauchamp's true intentions were in patenting the single-cone resonator guitar, but there is no doubt that it was a good business decision. Not only did it allow National to make a new, more competitively-priced instrument (and one that would go on to be by far the company's most successful style of instrument), it also closed a loophole in the wording of John Dopyera's patent which could have possibly opened the doors to competitors wishing to market similar types of instruments. What makes this conflict between Beauchamp and Dopyera even more peculiar is the fact that at the time Beauchamp applied for the single-cone guitar patent, National was already making single cone instruments – just not guitars. Both the company's mandolin and ukulele designs employed a single resonator and these were almost certainly designed by John Dopyera. Interestingly, although John Dopyera was never anything but disparaging about the single-cone resonator design patented by Beauchamp, both at the time and in later life, the instruments he would make with his brother Rudy at Dobro were essentially a variation on the single-cone design.

[50] Dopyera, "Stringed Musical Instrument 1."

Figure 2.4 – National String Instrument Catalogue (Back Cover), 1930.

(clockwise from top, Ted E. Kleinmeyer, president, George D. Beauchamp, secretary and general manager, C. L. Farr, director and company lawyer, Glenn E. Harger, assistant secretary, Adolph Rickenbacher, engineer, Harry Watson, factory superintendent, Jack Levy, sales representative, Paul M. Barth, vice president.)

In the middle of January 1929, John Dopyera "left his position and refused to return."[51] An emergency board meeting was called on January 17, at which the remaining members of the board of directors gave George Beauchamp a vote of confidence. Like many of the other conflicts at National Stringed Instrument Corporation, the events are known, but the particulars of, and reasons behind them, are not detailed in the minutes. Although it is not certain why Dopyera left National, it is easy to surmise from the foregoing that he felt aggrieved by many of the circumstances previously mentioned. What is clear is that Dopyera left National in a somewhat dramatic fashion after some kind of turbulent disagreement or outburst.

The back page of the 1930 National catalogue provides snapshot of the high-ranking employees of National String Instrument Corporation just before George Beauchamp's departure (see fig 2.4). The most immediate and striking feature is that out of the eight people shown, not one is named Dopyera. This photo gallery also graphically highlights some of the questions and misunderstandings about the relationships and interrelationships of people associated with National String Instrument and the companies closely associated with them, in particular Adolph Rickenbacher's machine shop and the soon-to-be-formed Ro-Pat-In Corporation. It may be helpful therefore to attempt here to delineate some of the boundaries and interconnections between National Stringed Instrument Corporation and Adolph Rickenbacher and some of the other people shown here.

Much has been made of Adolph Rickenbacher's involvement with National String Instrument Corporation. However, the evidence suggests that this may be somewhat exaggerated; although Rickenbacher is featured on the back page of the 1930 catalogue and given the title of "engineer", it is clear that his main contribution to National was through his tool and die company, as a supplier of the stamped metal bodies for instruments. Records show that Rickenbacher had no day-to-day involvement in National and appears not to have been involved in any of the boardroom dramas, he being rarely mentioned in meeting minutes and then only in terms of being an outside contractor.[52] The Rickenbacker Manufacturing Corporation was a stockholder in National; it purchased 34 shares of preferred stock and 17 shares

[51] Frost Archive.
[52] Ibid.

of capital stock on June 21, 1928. However, this was an extremely small amount in comparison to the other shareholders.[53]

Jack Levy, National's head salesman is also featured in the back-of-catalogue gallery. Levy was a manufacturer's representative for several companies other than National. It should be remembered that prior to the 1950s it was not the case, as it is today, that musical instrument companies sold directly to music stores.[54] Instead music stores bought their merchandise from intermediaries, which could range in size from large wholesale companies down to individual salesman. All of these were known colloquially as "jobbers" (after the "job lots"[55] they sold). [56] Levy must have been fairly successful at this, as the lines he carried in the early 1930s included such well-known brands as Zildjian cymbals and F.E. Olds brasswinds.[57] Levy also appears to have been the connection between National and Chicago Musical Instruments (usually known as C.M.I.), one of the largest wholesalers/jobbers in the Midwest. It is not clear exactly what Levy's connection with C.M.I. was – Levy's early 1930s letterhead makes no mention of it, whereas it mentions the other companies he represents – but it is clear that it was strong as Levy controlled voting proxy of some 600 shares owned by C.M.I..[58] Levy's relationship with C.M.I. also appears to have been a key factor in getting C.M.I. to distribute National's instruments. It may have been this ambiguous relationship with C.M.I. that caused some to later surmise that Levy had a conflict-of-interest in regards to National Stringed Instrument Corporation.[59] Levy would later become a board member of National as well as head of sales and stay with the company until about 1935. He would also become the first sales representative of Ro-Pat-In Corporation.[60]

Like many aspects of George Beauchamp's tenure at National, the facts of the circumstances behind his leaving the company raise more questions than they answer. Whilst John Dopyera left National by walking out ballistically, George Beauchamp

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[53] Ibid.
[54] In the mid-1950s F.C. Hall, who was, by that time, owner of Electro String Instrument Corporation (the company that George Beauchamp would found with Adolph Rickenbacher [see chapter 4]), would introduce this way of doing business.
[55] A "job lot" was a collection of various merchandise sold as one lot.
[56] A more in-depth explanation of jobbers and their role in the musical instrument industry is given in chapter 8.
[57] Frost Archive.
[58] Ibid.
[59] Brozman, *The History and Artistry of National Resonator Instruments*, p. 38.
[60] Frost Archive.

would be friendly-fired. At the Board of Directors meeting on November 10, 1931, Beauchamp and Paul Barth were relieved of their management positions at National, being paid in full at 14 November. While Beauchamp and board member Charles L. Farr (who had replaced John Dopyera on the board)[61] abstained from voting, the other board members unanimously voted against Beauchamp and Barth. While it is tempting to think that the timing of this move by the National board was related to Beauchamp, Barth, Farr and Adolph Rickenbacher having incorporated the Ro-Pat-In Corporation a month previously on October 15, the reasons for the board's the decision are not clear, and once again, the company's minutes offer no enlightenment. However, two facts indicate that Beauchamp's fellow board members bore him no ill will; the first is that Beauchamp stayed on the board of directors (and would remain there until January of 1934) and the second was that at the meeting held on January 4, 1932, the board gifted Beauchamp with a specially-made guitar to commemorate the recent awarding of the single-resonator patent.[62]

The guitar presented to Beauchamp was a highly ornamented single-resonator model, with several features that make it unique amongst National instruments. The most noteworthy of these is the quality of the engraving; engraved (as opposed to models that were sandblasted) National instruments were typically engraved after plating which let the brass thus exposed contrast with the nickel plating. This particular instrument was re-plated after the first round of engraving and then engraved again with a similar design around the first engraving pattern to give a particularly ornate effect. The engraving pattern was an embellishment of the one used on the National style three Tricone.[63] It had Beauchamp's name engraved in an old English script in an arc below the fingerboard, and was also notable for having a white pearloid fingerboard and headstock overlay which commemorated Beauchamp's patent for the single cone resonator guitar.[64] Beauchamp obviously both appreciated and used the instrument; a few years later he installed electromagnetic pickup – not one based on his horseshoe design, interestingly enough – which remained on the instrument after his death.

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[61] Confusingly, on March 31, 1932, Paul Barth would replace Farr on the board.
[62] Frost Archive.
[63] John Dopyera always asserted that the top-of-the-line style four had inferior tone due to its heavy engraving and that the slightly less engraved style three sounded superior. This of course had nothing to do with the fact that Beauchamp had designed engraving for the style four and Dopyera and his wife had designed engraving for the style three.
[64] This instrument was for many years in the possession of Bob Brozman.

Figure 2.5 –Guitar Presented to George Beauchamp by Board of Directors of National String Instrument Corporation, January, 1932

Since so many of the personalities and businesses who influenced the creation and development of both the resonator guitar by the National Stringed Instrument Corporation and the electric guitar by the Electro String Instrument Corporation are introduced in this chapter, this may be an appropriate place to tie-up a few historical loose ends, not directly tied to the technical history of the electric guitar. This brief overview has dealt with those elements of the National story that pertain to George Beauchamp and his development of the guitar; there are many more machinations and subplots to the story of National Stringed Instrument Corporation than can be given here.

NATIONAL AND DOBRO MERGE

As previously noted, John Dopyera left National in January 1929. Almost immediately thereafter John and his brother Rudy appear to have formed a rival company to make resonator instruments, the Dobro Corporation. The instruments made by Dobro were, not surprisingly, of the type described previously as "Dobro-style" which had a style of single-cone resonator which faced away from the front of the guitar rather than the back of the instrument as was the case on National style instruments. Although the patent for these instruments was in Rudy's name, they are almost certainly primarily of John Dopyera's design, most likely to avoid legal problems with National.

A short note on the name "Dobro" may be in order here. While it is almost certain that the primary derivation of the name is a contraction of "*Do*pyera *Bro*thers", it has also been stated by the Dopyeras that a secondary inspiration for the name is that "dobro" (добро in Cyrillic) also means "good" (as well as "goodness", "nice", and "free") in Old Church Slavonic and other Slavonic languages derived from it. While this is true, it could be misleading as it appears the term refers to good and goodness in a moral or spiritual sense, rather than a physical or quality sense.[65]

One of the first orders of business for the new Dobro Corporation was to file a lawsuit against National Stringed Instrument Corporation seeking damages in the amount of $25,000. The charges stemmed from comments George Beauchamp appears to have made to various people, including musical instrument dealers, that Dobro was in

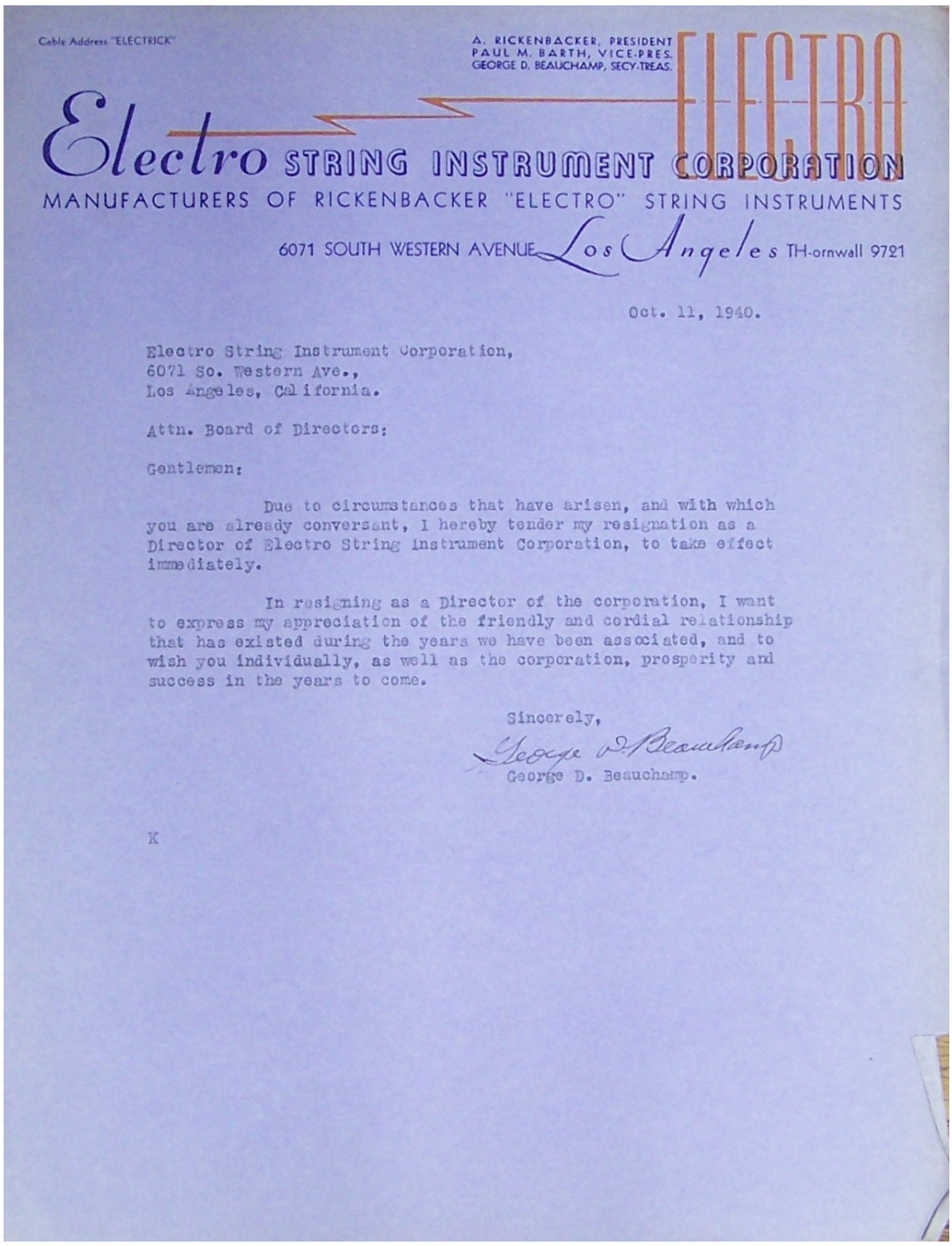
[65] Considering the apparent irascibility of the Dopyera brothers, this could possibly make the name "Dobro" somewhat ironic.

infringement of patents held by National and that National had recently won a lawsuit against Dobro Corporation regarding the patent infringements. This lawsuit would have ongoing repercussions for National until the end of 1933.

It is clear that despite the personal animosity and shifting alliances between the Dopyera brothers, they continued to have business dealings with one another. While the board minutes of National record dates and facts of events, there is almost no contextual information provided. By the time of the National Corporation's annual shareholders meeting on January 9, 1933, John's brother, Louis Dopyera, had acquired more than two thirds of National's stock. George Beauchamp, despite being effectively fired from National in November of 1931, would remain on the board of National until the annual shareholders meeting January 8, 1934. National's dispute with Dobro would ultimately end with the issue of 900 shares of stock to Dobro Corporation in settlement of the lawsuit. At the end of 1934, the addition of Dobro Corporation board member Emil Dopyera to the board of National seems to have created a de facto merger of the two companies. Around March of 1935 both companies moved to nearby 6920 McKinley Avenue, Los Angeles, and began operating as one company, known afterwards as "National Dobro Corporation". Even after examination of archival and other documentary evidence, the reasons for many of the actions the Dopyera brothers and instrument companies are obscure, but it is readily apparent that they had as much to do with personality conflicts amongst the principal players, both within and without the family, as they did with any business decisions.

GEORGE BEAUCHAMP AFTER PATENTING THE FRYING PAN

After Beauchamp's success in patenting the production-model of the frying pan in the summer of 1937 (see chapter 7), there appears to have been a gradual, but distinct, lessening in his involvement in the day-to-day activities of the Electro String Instrument Corporation. The reasons for this are unclear; there seems to have been no significant personal conflicts between Beauchamp and anyone else in the company, and extant archival material at Rickenbacker does not appear to present any business conflicts either. It is not known whether this gradual withdrawing from Rickenbacher is directly related to Beauchamp's subsequent resignation.



Cable Address "ELECTRICK"

A. RICKENBACKER, PRESIDENT
PAUL M. BARTH, VICE-PRES.
GEORGE D. BEAUCHAMP, SECY-TREAS.

ELECTRO

Electro STRING INSTRUMENT CORPORATION

MANUFACTURERS OF RICKENBACKER "ELECTRO" STRING INSTRUMENTS

6071 SOUTH WESTERN AVENUE Los Angeles TH-ornwall 9721

Oct. 11, 1940.

Electro String Instrument Corporation,
6071 So. Western Ave.,
Los Angeles, California.

Attn. Board of Directors:

Gentlemen:

Due to circumstances that have arisen, and with which you are already conversant, I hereby tender my resignation as a Director of Electro String Instrument Corporation, to take effect immediately.

In resigning as a Director of the corporation, I want to express my appreciation of the friendly and cordial relationship that has existed during the years we have been associated, and to wish you individually, as well as the corporation, prosperity and success in the years to come.

Sincerely,

George D. Beauchamp

George D. Beauchamp.

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Figure 2.6 – George Beauchamp's letter of resignation.

George Beauchamp resigned as a director of the Electro String Instrument Corporation in a letter written on company stationery and dated October 11, 1940. It is not clear exactly why Beauchamp resigned; his letter alludes to "circumstances that have arisen, and with which you are already conversant".[66] Interestingly, on October 14, three

[66] Rickenbacker Company Archives, Rickenbacker International Corporation, Santa Ana, CA.

days after his resignation, Beauchamp filed his last patent application, that for the second version of his electric violin.[67] Interviews many years later with people who knew Beauchamp suggest that he resigned from Rickenbacker to begin a company that manufactured fishing lures.[68] He certainly was a keen fisherman – a 1936 article in the Los Angeles Times mentioned Beauchamp as being on a two week long fishing trip to the Gulf of Mexico, the article describing the participants as "prominent Southland sportsmen".[69] A 1939 Los Angeles Times article mentions Beauchamp as being particularly successful on a fishing trip off the coast of San Diego.[70] Interestingly, both of these articles mention that the fishermen were using live bait rather than fishing lures. It is also tempting to speculate that these articles give some insight to Beauchamp's state of mind towards the end of his life. While apparently not poor, Beauchamp was far from wealthy and it possibly bespeaks a certain "work to live, rather than live to work" outlook on life that Beauchamp, who was married with two children, evidently felt comfortable, both financially and emotionally, with these extended trips away from his work and family. Certainly, his passion for fishing lasted until his death; George Beauchamp died of a heart attack while deep sea fishing off the coast of California near the city of Orange on March 30, 1941, less than six months after resigning his position at Rickenbacker.[71]

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[67] George D. Beauchamp, "Stringed Musical Instrument,"(United States Patent Office 2,310,199 filed October 14, 1940 issued February 9, 1943). This instrument will be discussed in chapter 6. Of course, since the application was filed by Beauchamp's attorney rather than Beauchamp himself, Beauchamp's last personal participation in the application must have been necessarily sometime earlier than this date.

[68] It is not known how far along this project was, or if, indeed, any progress had been made, at the time of his death.

[69] Los Angeles Times reference Anglers Head South for California Gulf Fishing
THE GILMORE SCOUT, Los Angeles Times (1923-Current File); Oct 18, 1936; ProQuest Historical Newspapers Los Angeles Times (1881 - 1987), pg. F:2

[70] Los Angeles Times reference DEEP SEA ANGLERS WAIT ON OLD SOL TO PERFORM, Kenneth Crist, Los Angeles Times (1923-Current File); May 14, 1939; ProQuest Historical Newspapers Los Angeles Times (1881 - 1987), pg. F:2

[71] Obituary 1 -- No Title Los Angeles Times (1923-Current File); Apr 1, 1941;
ProQuest Historical Newspapers Los Angeles Times (1881 - 1987), pg. 17

GEORGE BEAUCHAMP AND THE DEVELOPMENT OF THE "FRYING PAN"

Outside of the physical evidence presented by surviving instruments, very little is known regarding George Beauchamp's interest and involvement with electrical musical instruments prior to his initial creation of the frying pan. While it could be assumed that it was Beauchamp's dissatisfaction with the design and acoustic properties of the resonator instruments he helped develop that led to him creating the electric guitar, there does not appear to be any direct documentary evidence for this. In fact, it is possible that Beauchamp's interest in instrument amplification by means of electricity began simultaneously, or even slightly predated, his association with John Dopyera; Nolan Beauchamp asserts that by the early part of 1926 his father, George, had assembled a public address system from a Langevin amplifier and two horn-type speakers mounted on gooseneck stands.[1] However, Nolan Beauchamp is almost certainly mistaken about the brand of amplifier George used as the Langevin Company did not exist until the early 1940s. Nolan also has stated that soon after assembling his PA, George Beauchamp disassembled a carbon button microphone and attempted to attach it to the top of his flattop Martin guitar.[2] It is difficult to speculate on the exact configuration of Beauchamp's PA. It is, however, possible to make a fairly accurate guess as to what it was not – that is, a commercially available package designed specifically for amplifying stringed (or any other) musical instruments, since in 1926 no such thing existed. An examination of the Los Angeles city directories of the 1920s and 30s yields no entries for amplifier makers or sellers of any description until 1932.[3] Even then, the amplifier maker in question was geared towards the movie and movie theatre industry. The Philadelphia city directory of 1926 has no listings for public address systems, but the 1927 directory has one, and by 1928 there are three companies listed in the directory as selling public address systems.

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[1] Brozman, *The History and Artistry of National Resonator Instruments*, p. 40.
[2] Smith, *The History of Rickenbacker Guitars*, p. 9.
[3] Los Angeles Directory Co., *Los Angeles City Directory* (Los Angeles, CA: Los Angeles City Directory Co. (Incorporated), 1932).

The period from 1927 to 1929 saw a sea change in the public acceptance of electronic amplification and sound reproduction. It marked the end of the silent movie era – *Wings*, the 1927 winner of the Academy award for Best Picture was silent, while the next year's winner *The Broadway Melody*, was not. It should also be noted that even many of the silent movies made during this period were "silent" only inasmuch as they lacked spoken dialogue – their soundtracks were recorded and played to the audience by electronically amplified loudspeakers, rather than by live performers on an acoustic instruments. The 1927 film, *The Jazz Singer*, probably the most famous of the early "talkies", actually only had a few minutes of spoken dialogue, the rest of the film having a pre-recorded, music-only soundtrack. One factor in this widespread adoption of electronic amplification was almost certainly the development and commercial availability of the paper-coned speaker. Although first developed in 1921,[4] the paper-coned loudspeaker did not become mass-manufactured until about 1926-27. This new speaker offered a much higher fidelity than the older horn-type speaker, especially in the bass area of the sonic spectrum. This period also marks the point where the telephone industry – which only needed clear reproduction of the human voice – appears to begin to be to be less of a driving force in the development of amplification than the movie industry, which needed full dynamic range sound reproduction for the new recorded film soundtracks. George Beauchamp was well placed, both geographically and temporally, to take advantage of these developing technologies, and apply them to his nascent electric guitar.

It is not clear to what extent Beauchamp had any training, formal or otherwise, in electronics. It has been stated that he took night classes in electronics, but it is unknown where this took place or whether Beauchamp ever earned a credential or degree.[5] Like many of the would-be inventors of the electric guitar, Beauchamp's first attempts involved phonograph technology. Beauchamp took apart a Brunswick record player (a gift to his brother Alton from Ted E. Kleinmeyer) and attached the pickup to a 2 x 4 which had a tensioned string installed on it.[6] The phonograph's pickup was

[4] Edward J. Kellogg, "Sound Reproducing Apparatus,"(United States Patent Office 1707617 filed January 9, 1925 issued April 2, 1929); Chester W. and Edward W. Kellogg Rice, "Notes on the Development of a New Type of Hornless Loudspeaker," *Transactions of the American Institute of Electrical Engineers* 44(1925).
[5] Smith, *The History of Rickenbacker Guitars*, p. 9.
[6] Ibid. This is essentially the same experiment that Les Paul claims to have conducted at about the same time. Les Paul (born Lester William Polsfuss, 1915-2009) was a noted American guitarist and guitar

electromagnetic,[7] that is, having a coil of wire and a small magnet, and thus would have picked up some of the sound vibrating through the solid wood.

There is evidence to suggest that the wood-bodied prototype Frying Pan is not actually the first working model that George Beauchamp created to demonstrate his pickup design, which is unsurprising since it would be assumed that the concept would have been initially employed on one or more test rigs before going to the trouble of creating a fully functional musical instrument. There exists a technical drawing of an early design by Beauchamp, dated January 30th 1932, which differs significantly from Beauchamp's later realization of the frying pan.[8] The most obvious of these differences is the layout of the magnets; like the wood-bodied prototype (which was almost certainly made after the date of this drawing), the instrument depicted in this drawing employs two horseshoe magnets in its pickup, but rather than having the two pole ends of the magnets butting up against each other, as in the prototype (and all other subsequent horseshoe-style pickups), the horseshoe magnets on this drawing are shown parallel to each other, with the poles of the magnets pointing towards the headstock of the instrument. Unlike Beauchamp's later horseshoe pickup design, which had one pickup coil mounted underneath the strings, this pickup utilises two such coils; one above and one below the strings. The design is unusual as well in the fact that it appears to make the bridge an integral part of the magnetic pickup. The physical design of the instrument is even more minimalistic than the frying pan, consisting of a neck with a rather elongated headstock attached to a roughly U-shaped (as viewed from the side of the instrument) framework with an extension that attached to the neck. The drawing depicts the instrument with friction-type tuners such as those found on a flamenco-style guitar, which, if made of wood as is typical, would have been less than optimal on an instrument with high-tension steel strings. It is unknown if this design was ever actually made. Company documents in the Rickenbacker archive include a statement by Beauchamp, in a deposition to his lawyer preparation for a potential law suit against manufacturers infringing on Electro String's patented rights, in which he claims his first

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experimenter, who gave his name to one of the most popular models of electric guitar, the Gibson Les Paul. His contributions to the early electric guitar are discussed in chapter nine.

[7] Not all phonographs manufactured at this time were – some were still completely acoustic, like the earliest Edison cylinder phonographs.

[8] Smith, *The History of Rickenbacker Guitars*. p. 26. The technical drawing as published by Smith is actually a re-drawing of the original due to the original's ill-suitability for reproduction. This drawing was in the Rickenbacker archives as late as 1987 when Smith wrote his book. It is no longer in the archives and its whereabouts are unknown.

electric instrument was made in 1931, and that he had sold a small number of instruments before the first officially recorded sales of Rickenbacker instruments in August of 1932. None of these instruments are known to survive and, indeed, would possibly be difficult to identify if they did, since there appears to be no fuller description of them than this brief mention by Beauchamp.

Sometime during the summer of 1931 Beauchamp had his friend, Harry Watson, who up until the previous year had been the shop foreman for Beauchamp's other business venture, National Resonator Instruments, create the body of what would become the wood-bodied Frying Pan prototype. It is not known if Beauchamp designed the Frying Pan's distinctive shape (although there is no evidence to suggest otherwise) or whether this was done by Watson (or even someone else). The body is carved from a single piece of wood, either maple or hemlock, which company lore says came from a fencepost behind the factory. After unsuccessfully trying to interest his partners at National in the Frying Pan, Beauchamp approached Adolph Rickenbacker, whose tool-and-die company produced the stamped metal bodies of the National Guitars, to form a company to manufacture Beauchamp's invention. In October of 1931, the Ro-Pat-In Corporation (the origin and meaning of the name are now lost[9]) was incorporated to make an aluminium-bodied version of the Frying Pan, known as the Rickenbacher "Electro". The instruments were marketed under the name of "Rickenbacher" supposedly because it was easier to pronounce than "Beauchamp". Some comment on the spelling and pronunciation of Adolph Rickenbacker's name is appropriate here. Throughout his life, Adolph used both the spelling "Rickenbacher" and "Rickenbacker" for his last name. Typically, though, Adolph used the spelling "Rickenbacher" in his personal life and spelling "Rickenbacker" in connection with his businesses. He is also said to have used the "Rickenbacker" spelling to highlight his familial connection with the American World War I flying ace Eddie Rickenbacker, who was a distant relation. However, the production frying pans and other early instruments manufactured by Electro String were marketed under the spelling "Rickenbacher". While there was a shift towards the "Rickenbacker" spelling by the end of the 1930s, this was not always consistent, and in fact instruments with the "Rickenbacher" spelling can be found into the early 1950s (which were almost certainly made using older decals and nameplates).

[9] A full discussion of the name is given in chapter 4.

When it came to the pronunciation of his name, Adolph consistently used the Americanised RickenBACKer, rather than the more Germanic RickenBOCKer. The former pronunciation is considered correct and it is the one used by the company (and most guitarists) today.

It may be helpful here to interject a word on nomenclature: The term "frying pan" can refer to two different instruments. "The Frying Pan" (capitalised with a definite article) usually denotes Beauchamp's 1931 wood-bodied prototype. The aluminium-bodied production instruments are also known as frying pans (but with an indefinite article and often not capitalised). There were two models of production instruments: the A22 and A25 which differed in their scale lengths (22 and 25 inches respectively). It should be noted that the until modern times, the term "frying pan" was never used by Rickenbacker – around the "shop" both the prototype and the production instruments were referred to as the "pancake". However, almost from the beginning, the instruments were called "frying pans" by players and that is how they are generally referred to today.[10]

Although others, as previously noted, were aware of the general principles behind the electromagnetic pickup, it is generally agreed that it is Beauchamp's design that was the first to create a stringed instrument with an electromagnetic pickup, specifically the electric guitar, in the physical and electrical configuration that we know today, that is to say an instrument in which the acoustic properties of the instrument are irrelevant to its functionality as an electrically amplified instrument. The defining feature of Beauchamp's design is that it used the instrument's strings rather than its soundboard as the armature or immediate source of the electrical signal. As noted earlier, others had created instrument designs which used other parts of the instrument, such as the bridge or instrument top as the vibrating armature to create the electrical signal in a magnetic coil. Beauchamp's bypassing of all of the physical structures between the vibrating string and the soundboard made all the difference in the efficacy of his pickup. This made for a much more efficient and powerful design. Although it may appear to be of small consequence, the importance of Beauchamp's discovery of the effectiveness of using the instrument's strings as the armature for his electromagnetic pickup cannot be overstated, as it is this characteristic which has since become the defining feature of the

[10] Hawaiian-style players often refer to these instruments by the very similar nomenclature "fry pan".

electric guitar. Beauchamp's design is commonly referred to as a "horseshoe" pickup after the two horseshoe-shaped magnets placed end-to-end through which the instrument's strings pass. Although the prototype and production models are superficially similar in appearance (discounting, of course, the obvious difference between the wooden and aluminium bodies), there are many differences, some subtle and some less so, not only between the prototype and the production models, but between the two production models as well.

Figure 2.1 – The Frying Pan prototype in its display case at Rickenbacker International Corporation, Santa Ana, California.

Note the picture of Adolph Rickenbacker holding the instrument (taken in the early 1970s) in the lower left-hand corner.

COMPARITIVE DESCRIPTION OF THE FRYING PAN PROTOTYPE AND PRODUTION MODELS

The Frying Pan Prototype

The wood-bodied Frying Pan prototype is held at the Santa Ana, California, headquarters of the Rickenbacker International Corporation, the current name of the Electro String Instrument Corporation.

Figure 2.2 – The Body of the Frying Pan prototype.

Body

Although the body, neck and headstock of the Frying Pan are made from a single piece of wood, other than this material and general measurements, the features of each will be described separately. The Frying Pan is made from a single piece of what appears to be maple, but company tradition suggests is actually hemlock. The overall length of the instrument is 808 mm. The body of the frying pan is effectively a perfect

circle, measuring 172.5 mm across the centre east-west axis and being very slightly wider (0.2 mm approximately) on its NE to SW and NW to SE axis. The top and back of the body are flat and perpendicular with the instrument's sides. In addition, the top of the guitar is on the same plane as the top of the fingerboard. A rectangular cavity, 117.6 mm x 39 mm by approximately 31.2 mm deep, is routed into the top of the guitar to contain the pickup and mounting hardware. Six holes, countersunk to a width of 6.3 mm and a depth of approximately 1.5 mm, in a more or less straight line have been drilled through the body at the end opposite the headstock to serve as string anchors. It is interesting to note that these string anchor holes are virtually identical to those employed on the Fender Telecaster guitar, which was designed in 1949-50, some 18 years later.[11]

Neck

Although the entire instrument (neck and body) is made from one piece of wood, the neck (where it attaches to the body), is carved in such a manner as to suggest a two-piece construction, in the manner of that used for acoustic guitars. Examination of the grain pattern of the wood confirms the instrument's one-piece construction. The neck is of the rounded-section "Spanish-style" construction. It has no heel where it joins the body, but rather runs directly into the body with almost no flaring. The neck has a "V" section profile where it meets the body which tapers gently to a "C" profile at the top of the neck. The width of the neck where it joins the body is approximately 58 mm. This gradually tapers to 56.5 mm at the 12th fret and 47 mm at the nut. The depth of the neck at the 24th fret is 30.7 mm which tapers to 27.8 mm at the 19 fret, 26 mm at the 12th fret and 22.8 mm at the nut. The neck (not surprisingly due to its one-piece construction) has no truss rod.

Headstock

The headstock (see Figure 2.3) is 153 mm long by 72 mm wide at the top. It lies at an angle of 15 1/2° relative to the neck/body measured from the nut edge of the fingerboard. It is roughly trapezoidal in shape, narrowing somewhat towards the nut end. There are two slots cut into the headstock for the tuning machines in the manner typical of most classical guitars and 19th and early 20th century American guitars.

[11] This may not be as surprising as it appears at first glance; Doc Kauffman, whose relationship with Electro String Instrument Corporation will be explored later, was an early partner of Leo Fender and greatly influenced his early guitar designs.

Figure 2.3 – The Headstock of the Frying Pan prototype.

Fingerboard

The guitar does not have a separate fingerboard, but rather has the frets inlaid directly into the top of the neck, which is flush with the body.[12] The fingerboard is un-radiused (that is to say flat) and has 25 frets, all of which are on the neck, with none continuing onto the body of the instrument. The frets appear to be made of nickel silver. They are "T" sectioned and are approximately 1 mm wide. The height of the frets above the fingerboard varies between approximately 1.2 to 2.0 mm. It is unclear the degree to which these were formerly of uniform height as would be required for Spanish-style playing. There are position markers at the 5th, 7th, 9th, 12th, 17th, 19th, and

[12] Although it is unclear if Beauchamp or Watson had ever seen such instruments, this utilisation of a fingerboard flush with the guitar's top is in a manner similar to early 19th century guitars, and was not a common construction technique in the 1920s and 30s. The technique of inlaying frets directly into the top of the neck, rather than a fingerboard veneer, would be used 19 years later by Leo Fender for his Esquire/Broadcaster/Telecaster electric guitars.

24th frets. The position markers appear to be made of a white celluloid-type material. It is not clear whether these were created by inlaying conventional dot position markers or by drilling holes into the top of the finger board and filling them with some kind of material, although, judging by the slightly concave appearance of the dots, the latter possibility seems more likely. All of the position markers are single dots, except those at the 7th and 19th frets which consist of two dots, and those at the 12th and 24th frets which have three dots. There are no position markers on the side of the neck.

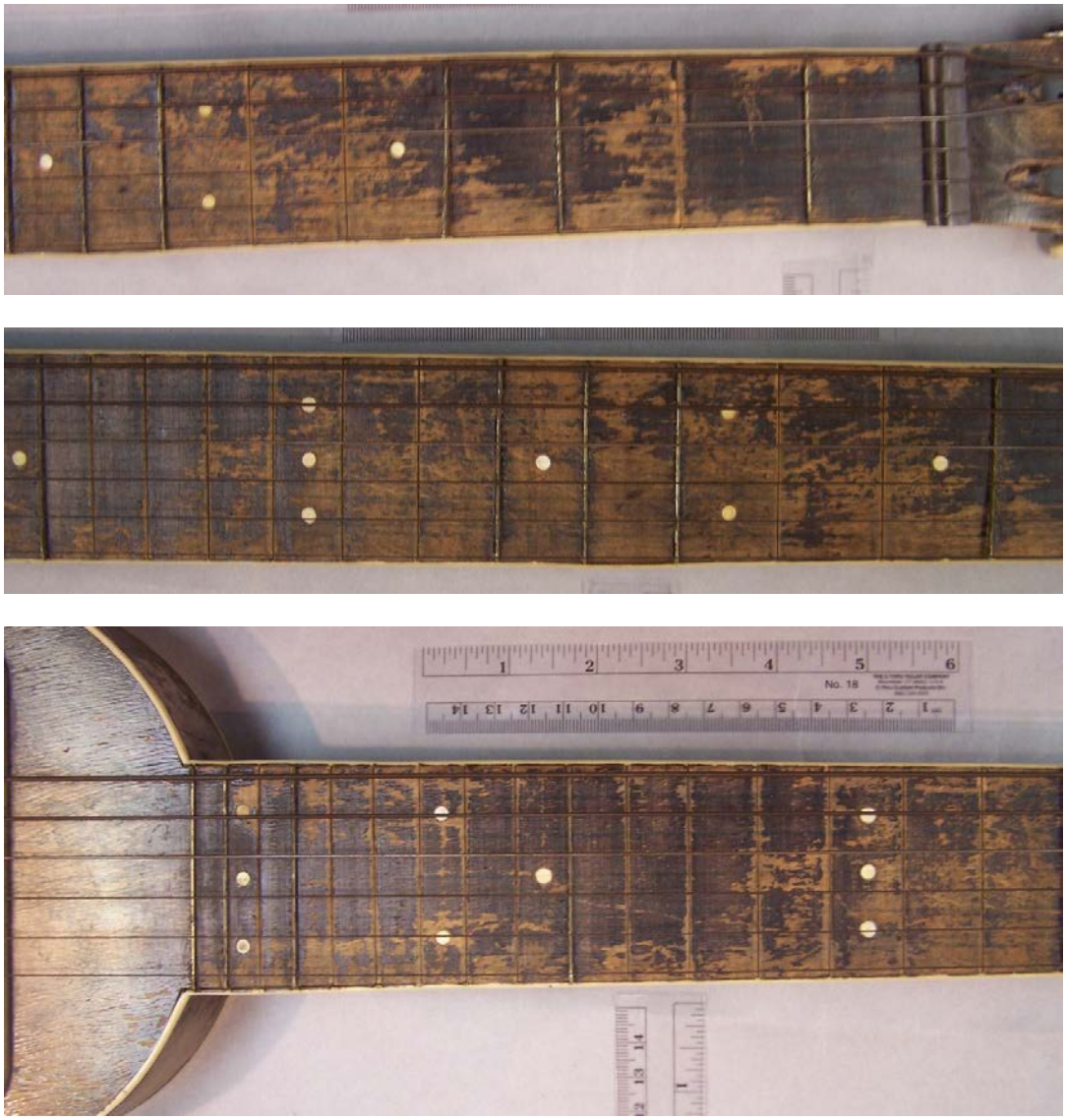


Figure 2.4 – The Neck and Fingerboard of the Frying Pan prototype.

Hardware

The hardware on the Frying Pan is minimal, and functional rather than decorative. The guitar has no tailpiece as such, the strings being anchored through the

body as previously described. The bridge of the instrument consists of a half-cylindrical chromed metal bar, 82.5 mm by approximately 12 mm, with somewhat domed edges on either end. There are seven countersunk holes drilled into the top of the bar to allow the bridge to be attached to the body by means of screws. Only four of these holes, the two outer ones and the holes between the D and G strings and the G and D strings actually have screws in them at present, although it can be seen that all seven holes had screws in them at one time. The screws are slotted flathead screws and most likely made of steel. After passing through the body and exiting out the top of the instrument, the strings then pass over the bridge in between the holes. The bridge has the look of something that has been repurposed; it is possible that this was made from part of a steel guitar playing bar, ground down, drilled and re-chromed.

The pickup mounting plate is made from a dark grey fibreboard material, possibly some kind of vulcanised electrical insulation, and measures 139.6 mm x 88.6 mm with the aperture for the pickup measuring 117.6 mm x 39 mm. The mounting plate is somewhat rounded at the edges and this looks like it was done by eye as the corners do not seem particularly symmetrical. The two thumbscrews for the connection to the amplifier are attached to the bass side of the mounting plate, located between the pickup and bridge.

The nut of the instrument actually consists of two nuts, one mounted over the other (see figure 2.5). The underneath nut appears to be a conventional Spanish guitar type, inset into a slot cut into the end of the fingerboard. It is of a dark indeterminate material, possibly wood. This nut appears to be slotted for strings. On top of this is a metal overlay nut, most likely made of cast zinc, with the brand name "Perfect". This nut raises the instrument action to make it suitable for Hawaiian-style playing.

The tuning machines on the Frying Pan are of the conventional three-a-side type, with the machines mounted on a plate (see figure 2.6). Interestingly, although similar, the machines on each side do not match. The machines on the treble side of the instrument have oval white plastic buttons. The plate is of the common "dog bone" shape with a point flanked by two small semicircles at each end, and a simple pressed engraving of a row of small dots along each side. The bass side machines are slightly more ornate, with a modified dog bone shape of two small rounded points played by elongated semicircles at each end, and a more elaborate filigree-style pressed engraving

along the entire plate. The tuning buttons, which are now missing, were almost certainly originally made of plastic, most likely white (as this was the most common colour for buttons of this type and quality). The screws securing both machine heads to the headstock are slotted oval-head type screws of an indeterminate type of metal.

Figure 2.5 – The Nut of the Frying Pan prototype.

Figure 2.6 – The Tuning Machines of the Frying Pan prototype.

The six strings are made of a ferrous material, almost certainly steel (as they have to be in order to activate the electromagnetic pickup). The three highest-pitched strings are unwound while the lower three strings are wound. The strings are of the following

thicknesses: 1st string, e', .42 mm (0.017"), 2nd string, b, .49 mm (0.019"), 3rd string, g, .57 mm (0.022"), 4th string, d, (modern replacement), .87 mm (0.034"), 5th string, A, 1.05 mm (0.041"), 6th string, E, 1.40 mm (0.055").

Electronics

The pickup on the Frying Pan is of the type commonly known as a "horseshoe" pickup, due to its employing two large horseshoe magnets which surround both the pickup coil and the strings. These horseshoe magnets are arranged with their poles facing each other. Each magnet is made from chromium-plated tungsten steel bar stock with a width of 37.5 mm and a thickness of 9.6 mm. The length of each magnet is 57.5 mm and the outside dimensions of the U of the magnet are approximately 42 mm. The magnets are attached to the body by means of a mounting platform which is fastened to the instrument by means of four slotted oval-head steel screws from the rear of the instrument. This can be determined due to the spacing of the screws being wider than the dimensions of the magnets. The two screws closest to the bottom of the instrument have tabs attached to them (added in the later 20th century) that allowed the instrument to be hung horizontally in its display case.[13] There are two non-original tabs attached to the pickup mounting screws for hanging the instrument. The pickup coil is mounted inside the "U"s of the magnets on the side furthest away from the strings. The pickup coil bobbin is 72.2 mm long by approximately 32 mm wide by approximately 14.5 mm deep and appears to be made of the same material, possibly vulcanised fibreboard, as the pickup mounting plate. In the centre of the coil there are six pole pieces, which are adjustable by means of a slotted screw head in the top of the pole piece. The coil is wrapped with copper wire of an indeterminate gauge and number of winds, which is wrapped (and therefore hidden) by a dark cloth tape.

There are no volume or tone controls on the instrument; it is assumed that the pickup is wired directly to the output terminals. The output terminals are of the type typically used during the early part of the 20th century (and sometimes even today) for bare wire connections of electrical equipment. These are located on the bass side of pickup cover plate, adjacent to the E string between the pickup and bridge. There are two of these terminals, one each for the live and the ground wire. These are threaded and were most likely fashioned from machine screws. The visible section of the terminal

[13] These were added by Rickenbacker CEO John Hall.

posts are attached to the pickup cover plate by means of metal hex nuts. The terminals are marked "+"(the terminal closest to the edge of the body) and "-", lightly scratched into the fibreboard pickup mounting plate. Screwed onto the posts (and thus clamping the connecting wires to the instrument) are two threaded brass knobs, approximately 10 mm in diameter and 7 mm high. The knobs are shaped somewhat like a sideways mounted yo-yo, with a machined waist in the centre of the cylinder. The uppermost part of the cylinder of each knob is reeded, in the manner of a coin, and a slightly larger in diameter than the bottom part. Although the two knobs are very similar in appearance, they are not identical, and it is almost certain that they were made by different manufacturers. This suggests, somewhat, that these knobs, like the machine heads, were from a stock of used and/or leftover parts lying around the factory, rather than brand-new when the instrument was made.

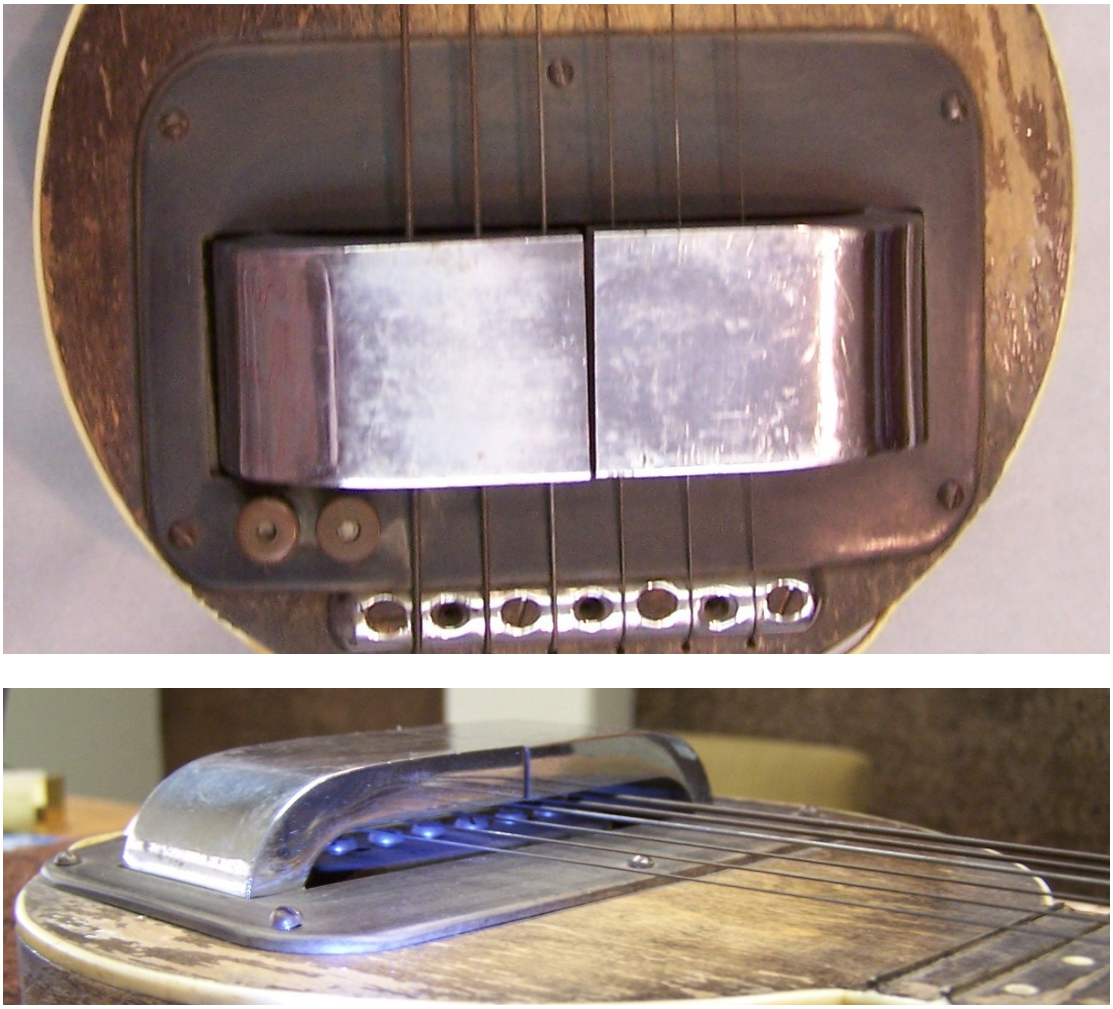


Figure 2.7 – The Horseshoe Pickup of the Frying Pan prototype.

Decoration

The entire instrument, including the top of the fingerboard appears to be French polished, dark brown in colour.[14] The finish is lightly applied, allowing the open pores of the wood grain to clearly show through, rather than giving a solid or glossy appearance. There is a light to dark shading, in the manner of a typical violin finish, on the front and back of the round body, and on portions of the neck and on both sides of the headstock between the slots for the machine heads.

The body is bound, both on the top and back, in a cream coloured plastic/ivoroid material, 1.6 mm wide and 3.25 mm deep. The neck is bound in the same material, but appearing slightly less deep and wide, most likely due to scraping and sanding while shaping the neck. The headstock of the guitar is unbound.

There are no position markers on the side of the neck. The position markers on the top of the neck appear to be celluloid, due to the observable shrinkage of some of them. The inlay pattern on the frying pan is somewhat unusual, having a single position dot at the 5th fret, two position dots at the 7th fret, one at the 9th, three at the 12th, one of the 17th, two at the 19th, and three at the 24th.

Condition

As far as is known, the Frying Pan is for the most part, in its original state, having never undergone significant restoration. The strings appear to be original except for the fourth string which was replaced in the 1980s.[15] Overall, the instrument is in somewhat rough condition. The finish is flaking off in several places, in particular where the neck meets the body, the top, the back, the back of the neck and to a slightly greater extent, the top of the fingerboard. The side of the body has a crack on it running from the top to the back of the instrument on the bass side approximately 20 mm from the neck. The neck has a pronounced twist to it. The frets are missing at the 2nd, 5th, 6th, 10th, 11th, 12th, 13th, 14th, 15th, 17th, 18th, 19th, 20th, 21st, and 23rd frets. In addition, the 4th fret is lifting off significantly. All of the existing frets show small amounts of corrosion. It is possible that the combination of string tension and the open

[14] French polishing is a wood finishing technique in which multiple thin coats of alcohol-diluted shellac are applied using a soft cloth. It is commonly employed on violin-family instuments.
[15] Interview with John Hall 15/3/2005.

slots left by these missing frets, in combination with the lack of truss rod, may have contributed somewhat to the twisting of the neck.

The bridge is in relatively good condition; although it shows some nicks and scratches, it is unclear if these occurred through use or during the manufacturing process. The flathead screws securing the bridge to the body show surface rust but are otherwise in good condition.

The plating on the pickup is in good condition, with a small amount of wear on the top edge, closest to the neck, of the bass side horseshoe magnet. This wear has revealed a layer of copper-plating underneath, which indicates a high-quality plating job.[16] The top exposed part of the horseshoe magnets do show some scratching and wear commensurate with their age. The mounting plate for the pickup shows fine, but pervasive, scratching over the entire surface. This is most likely from the manufacturing process rather than playing wear. The mounting plate screws show some light wear and oxidation, as do the brass knobs of the wire terminals. Interestingly, the mounting plate screws do not show any signs of having been repeatedly screwed and un-screwed, i.e. damage to the slot from improper use of a screwdriver. Since it is unlikely that the screws have been replaced at least since the mid 1950s (see note on provenance below), it suggests that the pickup of the Frying Pan may have spent most of its life relatively undisturbed.

The overlay nut is in good condition, but has oxidised slightly to the dull grey colour typical of un-plated cast zinc items.

As previously noted, the buttons on the tuning machines on the bass side of the Frying Pan are missing. However, the remaining tuning buttons on the machine heads of the treble side are in remarkably good condition.

The binding on the instrument as a whole is in relatively good condition, although it has yellowed significantly, as is typical with this type of plastic binding. The binding has bubbled and come away from the body near the edge of the bridge on the treble side. While most of the position markers are in good condition, those at the 7th and 24th frets have yellowed and shrunk somewhat.

[16] Although a detailed discussion of metal plating techniques is outside the scope of this thesis, it should be noted that high-quality metal plating is rarely directly applied to the surface to be plated, but usually involves intermediate plating of various metals (analogous to paint primer) to achieve proper adhesion, durability and finish.

Provenance

The provenance of the 1931 prototype is not particularly well known up to the mid 1950s. Once it had filled its function of demonstrating the possibility of the electric guitar, the instrument presumably sat neglected at Rickenbacker's Los Angeles factory. Other prototype instruments were known to "kick around" the factory.[17] No known photographs of the instrument exist before 1956, when Rickenbacker displayed the Frying Pan at a music trade show to highlight the 25th anniversary of the electric guitar's invention.

Figure 2.8 – Visitors at 1956 trade show holding the Frying Pan prototype.

[17] In particular, an electric piano which will be further discussed in chapter 6.

The photographic documentation of the Frying Pan at this trade show (it is unknown where this trade show took place) in 1956 is extensive. In the photos, banners emblazoned with the year 1956 and celebrating "the 25th anniversary of the electric guitar" invite trade show guests to "have [their] picture taken with the first electric guitar". Photo after photo depicts visitors doing just that. Examination of these photos shows the Frying Pan in a condition almost identical to that which it is in today. Since it is highly unlikely that the Electro String Corporation would have gone to the trouble to fake such an instrument in 1956, especially since there were so many people alive at the time who could have refuted Electro String's claims if they were spurious – and who would have had a financial incentive to do so if they could – it seems safe assume that the Frying Pan is the instrument that it claims to be. In addition to the documentation of the Frying Pan in the 1950s, there are also several photographs taken in the early 1970s of Adolph Rickenbacker posing with the Frying Pan, both alone, and with future Rickenbacker International Corporation CEO John Hall and his wife Cyndalee, future Rickenbacker International Corporation president.

Although it does not ever appear to have had any particularly rough handling, the Frying Pan does show signs of sustained heavy use. Interestingly, this does not only appear to have been playing use; the neck and body show wear consistent with being held in the position shown in the photographs – the left-hand on the neck close to the body and the right hand cradling the round body of the instrument.

Contextual Comments on the Frying Pan Prototype

While it is now generally recognized that the 1931 Rickenbacker "Frying Pan" was the world's first stringed instrument with an electromagnetic pickup, there still seems to be a reluctance to acknowledge the Frying Pan as a fully-fledged electric guitar due to its being a Hawaiian-style lap steel, rather than a Spanish-style instrument.[18] Indeed, the organological nature of the Frying Pan is ambiguous and it displays elements of both Hawaiian and Spanish-style guitars which are incongruous when found on the same instrument. In fact, far from being an inherently Hawaiian style instrument, the Frying Pan's design deliberately incorporates elements of the Spanish guitar which do not benefit its Hawaiian style playing capabilities.

[18] Interestingly, there does not appear to have been much debate on the subject, with the vast majority of authors simply assuming (most likely based on appearance alone) the non-Spanish nature of the frying pan.

The most obvious of these is the instrument's neck; the Frying Pan has a Spanish-style neck, that is, a neck with a rounded section. This is significant, in that National Stringed Instrument Corporation, the company with which Beauchamp and the others behind the Frying Pan were so involved, made guitars with both Spanish-style necks and square-sectioned Hawaiian necks.[19] If the Frying Pan was only intended to be used as a Hawaiian-style instrument, there is no benefit to employing a Spanish-style neck. Indeed there are several disadvantages: a Spanish-style neck is more difficult to make from a production standpoint than a square-section neck. Also, making the neck round takes away mass from the neck that would help prevent it from warping. In its present condition, the Frying Pan, which was made without a truss rod, has a rather severe twist in its neck.

While its round-sectioned neck strongly suggests an instrument with Spanish-style playing capabilities, the fact that the Frying Pan's neck is fretted does not necessarily make a case either for or against its being a Spanish-style instrument. Hawaiian guitars made by National with square-necks also had fretted fingerboards although they were not intended to be played Spanish-style.

By far, the strongest evidence of the dual Spanish/Hawaiian nature of the Frying Pan prototype comes from the instrument's nut. As can be seen, this appears to be a conventional high-action nut for Hawaiian-style playing. But closer examination shows that this is actually not one, but two nuts: on top of a standard Spanish guitar nut is a metal secondary nut which raises the strings to the proper height for Hawaiian playing.

Since it is not possible to remove the strings of the instrument (due to the deterioration of the buttons on the bass-side tuning machines) to examine the two nuts, the dual nature of the instrument's nut has not been previously recognised.[20] It has been previously assumed that this nut had been made specifically for this instrument by either Beauchamp or Harry Watson. However, the present author's research has confirmed this metal nut as a commercially produced item, the "Perfect" height adjusting nut, which was marketed as a device to raise the height of the strings at the nut, thus allowing the guitar to be played with a steel bar. In the late 1920s these devices were a

[19] Although a Spanish-style instrument could be strung for Hawaiian-style playing, most Hawaiian-style players seem to have preferred playing on a dedicated Hawaiian-style instrument.
[20] However, it has previously been noted, although its significance is not to have been fully understood: George Gruhn, "Rare Bird," *Guitar Player* 1981. (month unknown).

popular and inexpensive means of adapting the much more readily available Spanish guitar for use as a Hawaiian-style instrument. While this style of nut does not appear to have come as standard on any model of National guitar, it was offered by National as an accessory in their 1936 catalogue. That there is a conventional nut underneath the metal nut appears to indicate that the guitar was made to be played with a much lower action, in other words Spanish-style. There appears to be no reason to make a nut this way unless the instrument was made or designed to be played in both manners.

It should not be supposed that because the prototype Frying Pan was made with Spanish guitar attributes that it was ideally suited to be played as such. When trying to play this as a Spanish guitar, the instrument would have been extremely neck heavy. In fact, saying this instrument is neck heavy is misleading, since it is almost entirely neck.

Notwithstanding its wood body, the prototype Frying Pan is so similar in appearance to the aluminium production model (which was intended to be played only as a Hawaiian guitar) that the features of the prototype that indicate its utility as a Spanish-style instrument have simply been not recognised. However, most of the Spanish features of the prototype are downplayed in the production model. This is probably the major factor in the wood-bodied Frying Pan not being previously recognised as a Spanish guitar.

The question must be asked, if the Frying Pan was designed to be used as a Spanish guitar, was it ever used as such? Despite its worn condition, the instrument gives us few clues. The instrument is missing many of its frets but the first, third and fourth frets remain. If the instrument had been extensively played, these would have almost certainly have shown wear which they do not.

As stated earlier, it is generally acknowledged that it was former National String Instrument Corporation factory superintendent Harry Watson who carved the body and neck of the prototype Frying Pan.[21] It is no surprise, then, that the design of the headstock of the guitar is almost identical to that found on several National models. As previously shown, it appears that Watson and Beauchamp incorporated many previously used parts into the Frying Pan, notably the tuning machines and possibly the bridge as well. At first this may seem incongruous with the otherwise good standard of

[21] Brozman, *The History and Artistry of National Resonator Instruments*; Smith, *The History of Rickenbacker Guitars*.

workmanship. However, it should be remembered that 1931 was the height of the Depression, and so it is perhaps not surprising that Beauchamp would have used whatever parts he had on hand, whether they matched or not.

The obvious care used in its construction seems to indicate that the Frying Pan was not simply a test rig for Beauchamp's electromagnetic pickup, but a fully-realised musical instrument that was designed to be attractive as well as functional. It was varnished in what we would now call a sunburst finish (although this is not the heavily-shaded airbrushed sunburst finish common on mid-century and later guitars) and both the body and neck are bound with white plastic binding. The requisite frets are marked with position dots and the horseshoe magnets of the pickup are heavily chromed. All these features only improve the appearance and not the functionality of the instrument.

While almost certainly intended to be played solely as a Hawaiian guitar, the aluminium-bodied production model frying pan retained many of the Spanish guitar elements of the wood bodied Frying Pan prototype. These included the rounded neck and frets. However, on the production model (described below), the frets were actually scalloped indentations in the finger board. If these were simply intended as fret position markers, a simple painted line or etched mark would have served just as well. The fact that the production model frying pans did not have separate inlaid frets as on conventional guitars is not conclusive proof that the frying pan was never intended to be used as a Spanish guitar: the Bakelite-bodied electric Spanish guitar made by Rickenbacker in the mid 1930s had frets that were simply moulded into the neck. Interestingly, patent documents suggest that the round neck of the production guitar could be used Spanish-style, but no known company advertisements of the time suggest this.

Production Frying Pan Models- A25 and A22

The frying pan was commercially produced in two versions, the A25 and A22. The "A" in the model designation indicates that it was the first model introduced (the guitar's Bakelite-made successor was the model "B") while the numbers indicated the instrument's respective scale lengths in inches. The earliest frying pans were of the A25 model, but the vast majority of all frying pans made were of the subsequently introduced and shorter scale A22.

While at first glance it might appear that there are huge differences between the prototype Frying Pan and the later production models, closer examination shows that there are fewer differences than it might appear. Of course, the most obvious difference is the main material of the bodies; while the prototype is made from wood, the production frying pans have bodies of cast metal. Conversely, while it first appears that there are few differences between the different production models, a closer examination reveals that there were small yet significant changes throughout the production life of the metal-bodied frying pan.

Rickenbacker Model A25

This instrument is one of the earliest production frying pans made (see Figure 2.9). It is serial #30 (which may or may not indicate it was the 30th instrument made as early Rickenbacker serial number sequences are not completely understood), and is currently in the collection of Lynn Wheelwright. This guitar was the personal instrument of the well-known early electric guitarist Alvino Rey. At some point in the mid-to-late 1930s Rey created a conventionally guitar-shaped apparatus and semi-permanently mounted the frying pan within it. Rey stated that his reasons for doing so were to disguise the instrument as a more conventionally-shaped guitar due to his annoyance with people at performances, who continually asked him what the instrument was and how it worked.[22] It is also possible that he intended that the added body would make the instrument more comfortable to hold when playing it Spanish-style. It is noteworthy that Alvino Rey did this several years before Les Paul made his famous "Log" solid-body electric guitar using a somewhat similar technique of attaching decorative wings to the instrument to make it look like a conventional arched-top guitar and disguise its solid-body/non-acoustic nature.[23]

[22] Interview with Lynn Wheelwright 4/22/2007.

[23] This makes Alvino Ray's guitar the earliest known electric guitar with an inner/outer case construction, analogous to the inner/outer case construction employed on 16th and 17th century Italian harpsichords. Edward L. Kottick, *A History of the Harpsichord* (Bloomington: Indiana University Press, 2003). p 68. A later example of an electric guitar of this type is the "bikini" model made by the Gretsch guitar company in the 1960s, which also featured a body-within-a-body construction. It is of possible further interest to note that by this definition, the early 1960s Gibson-made Firebird electric guitar and Thunderbird electric bass could be considered examples of false inner/outer case construction electric stringed instruments.

Figure 2.9 – Rickenbacker model A25, serial no. 30, formerly owned by Alvino Rey.

The instrument is mounted in a non-original guitar-shaped holder.

Body

Like the wood-bodied Frying Pan prototype, the production A25 features a one-piece construction, in this instance the instrument being made entirely of cast aluminium. The body dimensions and general layout of the instrument are virtually identical to that of the wood-bodied prototype. The circle of the body measures 169.9 mm in diameter. Like the prototype, the top and back of the body are flat and perpendicular with the instrument's sides, with the top of the guitar on the same plane as the fingerboard. The entire interior of the instrument, both neck and headstock, is hollow. A rectangular hole, 119 mm x 42 mm, with semi-circular cut-outs that extend the total width to 138 mm, is cut into the top of the instrument for the pickup and its mounting hardware. This hole also allows access to the interior of the instrument for the mounting of the volume control and output jack. The body depth of the instrument is 38 mm, the same as the prototype. Six holes are countersunk in the same location and manner as the prototype to serve as string anchors.

Neck

Like the prototype instrument, the neck of the A25 where it meets the body is designed to mimic the neck-to-body join of acoustic guitars. The shape of the Spanish-style neck is broadly similar to the prototype with the difference that the production model's neck profile is the opposite of the prototype, having a "C" profile where it meets the body which then gently tapers to a "V" section profile at the top of the neck. The neck flares slightly where it joins the body, making the measurement somewhat ambiguous, but it appears to be about the same dimensions as the wood-bodied prototype. The neck tapers to 53 mm at the 12th fret and 48 mm at the nut. The depth of the neck at the 24th fret is 27 mm which tapers to 24 mm at the 19 fret, 23.5 mm at the 12th fret and 22 mm at the nut. Like the prototype, the neck has no truss rod, which given its all-metal construction, is not surprising, since the entire neck would essentially serve as its own truss rod.

Headstock

The headstock is 144.5 mm long by 68.25 mm wide at the top. It lies at an angle of 9° relative to the neck/body measured from the nut edge of the fingerboard. Although the dimensions vary slightly, the headstock is in roughly the same rectangular/trapezoidal shape that narrows towards the nut end, as that on the wood-

bodied prototype. The headstock of the A25 has classical guitar-style slots for the mounting on the machine heads, again virtually identical to those on the wood-bodied prototype. The name "Electro" is hand engraved in script with flourishes on the front of the headstock at the top.

Fingerboard

The fingerboard of the A25 is where the design (other than the aluminium body of course) really starts to diverge from the wood-bodied prototype. Like the prototype, the production model does not have a separate fingerboard. However, the fingerboard of the A25 is scalloped, with the top of the scallops creating both intonation markers for Hawaiian playing and a fret-like surface for playing the instrument Spanish-style.[24] So, although the production model frying pan has no conventional frets as such, it is perfectly capable of being played as a Spanish-style guitar. There are a total of 25 of these "frets" with the 25th being were the neck meets the body.

Hardware

The hardware on the production model frying pan is broadly similar to that of the prototype, being minimally functional rather than decorative. Like the prototype, the strings are anchored through the body, as previously described, without the use of a separate tailpiece. The instrument's bridge is cast into the body, with the metal bridge saddle being inlaid into a slot on the bridge.

The A25 has no separate pickup mounting plate like the wood-bodied prototype, instead having the pickup mounted directly into the cast aluminium body. Unlike the wood-bodied prototype, the nut of the A25 has no duel Spanish/Hawaiian aspect to it. It consists of a conventionally guitar-nut-shaped piece of metal, raised high off of the fingerboard for Hawaiian-style playing, mounted in a slot located at the expected place at the end of the fingerboard.

The tuning machines on the A25 are of the conventional three-a-side style, with the machines mounted on "dog bone" shaped plates. The machine heads on the treble side are actually a set designed to be mounted on the bass side of the headstock which

[24] As has been noted elsewhere, although the vast majority of musicians played the frying pan in a Hawaiian style, it was capable of being played Spanish-style (although how well this worked is possibly open to debate). Alvino Rey, the owner of this particular instrument seems to have played this particular instrument in Spanish as well as Hawaiian style.

means that on this instrument the tuning buttons point up rather than down when playing in a Hawaiian-style position. Interestingly, the machine heads are mismatched in almost exactly the same way as those on the wood-bodied prototype, with the bass side machines almost a perfect match with the treble side machines of the wood-bodied prototype and the treble side machines a very close match (differing mainly in the style of engraving) for the bass side machines of the prototype. This, however, does not imply a direct relationship between the two sets of machine heads on these instruments. It is known that Alvino Rey almost certainly changed the treble side machine heads at some point, as there are photos of him playing this instrument from the early and mid-1930s which show the instrument with both sets of tuning buttons pointing towards the back of the headstock. The most likely explanation for this coincidence is that both styles of machine heads were commonly available during this period.[25]

Since the strings are not original to the instrument, but obviously from a much later, if not recent period, they will not be described here.

Electronics

It is known from photographs of Alvino Rey playing this instrument that the horseshoe pickup on the guitar is not the pickup originally fitted to the instrument. The original pickup was also of the horseshoe type, but had slightly larger and thicker horseshoe magnets. The general configuration of both the original and the current pickup is essentially the same as that on the wood-bodied prototype. Each magnet is made from chromium-plated tungsten steel bar stock with a width of 38 mm and a thickness of 5 mm. The length of each magnet is 55 mm and the outside dimensions of the U of the magnet are 31 mm. Unlike the wood-bodied prototype, the pickup is mounted to the body from the top by means of two screws attached to a roughly trapezoidal mounting plate on each side. These mounting plates attach to the larger pickup mounting plate by means of a spring-loaded machine screw which is topped by a chromium-plated reeded knob (very similar in appearance to the brass terminal post connectors on the wood-bodied prototype) which allows adjustment of the pickup height relative to the strings. Like the wood-bodied prototype the pickup coil is mounted inside the "U"s of the magnets on the side furthest away from the strings. The

[25] Bob Brozman, author of *The History and Artistry of National Resonator Instruments*, certainly thinks that this is the case. Email correspondence with Bob Brozman.

pickup coil bobbin is slightly larger than that of the wood-bodied prototype, 76 mm x 32 mm x 16.3 mm deep. The bobbin is attached to the pickup mounting plate by the means of four small oval-head screws, one of which secures the ground wire for the pickup. The other, positive (+) wire is connected to the pickup bobbin through a countersunk slot in the bottom of the mounting plate. The mounting plate is made of aluminium with the dimensions of 116 mm x 38 mm x 5 mm deep with two semi-circular tabs on either side (which mimic the shape of the mounting hole), giving a total length of 136 mm.

The volume knob and output jacks are not in their original state, due to the instrument having been mounted by Alvino Rey into its guitar-shaped holder. The instrument currently has a volume knob/potentiometer, but it is unlikely that these are original to the instrument as it appears that the volume knob was not made standard until sometime in late 1933 or early 1944. At some point it appears that Rey added a volume knob to the top of the instrument in the same place Electro String mounted them and then later, when Rey created the guitar-shaped holder for the instrument, moved the volume knob again to the upper bass bout of the guitar-shaped holder. It could also be the case that at one time this later added knob was a tone control, which was capable of rolling off the high-end frequencies of the pickup output, creating a "mellow" and "darker" sound.[26]

The output of the instrument (which would be connected to an amplifier) is by means of a quarter-inch phone jack. It seems appropriate here to digress slightly and discuss more fully this omnipresent, yet often overlooked, form of connecting electric musical instruments to amplifiers. The production Rickenbacker frying pan appears to have been the first electric instrument to use this connection, which has become the standard method of connecting a guitar to an amp ever since. The use of quarter-inch phone jack (the name comes from the fact that this type of connector was typically used in telephone switchboards and that the shaft of the plug was a quarter inch in diameter) seems so obvious to modern musicians that is hardly deserving of note, but the very ubiquity of the quarter-inch phone jack is significant in that there is no electrical or mechanical reason why this should be so. There were (and still are) many other electrical connectors that could have been used to achieve the same result. The bare-wire screw

[26] Both of these were common terms during the 1930s for timbres that were not bright.

terminals used on the prototype Frying Pan, while not being conducive to quickly connecting the instrument to an amplifier, were perfectly functional. The very earliest production instruments from Electro String Instrument Corporation used a type of connector known as "banana plugs", with a separate jack for each of the two wires. This same type of banana plug connection was used by other audio devices at the time, especially radio extension speakers. It was also used by other early electric stringed instruments by other makers; both the earlier Stromberg-Voisinet Electro instruments and the slightly later ViViTone instruments made by Lloyd Loar (see chapter 10) employed this kind of connector. However, Electro String almost immediately moved to the quarter-inch phone jack. Although there have been sporadic and isolated attempts since then to use other types of connectors (for example, during the 1970s, electric guitars with low impedance pickups often had, in addition to standard quarter-inch jack output, an XLR output of the same type used for connecting microphones to PA systems, and during the Soviet era, Russian instruments typically used a five pin connector similar to that used on modern midi cables), since its first use of the Rickenbacker frying pan, the quarter-inch phone jack has become the world standard for connecting electronic musical instruments to amplifiers.

Decoration

This particular instrument has an unusual gold finish; it is much more opaque than other known examples of gold finish frying pans. It is unknown whether or not this was a custom option for Alvino Rey, but what is known of the instrument's provenance suggests that this was not the case. It is also unclear whether this instrument originally had the gold finish on the fingerboard and top as well as on the back and sides.

The position markers of the A25 (and A22 was well) consist of small holes of about 3 mm in diameter drilled through the fingerboard to the hollow core of the neck. In its original state, this instrument almost certainly had these holes filled with a plastic substance of various bright primary colours. These position markers were very prone to falling out and few instruments survive with all or any of their position markers. There are position markers at the 5th, 7th, 9th, 12th, 17th, 19th, 21st, and 24th frets. Like the wood-bodied prototype, the A25 does not have position markers on the side of the neck.

Condition

This A25 is far from being in its original state, but most of its modifications are due to Alvino Rey's creation of the guitar-shaped holder to mask the instruments true nature and appearance rather than to alter the instrument's functionality. The most noticeable of these modifications is, of course, the guitar-shaped holder that Rey created to make the instrument look more like a conventional guitar. In doing this, he painted all visible areas of the guitar not hidden by the guitar-shaped holder, with the exception of the fingerboard and top of the instrument, with what appears to be white house paint. As previously noted, the instrument was originally finished with a gold-anodised finish, and on the areas of the neck and back of the instrument hidden from view by the guitar-shaped holder, the finish is in remarkably good condition. There are four holes drilled into the back of the instrument that were used to secure it to the body of the guitar-shaped holder; one of these is on the back of the neck at about the 12th fret position, with the other three on the back of the body at the 9, 12, and 3 o'clock positions when looking at the instrument with the headstock pointing up. Traces of lacquer also still exist on the sides of the headstock where the machine head plates are mounted. At some time previously, the anodising appears to have been deliberately removed from the fingerboard and top of the instrument.

The first production frying pans had no volume control, but by the end of 1934 this became standard on the guitar. This simple feature greatly enhanced the functionality of the instrument.

Rickenbacker Model A22

It is commonly assumed that the model A22 frying pan (see Figure 2.10) differed from the A25 only in its scale length (22 inches versus 25 inches). And while this is broadly true, there are some subtle, yet significant, differences between the two models. As it was introduced approximately nine months after the A25, and was by far the most numerous model of the frying pan produced, the 1934/35 A22 can be considered the most representative exemplar of the frying pan. While the following description holds true for the vast majority of A22 frying pans, the actual instrument described is serial number 87, currently in the collection of Lynn Wheelwright.

Body

Like the A25, the A22 is cast from aluminium with headstock, neck and body being all one piece. The total length of the instrument, at 727 mm, is of course significantly shorter than the long-scale wood-bodied prototype and the A25. The string length of the A22 is 566 mm. The body diameter of the A22, at 177 mm, is slightly wider than both the A25 and the wood-bodied prototype.

Neck

The dimensions of the neck are for the most part very close to those of the A25, for the most part varying no more than 1.5 mm from the dimensions of the A25.

Fingerboard

The fingerboard of the A22 is of the same integral and scalloped configuration as the A25. The most notable difference is the number of "frets" (which of course are not actual frets, but the top ridges of the scallops in the fingerboard); the A22 has only 23, as compared to the 25 frets of the A25 and wood-bodied prototype.

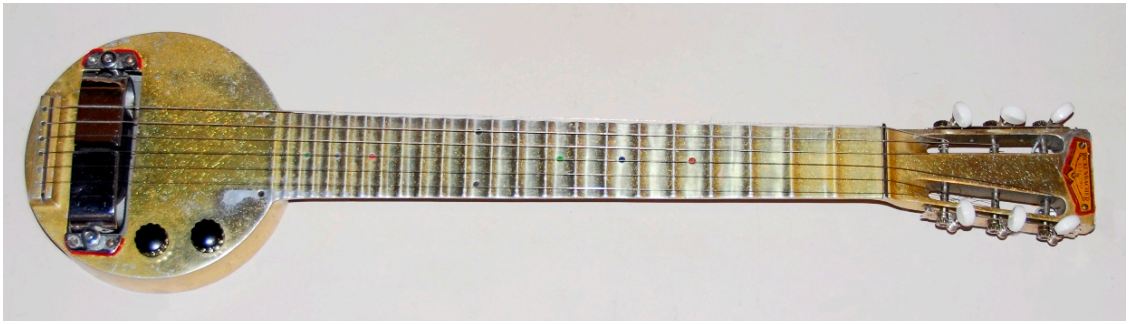


Figure 2.10 – Rickenbacker model A22, serial no. 87.

N.B. the knobs and tone control [on right] are not original to this instrument.

Rickenbacker Model A22 Seven String

The seven string model of the A22 was essentially identical to the six string model except for those features directly relating to the extra string. These included a four-on-a-plate machine head tuners (of the same type used on mandolins) on the treble side of the headstock and seven anchor holes for the strings drilled through the body behind the bridge. It is not clear whether the seven string A22 was a separate casting

from the six string A22. The horseshoe pickup of the instrument also had seven pole pieces on its coil. The purpose of the seventh string was not to increase the pitch range of the instrument, as would be expected, but instead to increase the chord playing abilities of the guitar without having to retune the instrument.

Contextual Comments on the Production Model Frying Pans

The nut on Alvino Rey's A25 is significantly lower than that of a typical frying pan model, yet is significantly higher than a standard nut for Spanish-style playing. It can be seen by the thumb wear on the back of the neck, that the Alvino Rey instrument was used at least on a few occasions as a Spanish-style guitar.[27] The wear is most pronounced from the fifth to ninth frets, with wear from the seventh to ninth frets being particularly heavy. On reflection, this is not surprising; if Alvino Rey played the instrument Spanish-style with the current nut (and there is nothing to indicate that this is not the case), the height of the nut would have made it difficult to play the first three frets Spanish-style.

It is commonly assumed that the metal-bodied frying pans were unfinished, that is to say that their finishes were simply polished bare-metal aluminium. This, however, is not the case; almost all production frying pans, except for some of the very earliest examples were finished in some way. The back of the neck and the rest of the body were typically finished with some type of lacquer (described in an early brochure as "high polished silver Duco").[28] This finish is particularly susceptible to wear, typically wherever the player held or touched the instrument, and what finish remains is typically discoloured, giving surviving examples of these instruments their distinctive greenish-silver tinge. The fingerboard and top of the instrument was often highly polished but otherwise unfinished. However, there are examples of instruments with the fingerboard and tops lacquered in the same way as the rest of the instrument is. A semi-translucent gold-toned finish was also offered as an option, although very few of these were made. It appears that it was not unusual for these gold-finished instruments to be lacquered on the fingerboard and top of the guitar as well. In addition to the standard silver and much rarer gold-toned finishes, a few examples of frying pans were made from the late

[27] Alvino Rey was not the only professional player to have used a frying pan Spanish-style; noted 1920s and 30s multi-instrumentalist Roy Smeck is also said to have done this.
[28] Rickenbacker Company Archives, Rickenbacker International Corporation, Santa Ana, CA. The use of duco paint is confirmed by financial documents in the Rickenbacker archives.

1930s to start of World War II with a black "crinkle" painted finish of the same type used on the accompanying metal-cased amplifiers.

It can be seen from the foregoing that despite it appearing otherwise, there is a specious uniformity to the production models of the frying pan. In fact, the frying pan changed subtly but significantly, even within its different models, throughout its production. Indeed, comparison could be made with the Volkswagen type one automobile (the famous "Beetle"), in that, while the common perception is that the model never changed, it in fact changed a great deal over the course of its period of manufacture. These changes to production model frying pans continued until the end of the frying pan's production in the mid 1950s.[29]

It is often assumed that since Adolph Rickenbacker was a machinist and owned the tool and die shop that stamped the metal bodies for the National resonator guitars, that the bodies for the frying pans must have been cast in-house. Documents in the Rickenbacker archives show that this was not the case, with the work being outsourced to at least three different local companies.[30]

While both the A25 and A22 models were for the most part standardised by the second half of 1934, as can be seen by the foregoing, there were many minute variations in these instruments up until that time, especially in instruments made before the second quarter of 1933. While some of these minor differences are best explained by variations in manufacturing such as the fact the body castings were made by various companies, others suggest that Ro-Pat-In/Electro String was intentionally tinkering and subtly refining the design for some time after manufacturing began in earnest. However, one should be cautious in putting too much stock in this idea. Where it is generally accepted that mass-manufactured instruments made of wood will have many subtle variations in designs, many or most of which are not noted in manufacturers' catalogues or spec sheets, it is often assumed that items cast or moulded from metal or plastic will not have these variations, instead being all exactly alike. This idea, while appealing to proponents of interchangeable parts, is simply not true. Items may easily be interchangeable without

[29] Although company literature from 1935 states that the metal-bodied frying pans were superseded by the Bakelite bodied B6-styled instruments, suggesting that the models were no longer available, in fact Rickenbacker continued to sell metal-bodied frying pans well into the 1950s. These differed significantly from the 1930s models in having removable backs to allow easy access to the electronics and having a back-painted clear Plexiglas fingerboard is opposed to the scalloped fingerboards found on the originals.
[30] This will be discussed more fully in chapter 4.

being identical. Moulds break or wear out and must be replaced. Jigs wear, and as they do, change subtly the items being made on them from example to example. In some cases these changes may be very slight, in others quite noticeable. Future research that documents these changes in the frying pan over its manufacturing life may answer some of these questions.

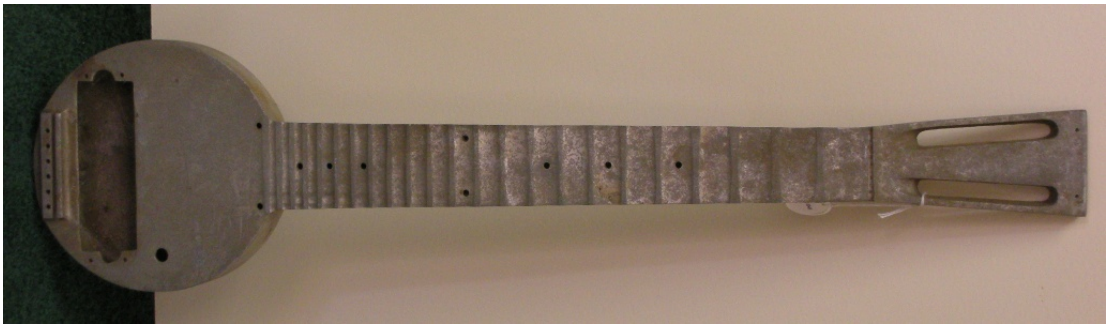


Figure 2.11 – Rickenbacker model A22, possible prototype.

A Possible Rickenbacker Model A22 Prototype

This instrument was found at the Rickenbacker International Corporation headquarters in Santa Ana, California, in a box of unfinished frying pan bodies made at various times between the 1930s and the 1950s. A number of unusual features on the instrument make it possible that this might have been a prototype for the metal-bodied frying pan, most probably dating from late 1931 to early 1932. The mounting hole for the pickup is of a different shape than the production model, lacking the semi-circular cut-outs for the height adjustment screws. Scratch marks indicating where they are to go can be clearly seen. Since the mounting hole for the pickup was not cut, but created when the body was cast, this suggests that this instrument was used to work out the spacing of the pickup mounting. The multiple and off-centre screw holes for a cover plate (which is found on the wood-bodied Frying Pan but not on the production models), also suggests a design in transition.

However, the most significant feature of this instrument in regard to its relationship to the wood-bodied Frying Pan is its nut. The production model frying pan has a non-adjustable integral nut which is set up for Hawaiian playing. As can be seen from its mounting holes, the nut on this guitar would have been a separate piece, attached to the neck by two screws or pegs. This would allow the use of interchangeable nuts of different heights, a similar set up to that of the wood-bodied Frying Pan.

Considering how iconic a design and well-regarded a playing instrument the frying pan style guitar is today (it is still one of the most popular styles of instruments used by Hawaiian lap steel players), it is interesting to note that the frying pan was only featured as the flagship instrument of the Ro-Pat-In/Electro String Instrument Corporation for a very short period, 1932 to 1935. Indeed, a 1935 catalogue shows a photograph of one of the earliest A25 frying pans, but noted in the caption that this instrument had been superseded by the new Bakelite models. While Electro String continued to offer the A22 and A25 frying pans for sale, by 1936 they had stopped promoting the frying pan models in any meaningful way; a photo of a Rickenbacker tradeshow display in 1941, while including an amplifier of virtually the same design as those made in late 1934,[31] includes no instruments of the frying pan type.[32] However, the very fact that Electro String Instrument Corporation never fully ceased production of the frying pan until 1957 (although no instruments were produced between 1950 and 1954), stands as a testimony to the functionality, playability, and hence, longevity of George Beauchamp's design.

Although the A25 was the first production frying pan model introduced, there were far more A22 models produced. Although the A25 seems to have been almost immediately superseded by the A22 (which was then superseded by the Bakelite B6), it appears that Electro String never completely abandoned the model. It is known that a small number of A25 models were made at various times up to the beginning of World War II and even after. It is not known if these later instruments were new castings or instruments made from leftover A25 castings. There is no question, however, that from the moment of its introduction, the A22 appears to have been much more popular than the A25. The reasons for this are not clear, but it is possible that the shorter scale A22 made advanced left-handed playing techniques (such as using the guitar steel diagonally instead of perpendicular to the strings, which enabled quick chord shifts), easier to execute.

Adolph Rickenbacker has stated that the first few A25 frying pans were made with solid aluminium necks. These were considered too heavy and the factory began to

[31] It should be noted that the amplifiers sold and used with these early frying pans, although specially made for Electro String under the Rickenbacker brand, do not appear to have been directly designed by Beauchamp or manufactured by Electro String. The amplifiers sold by Electro String will be considered in chapters 4 and 5.
[32] Smith, *The History of Rickenbacker Guitars*. p. 23.

drill the core of the necks to reduce weight, but Rickenbacker and Beauchamp believed that the hollow neck hurt the tone of the instrument. In an effort to remedy this, Adolph Rickenbacker evidently tried to stuff the hollow necks with crumpled newspaper to reduce the undesired resonances.[33] It should be noted that no examples of frying pans that have been cast with solid necks or that have retroactively hollowed out necks appear to have survived. It is known, however, that on later Electro String instruments made from stamped metal, such as the Silver Hawaiian, it was standard practice to stuff the neck (which was square-sectioned and much thicker than that of the frying pan) with newspapers for the same resonance-reducing reasons.[34] The A25 and A22 frying pan was Ro-Pat-In/Electro String's flagship model for less than two years. Why the frying pan was superseded by the Bakelite-bodied B6 model is not entirely clear. One of the oft-given reasons is that the all-aluminium body was subject to expansion and contraction under changing temperatures, such as those created by hot stage lights, which tended to make the instrument go out of tune. It is also said that players' fingers would turn black from contact with the un-coated and polished aluminium top and fingerboard of the instruments – although this would not have been an issue with the later all-black crinkle-finished instruments. While these issues may have been real, a more likely explanation is purely economic; the cast aluminium bodies, which had to be subcontracted out, were expensive to make. Adolph Rickenbacker had been experimenting with Bakelite since the late 1920s (it is almost certain it was he who made the Bakelite necks used on some late 1920s National resonator guitars), and it is likely he believed that making the instruments out of Bakelite and in-house would be more cost-effective.

[33] Ibid. p. 28.
[34] Indeed, examining the dates on the stuffed newspapers is the most accurate way of dating these instruments, as they often had no serial numbers.

THE EARLY RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

THE EARLY ACIVITIES OF THE RO-PAT-IN CORPORATION

The Ro-Pat-In Corporation was incorporated in the state of California on October 15, 1931. The initial partners in the venture were Adolph Rickenbacher, George Beauchamp, Paul Barth and C. L. Farr. The first three had previously had involvement with National Stringed Instrument Corporation; Beauchamp and Barth as employees of the company, and Rickenbacher as a supplier. There is a gap of close to a year between the incorporation of the company and its first recorded sales. Other than pre-production planning for the manufacturing of musical instruments, it is not clear what other activities the nascent Ro-Pat-In Corporation engaged in. Other than the incorporation papers, the earliest evidence of activity by the Ro-Pat-In Corporation is the mention in the minutes of the National String Instrument Corporation noted below. This is somewhat surprising, since there appears to be no evidence for other economic activity by Beauchamp and Barth during this time and it is doubtful that either would have had the means to live independently during this time, the height of the Great Depression. In particular, it is not known whether Beauchamp working as a professional musician during this time, or if he engaged in his previous profession of house painting.

It is not clear why the company marketed the instruments made under Adolph Rickenbacher's name rather than George Beauchamp's, but an often repeated piece of company lore states that it is because the name “Rickenbacker” was somewhat easier to pronounce than “Beauchamp”. This is of course probably somewhat tongue in cheek, since many people have difficulty with the proper pronunciation of “Rickenbacker”, giving the third syllable a mock-German pronunciation, making it rhyme with “rock” rather than “rack”, which was the pronunciation that Adolph Rickenbacher used.

No one knows the exact derivation of the name "Ro-Pat-In". It is tempting to speculate, and not too much of a mental stretch, that the name comes from a truncation of "electRO PATented INstrument(s)". One of the factors in favour of this supposition is that the earliest Frying Pans were marketed under the name "Electro". However, there are a couple of factors which make this assertion less than straightforward. The most noteworthy of these is a comparison of the way that the name "Ro-Pat-In" is printed in company literature and typed in company documents with the way that term was handwritten in papers in the company's archives (see figures 4.1 and 4.2). In printed materials that are not in all capitals (as the company letterhead was), "Ro-Pat-In" is invariably printed or typed with the "o" in lowercase. However, in handwritten documents, the "Ro" in "Ro-Pat-In" is very often written in all capitals with the rest of the words being conventionally noted: "RO-Pat-In". It is not known why this was done.


THORNWALL 9721

STATEMENT

RO-PAT-IN CORPORATION

MANUFACTURERS OF

ELECTRO STRING INSTRUMENTS

6071 SOUTH WESTERN AVENUE
LOS ANGELES, CALIFORNIA

Date_____

Figure 4.1 – Letterhead on Ro-Pat-In company statement form.

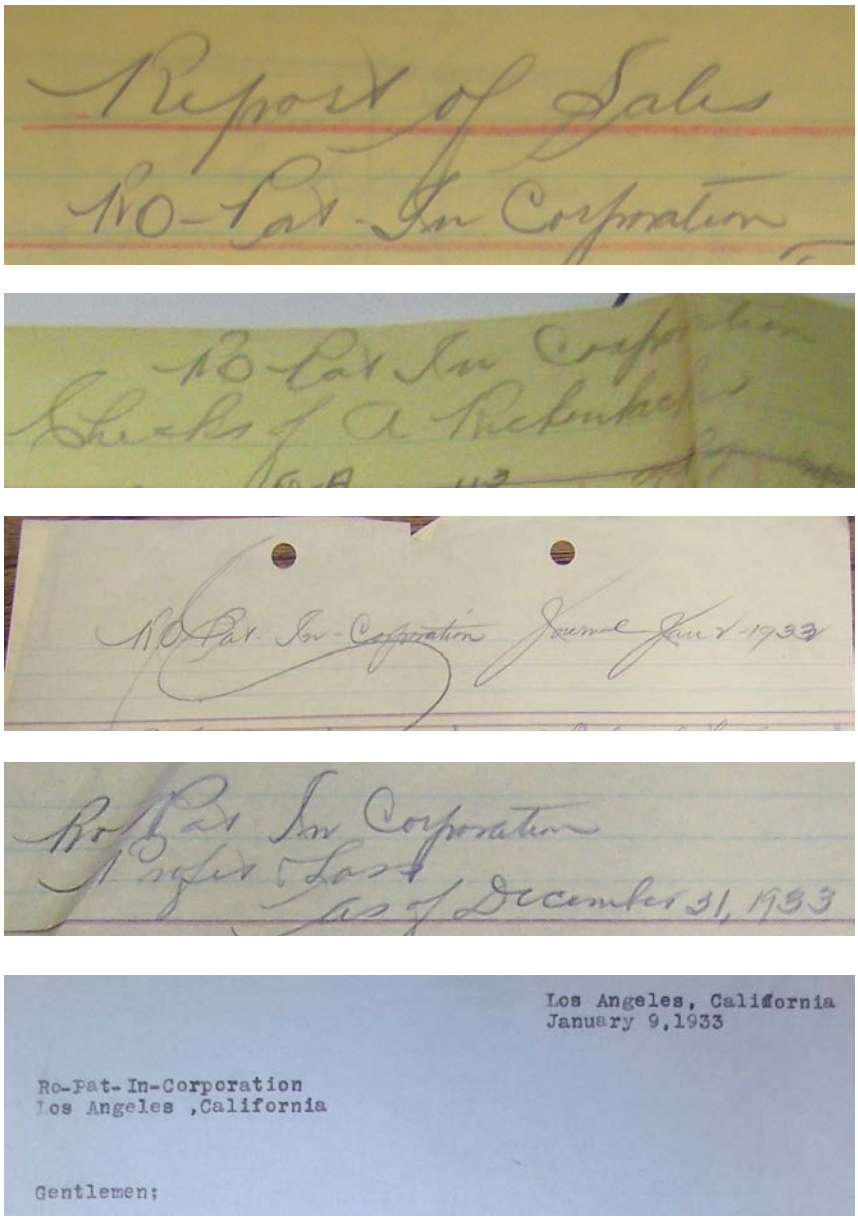


Figure 4.2 – Examples of the use of "RO-Pat-In" and "Ro-Pat-In" on early handwritten and typed company documents.

The top four examples all appear to be in the same handwriting, showing the inconsistency. The bottom example shows a conventionally type-written "Ro-Pat-In" for comparison.

PRODUCING THE FRYING PAN

A list of cash advances by Rickenbacher Manufacturing Company (which would be giving money on behalf of the fledgling Ro-Pat-In Corporation[1]) from the second half of 1932 gives some insight into the probable logistics of manufacturing the frying pan.[2] The earliest of these cash advances is dated August 3 and is to the Carlson Pattern Shop for $4.68. An earlier, undated advance of $50 was paid out to the same company "pre-organisation". It is not clear what time period is meant by this, since it is almost certain that this transaction occurred after Ro-Pat-In was organised in October of 1931. These cash advances to the Carlson Pattern Shop were almost certainly for the wooden patterns used to make the casting moulds for the aluminium frying pan bodies.

Since the production model of the frying pan electric guitar was made of aluminium it has often been assumed that the instruments were produced entirely in-house. An examination of existing records of the Ro-Pat-In/Electro String archives shows that this is not the case. While Adolph Rickenbacher's business was a fully equipped machine shop, this did not extend to metal casting, which at the time was considered a separate specialty. It is likely that this inability to produce the frying pan completely in-house was a motivating factor in Electro String switching to instruments made out of Bakelite. Bakelite was a material in which Rickenbacher's workshop often worked, making various small items including chess pieces and toothbrushes handles for the "Kleen-B-Tween" company.[3]

The minutes of the National Stringed Instrument Corporation for April 28, 1932 show that Jack Levy, who was National's sales manager was also the sales manager for the new Ro-Pat-In Corporation. In addition to his sales work for these two companies, Levy was also an independent sales representative for other musical instrument companies, including Zildjian cymbals, of which he was the exclusive West Coast distributor.[4] Interestingly, in the minutes the name of the instruments being produced by Ro-Pat-In was given as "Elektro" rather than "Electro". As there is one known exemplar of a model A25 frying pan with the name on the headstock spelled in

[1] It should be remembered that although they were heavily intertwined, Rickenbacher's tool and die business and Ro-Pat-In were two separate entities.
[2] Rickenbacker Archives.
[3] Smith, *The History of Rickenbacker Guitars*. p.10.
[4] Al Frost Archive.

this fashion,[5] it is clear that for a short period this was the preferred spelling of the name. This alternate spelling of "Electro" in the National minutes gives a clue to the production dates of the earliest frying pans; since it is known that the company had reverted to the spelling "Electro" on the headstock of the A25 model frying pan by the time of the first recorded sales of the instruments in August 1932,[6] it must be concluded that the alternative spelling "Elektro" was used before then, almost certainly concurrently with the alternative spelling used in the National minutes.

Figure 4.3 – Jack Levy.

(Photo from the back cover of the 1930 National String Instrument Catalogue)

Although it has been previously commonly assumed that the amplifiers sold with Ro-Pat-In's new electric instruments were sourced from a local radio shop, a review of Ro-Pat-In's records shows that the amplifiers were assembled in-house from components bought from and/or specially made by suppliers. Until the company's introduction of an electric upright bass in the mid 1930s, only one model of instrument amplifier was offered by Ro-Pat-In/Electro String, although the housing in which it was encased changed during this time. The cabinets for the earliest amplifiers were made of wood and were manufactured by Johnson Cabinet Works.[7] Around 1935 the design of the amplifier cabinets was changed to a stamped all-metal enclosure, with a black

[5] This instrument is now in the collection of Bobby Carlos.
[6] Rickenbacker Archives.
[7] There is more than one Johnson listed as a cabinetmaker in the Los Angeles city directories of the 1930s; it is unknown which of these is the Johnson referred to.

painted crinkled finish. This was almost certainly produced by Rickenbacker's tool and die shop.

Schedule #2 of Ro-Pat-In's end-of-year accounts for 1932 lists the following suppliers of electrical components:[8]

- Radio Manufacturing and Supply Company
- L. A. Warehouse (speakers) (this is possibly a misspelling of "L. A. Wholesale")
- Phelps Dodge Company National Products Company
- Yale Radio
- Magnavox Company
- Radio Manufacturing and Supply Company
- Carter Radio Company.

From this list is possible to see that not only were the suppliers of electrical components to Ro-Pat-In varied, no one type of component was exclusively supplied by any one supplier; for example both L.A. Warehouse and the Magnavox Company were suppliers of speakers.[9] It is not clear who designed the amplifiers that were sold with the frying pan, but it is known that they were assembled by Roy Van Nest, whose address is given in the 1932 Los Angeles City Directory as 1354 W. 85th Street.

Sometime during 1933, the Ro-Pat-In Corporation changed its name to Electro String Instrument Corporation; The end of year report for the company dated December 31, 1933 still uses the name Ro-Pat-In, whilst the end the year report for 1934, dated December 21, uses the name Electro String Instrument Corporation. It is not known exactly when, or indeed why this name change took place. It is interesting to note that the change of the company name to Electro took place at roughly the same time as the company changed the name on production instruments from "Electro" to "Rickenbacher".

[8] Rickenbacker Archives.
[9] The the list of suppliers in the 1933 Schedule #2 is not broken down by suppliers of electrical components for amplifiers and electric guitars, so it is likely that some of these suppliers also provided components for Ro-Pat-In's instruments as well.

KEY PEOPLE IN RO-PAT-IN/ELECTRO STRING

While George Beauchamp was the key personality in the development of the Frying Pan electric guitar, it does not follow that he was the dominant figure in its manufacture. While Beauchamp had experience of creating and running a guitar manufacturing enterprise from his four years with the National Stringed Instrument Corporation, his position at National appears to have been his first job that did not involve playing music or house painting. Like National Stringed Instrument Corporation, Beauchamp's nascent Ro-Pat-In/Electro String Instrument Corporation appears not to have had one principal overseer, but instead was decidedly a group effort, utilising the different talents and assets of a number of people.

Adolph Rickenbacher

Adolph Rickenbacher[10] was born Adolf Adam Riggenbacher in Basel, Switzerland on April 1, 1887. His father, also named Adolph, was a self-employed cabinetmaker. In October 1891, Adolph Rickenbacher's family emigrated to the United States, settling first in New York. The spelling of his surname as "Rickenbacher"[11] (which Rickenbacher most commonly used for the rest of his life) appears to date from this time. Rickenbacher further Anglicised his name in the early 1930s to its best-known spelling "Rickenbacker" to capitalise on the connection to his second cousin Eddie Rickenbacker, the well-known ace fighter pilot of the First World War and Congressional medal of honor winner. Like many recently arrived immigrant families, conditions were tough for the Rickenbachers and the family needed to be resourceful; a family story relates that shortly after arriving in the United States, the group of people the Rickenbachers had arrived with were given tomatoes to eat. Adolph senior convinced the others that the tomatoes were poisonous and then collected the discarded fruit to feed his family.[12] In 1893 the family moved to Ohio, where Adolph met and married his wife, Charlotte. The couple first lived in Illinois, but in 1918 moved to California, where, according to his 1918 United States draft card, Rickenbacher worked as an engineer/machinist for the Hotpoint Corporation, makers of electric stoves.

[10] Much of the early biographical information presented here is from an unpublished article by Bänz Friedli. Rickenbacker Archives.
[11] The spelling "Rickenbacker" is used in this thesis to denote the company while the spelling "Rickenbacher" is used to refer Adolph Rickenbacher. See Terminology and Conventions.
[12] This is not as strange as it first might sound; it was a common folk superstition, both in Europe and the United States, that tomatoes, often known as "love apples", were poisonous. The superstition has a slight basis in fact as tomatoes are a member of the deadly nightshade family.

Figure 4.4 – Adolph Rickenbacher.

(Photo from the back cover of the 1930 National String Instrument Catalogue)

Sometime in the early 1920s Rickenbacher started his machine shop in Los Angeles at 6701 S. Western Avenue[13] although the first mention of Rickenbacher's machine shop in Los Angeles City Directory is not until 1929. The 1923 Los Angeles City Directory lists Rickenbacher as an engineer and his wife Charlotte as a stenographer. Adolph Rickenbacher had strong connections with the National String Instrument Corporation, although he had no day-to-day involvement with the company. It is almost certain that it was through the connection with National that Adolph Rickenbacher met George Beauchamp and the others with whom he formed Electro String Instrument Corporation. Although it is clear that Adolph Rickenbacher was key in both the financing of the nascent Ro-Pat-In and providing technical expertise regarding the mass production of the electric guitar, it is much less clear what involvement, if any, he had with the creation of the design, either electrically or physically, of the instrument. Although it has been generally assumed that Rickenbacher had no previous experience with electrical matters, his earlier employment at Hotpoint suggests otherwise, although it is not known what involvement he had, if any, with things electrical at Hotpoint. After the departure of George Beauchamp in 1940, Adolph Rickenbacher appears to have taken less of a leading role in the company,

[13] While its location remained the same, the street number of Rickenbacher's shop changed at least twice before the business was moved to Santa Ana California in 1960. Since then the address has changed yet again, with the number 6701 no longer being used.

delegating many of its day-to-day operations to Paul Barth. The entry of United States into World War II at the end of 1941 further curtailed the business activities of the Electro String Instrument Corporation, due to the wartime restrictions on the use of metal and other materials deemed essential to the war effort. After the end of the war the company resumed the manufacture of electric guitars, with a particular emphasis on Hawaiian guitar models. However, while Electro String's share of the Hawaiian guitar market remained significant, due to in no small part to the instrument's pre-war popularity, by the beginning of the 1950s it was clear that Adolph Rickenbacher was losing interest in the guitar manufacturing business.

Adolph Rickenbacher sold Electro String in December 1953 to Francis Carey Hall, the father of the present CEO of the company, John C. Hall. However, he kept in contact with the company until the time of his death. Rickenbacher was very conscious of his role in developing the electric guitar; in his later years he was known to carry business cards saying "Adolph Rickenbacker, The Father of the Electric Guitar". Rickenbacher died on March 7, 1976 in Fullerton California. While he may not have actually invented the electric guitar, it is clear that without Adolph Rickenbacher's technical expertise, financial support, and obvious business acumen, George Beauchamp's electric guitar design might never have been produced commercially.

Paul Barth

As noted in chapter two, Paul Barth had been both an employee and board member of National String Instrument Corporation. Barth was a relative (most likely a nephew) of John Dopyera, one of National's founders and the inventor of the resonator guitar. It was Dopyera who introduced Barth to instrument making, a trade he would pursue in one form or another until his death in 1973. Moving to Los Angeles in the mid-1920s, Barth was hired by Dopyera to work at the Dopyera brothers' banjo shop, actually living for while in the shop itself. He began to work for National when that company was formed; on the back of the 1930 National catalogue he is listed as Vice President. He and George Beauchamp were forced out of their positions at National on November 10, 1931, most likely in reaction to the formation of the Ro-Pat-In Corporation. Barth appears to have dealt with many of the practical day-to-day matters of the company; a significant part of the surviving correspondence of the company during the 1930s and 40s is either to or from Barth. After George Beauchamp's

departure from Electro String in 1940, Barth took over Beauchamp's position, overseeing the company's shift to wartime production.[14] He remained with Electro String until 1956, two years after the company was sold to F.C. Hall.[15] Even in retirement, Barth remained active in the guitar manufacturing business; during the early to mid-1960s, he had a small company, "Bartell" (sometimes known as "Bartell of California"), which manufactured solid body guitars of a decidedly Rickenbacker-like design. These instruments were made in very small numbers and appear to have been distributed only in Southern California and parts of Arizona.

Figure 4.5 – Paul Barth.

(Photo from the back cover of the 1930 National String Instrument Catalogue)

C. W. Lane

Almost nothing is known about Charles W. Lane. Although it is known he was a machinist for Ro-Pat-In/Electro String, it is not known what his exact duties with the company were. The 1932 Los Angeles city directory shows four individuals surnamed Lane with the correct Christian name and initial. The most likely candidate is a Charles W. Lane (wife's name Bessie) with the given occupation of machinist whose home address is given as 1241 E. 69th Street, about 4 miles away from the Ro-Pat-In offices and workshop at 6071 S. Western Avenue.[16] Whilst this is somewhat farther away from

[14] Rickenbacker Archives.
[15] Smith, *The History of Rickenbacker Guitars.*, p. 23. Rickenbacker Archives.
[16] Los Angeles Directory Co., *Los Angeles City Directory* (Los Angeles, CA: Los Angeles City Directory Co. (Incorporated), 1932).

his workplace than other people involved with Ro-Pat-In/Electro String (as well as National Stringed Instruments) tended to live (with the notable exception of lawyer C. L. Farr), in the early 1930s Los Angeles's then excellent public transportation system made this distance easily traversable. It is also noteworthy that this address is east of Western Avenue, whereas many of the people involved with Ro-Pat-In/Electro String and National tended to live west of Western Avenue. However, this may simply reflect the working conditions and social status of a machinist; many of the metalworking businesses in Los Angeles, including the metal casting shops that Ro-Pat-In/Electro String subcontracted the fabrication of the frying pan bodies to, were located in the eastern section of the city, while the western section of the city then, as it remains today, was decidedly more genteel.

Figure 4.6 – C. L. Farr.

(Photo from the back cover of the 1930 National String Instrument Catalogue)

C. L. Farr

Charles L. Farr was the lawyer for the Ro-Pat-In/Electro String Instrument Corporation. It is noteworthy that he was one of the directors of the National String Instrument Corporation and was listed as such along with his photograph on the back of the well-known 1930 National catalogue. Although Farr took care of the legal matters for the nascent Ro-Pat-In company, including helping to file its incorporation papers, his legal services did not include assistance with patenting Beauchamp's electric guitar designs, which were handled by Arthur F. Larrabee (first attempt) and William H.

Maxwell (second, successful attempt).[17] This is, of course, not surprising, since patent law tends to be practised as a specialty. His career during the early 1930s was evidently quite successful; the 1932 Los Angeles city directory shows him living at 2628 Armstrong Street, near Griffith Park, which at the time was a somewhat exclusive neighbourhood. Although Farr was obviously well-to-do, it is not clear to what extent, if any, he provided financial backing for Ro-Pat-In; while the existing company records show in detail the money that Adolph Rickenbacher personally laid out for Ro-Pat-In's start-up, no such records appear to exist concerning Farr. Although it is not known with certainty, when considering Adolph Rickenbacher's well-known aversion to paying for lawyer's services,[18] it is tempting to speculate that Farr received his directorship in Ro-Pat-In in lieu of payment for his legal services in setting up the company.

Doc Kauffman

Clayton Orr "Doc" Kauffman is probably the most unusual of the key people in the early Electro String Instrument Corporation; while he appears to have been closely involved with certain aspects of the company during the mid 1930s he was never actually employed by, or had any official capacity at, the company. Kauffman's association with Ro-Pat-In/Electro String appears to have first been connected with the use by the company of an invention of Kauffman's, the Vib-Rola tailpiece.[19] The Vib-Rola was a hand-operated vibrato unit that replaced the tailpiece on a conventional acoustic guitar which allowed the player to mimic variations in pitch created by guitar players using a guitar steel (the steel bar used by Hawaiian-style players to fret the strings). The Electro String Instrument Company not only used these vibratos on some of their early instruments, but actually manufactured them under licence from Kauffman. A series of invoices preserved in the Rickenbacker company archives shows that, although Kauffman's Vib-Rola is fairly well-known today amongst guitarists (John Lennon's famous 1958 Rickenbacker model 325 was originally fitted with one), a very small number of the units were actually made and sold during the 1930s. This limited commercial success was not due to any lack of effort on the part of the Electro String; the company archives show numerous attempts to promote and distribute Kauffman's device, including arranging a meeting with the large California-based wholesaler/jobber

[17] Chapter 7 examines Larrabee's and Maxwell's roles in Beauchamp's patent(s) in greater detail.
[18] This is examined in greater detail in chapter 7.
[19] Rickenbacker Archives.

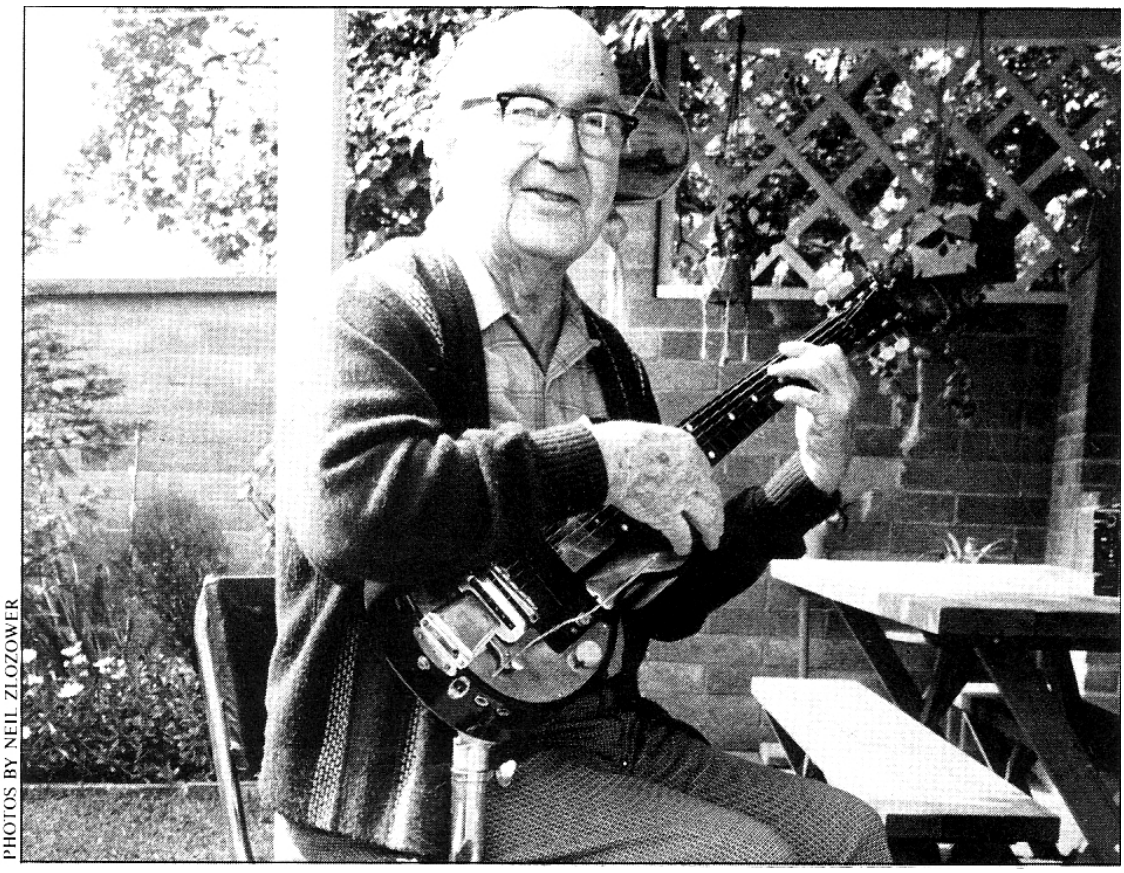
Coast Wholesale.[20] In 1937, Kauffman demonstrated a new guitar design for George Beauchamp and the others working at Electro String; the "Vibrola" (no hyphen) electric Spanish guitar. The Vibrola guitar was in essence a version of the Bakelite-construction Rickenbacker electric Spanish guitar (which was, in turn, a version of the similarly-made Rickenbacker B6 Hawaiian guitar) with a motorised version of the Vib-Rola tailpiece. He licensed the design to Electro String, which began manufacturing the instruments in late 1937. Although the Vibrola guitar was manufactured and marketed until at least late 1941 (with the United States' entry into World War II on December 8, 1941, musical instrument manufacturing would be severely curtailed), it was not a commercial success and very few were made.[21]

Because of the connection with Electro String through the use, manufacture and distribution of his Vib-Rola unit it is commonly assumed and/or asserted that Kauffman was actually employed by the company, but records indicate that this was not the case. This lack of employment was not due to a lack of desire on Kauffman's part; letters in the Rickenbacker archive show that on more than one occasion Kauffman expressed interest in working for the company. It is not clear why he was never hired; the reason may have been as simple as there was no work for him to do, it being the middle of the Great Depression. The letters in the Rickenbacker archive do make clear that Kauffman enjoyed friendly relations with those at Electro String, and he, in turn, was well liked by them. About the same time that Kauffman was working with Electro String to create the motorised Vib-Rola guitar, Kauffman opened up a "Fix-It" shop, which as well as repairing small electrical appliances, such as radios and toasters, also appears to have repaired musical instruments.[22]

Doc Kauffman is probably best remembered today for his next musical instrument-related business venture. Around 1942 Kauffman and a friend of his, radio repair shop owner Leo Fender, began to make solid-body electric Hawaiian guitars that were influenced by the instruments that Kauffman had seen made by Electro String/Rickenbacker. These instruments were marketed under the trade name "Vibro".[23] Although these instruments were made of wood, they were closely modelled

[20] Ibid.
[21] This instrument is examined in greater detail in chapter 5.
[22] Rickenbacker Archives.
[23] Interview with Lynn Wheelwright (2010). Wheelwright has undertaken much interesting and significant (and currently unpublished) research into the early relationship between Leo Fender and Doc Kauffman

on the stamped-metal Hawaiian guitar designs made by Rickenbacker from the mid 1930s onwards. Doc Kauffman and Leo Fender would go on to start a company by the name of "K & F" to manufacture electric stringed instruments and amplifiers. After Kauffman's departure in the late 1940s, the company, which then changed its name to "Fender Electric Musical Instruments", would go on to be one of the biggest and most successful manufacturers of electric guitars and amplifiers in the world.



PHOTOS BY NEIL ZLOZOWER

Figure 4.6 – Clayton Orr "Doc" Kauffman in 1982 playing a late 1930s Bakelite-bodied Rickenbacher electric Spanish guitar fitted his "Vib-Rola" tailpiece.

Photograph from Guitar Player Magazine, October, 1982

and the instruments they created before forming the K & F company, showing the significant links between the Rickenbacker and Fender companies.

THE GROWTH OF RO-PAT-IN/ELECTRO STRING

Although much of the activity of the early Ro-Pat-In/Electro String Corporation remains obscure (especially in the months between the incorporation and the first commercial production instruments in August 1932), it is clear that by the end of 1932 Ro-Pat-In was a fully functioning company. In January 1933 the company embarked on a period of heightened activity. The output of instruments increased and company took its first steps towards the commercial marketing of its instruments, a series of professional portrait-style photographs of the frying pan which would be later featured in their catalogue.[24] In January 1933 Ro-Pat-In also accepted a commission for an electric harp for the famous comedian and musician Harpo Marx.[25] It is clear that the period of 1933 to 1936 is the period of the greatest change and growth of Ro-Pat-In/Electro String prior to the company being sold to F.C. Hall in late 1953; it was during this time that its most commercially successful instruments were marketed and the company's designs for non-guitar family instruments were developed. It was also during this time that the company most greatly experimented with non-traditional instrument designs.[26] This expansion in instrument development was, not surprisingly, matched by an increased effort at marketing the new electric instruments; this period saw a marked increase in advertising as well as Rickenbacker instruments being taken on by a number of large wholesale jobbers, thus greatly increasing the visibility of the instruments and the Ro-Pat-In/Electro String Company.[27]

LEGAL ACTION BY THE ELECTRO STRING INSTRUMENT CORPORATION

The period of litigation by Electro String Instrument Corporation against other manufacturers in defence of Beauchamp's electric guitar patent was brief, but intense, and marked a pivotal point in the company's history. During the second half of 1937 William H. Maxwell, George Beauchamp's patent attorney, made contact with a number of companies who were making electric stringed musical instruments and attempted to persuade said companies to curtail their activities or seek a license for their manufacture

[24] This is discussed further in chapter 8.
[25] This instrument is examined in detail in chapter 6.
[26] See chapters 5 and 6.
[27] See chapter 8.

from Electro String.[28] The companies targeted by Maxwell included Epiphone, Vega, and interestingly, John D' Angelico, the noted New York arched-top guitar luthier.[29]

In contrast to the heavy-handed approach adopted by Benjamin Franklin Miessner in asserting his patents,[30] Maxwell and Electro String appear to have taken a much softer approach. Ben S. Berry, who visited the Vega factory on December 8, 1937 as Maxwell's agent, reported to Maxwell in a letter written the next day:

> I advised him (Mr. Nelson) that we were not assuming an unfriendly attitude towards him but that we felt that our rights were involved and intended to protect them. He then said that he did not want to infringe anyone's rights…[31]

One easily overlooked, and yet extremely important, legal action by Electro String undertaken during the mid 1930s was the application to trademark the name "Electro". On September 11, 1935, Maxwell wrote a letter in which he explained the process of obtaining a trademark on the name and expressed his surprise at the success of their application being accepted:

> Gentlemen:
>
> I am pleased and at the same time very much surprised to advise you that I have received notice that the trade mark application on 'ELECTRO', Serial No. 363, 493, has been cast to publication. This means that the application has been favorably acted upon by the Patent Office in response to the amendment that I recently filed and the mark is now to be published in the Official Gazette of October 1, 1935 so that anyone who believes that he would be damaged by the registration of the mark may oppose the registration by serving notice and prosecuting what is known as an opposition proceedings. An opposition proceedings is more or less in the nature of a lawsuit in which the opposer attempts to establish that the mark will damage him, whereas the applicant attempts to establish that the mark will not damage the opposer.
>
> After the mark has been published in the Gazette and no opposition has been filed within 30 days after publication, the mark is registered in the due course of business.
>
> When further action in this case is received, I will notify you.
>
> Very truly yours,
>
> William H. Maxwell

On November 19, 1935 Maxwell further communicated to Beauchamp that the application had been passed and that the certificate of registration would be issued on December 10, 1935. Maxwell's surprise at the acceptance of the application is not

[28] Rickenbacker Archives.
[29] Ibid. John D'Angelico (1905–1964) was probably the best-known American luthier of arched-top guitars. Note that D' Angelico was an individual maker, rather than a company.
[30] See chapter 9.
[31] Rickenbacker Archives.

surprising; the name "Electro" had been used on a number of sound reproduction products previously, including the famous audio products manufacturer Electro-Voice, which was incorporated on June 1, 1930.[32]

Adolph Rickenbacher appears to have been ambivalent about litigation for protecting the electric guitar later on in his life.[33] It appears that he felt the expense of prosecuting the patents and pursuing those who infringed upon them was not worth the possible benefits. Certainly, since there were multiple patent applications being pursued by Beauchamp and Electro String during this time, the cost involved was not insignificant; company archives, which do not appear to be complete, show several thousand dollars being paid to Maxwell for services rendered during the mid 1930s.[34]

[32] http://www.electrovoice.com/ Accessed 7/7/2007.
[33] Smith, *The History of Rickenbacker Guitars*. p. 20.
[34] Rickenbacker Archives.

GUITAR FAMILY INSTRUMENTS OF THE RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

THE FIRST RO-PAT-IN GUITARS

Due to the prominence of the frying pan in the history of Rickenbacker specifically, and the electric guitar in general, it is easy to overlook the fact that Ro-Pat-In/Electro String from the very beginning made Spanish-style guitars and that these instruments were much more conventional in shape and construction – with wooden bodies and violin-style f holes – than the Bakelite-bodied Spanish instruments that followed. It should be remembered, however, that at this early stage any electric/electrified instrument would have been considered quite unusual in appearance. When considering the earliest Ro-Pat-In instruments it must be kept in mind that, while it was obviously the intention of the company to produce standardised models of instruments, the actual characteristics of the first standard production instruments made in 1932 had many (often small) differences from the instruments that would be produced from the beginning of 1933 on. This degree of variance is illustrated by three of the earliest consumer sales of Ro-Pat-In instruments; the instruments bought by Gage Brewer, Alvino Rey, and an unnamed Hawaiian band in anecdote recounted by Adolph Rickenbacher.[1]

Gage Brewer's Instruments

The Rickenbacker archives indicate that the first instruments sold by the nascent Ro-Pat-In Corporation to a professional musician were purchased by Gage Brewer from Wichita, Kansas, on 21 September, 1932.[2] Brewer bought two instruments, an A25 frying pan and an electric Spanish guitar (see figure 5.1). The electric Spanish guitar is currently in the collection of the Wichita-Sedgwick County Historical Museum in Wichita, Kansas and gives us an insight to the earliest Ro-Pat-In instruments. Although

[1] See "The Stolen Shipment" below.

[2] These were the 3rd and 4th instruments respectively sold by Ro-Pat-In, the first two being Hawaiian-style A25 frying pans sold to Platt Music in Los Angeles. Gage Brewer and his early use of Rickenbacker Electro instruments are discussed more fully in chapter 8.

at first glance the Brewer guitar appears to be much like the later Electro Spanish guitar (described in detail below), the two instruments are actually very different. While the most visually noticeable difference is the much smaller body of Brewer's guitar, the key feature of the instrument is its neck, which joins the body at the 17th fret. This was highly unusual for the time – most Spanish-style guitars then made, flattop or archtop, had neck-to-body joins at the 12th or 14th fret.[3] Although this feature on Brewer's guitar was not of electrical significance, it is nonetheless extremely significant in the development of the electric guitar, in that it foreshadows the design and playing techniques of the electric guitar as seen today. For most of the guitar's history a neck-to-body join at the 12th fret was most common. In the late 1920s Martin guitars introduced the OM ("orchestra model") flattop guitar with a neck-to-body join at the 14th fret in an effort to appeal to banjo players who were used to playing higher up the neck. By comparison, most modern electric guitars have neck-to-body joins from the 17th to 20th frets (depending on the body configuration and the total number of frets). The body to neck join is not the only unusual feature of the neck this guitar; the fingerboard has 24 frets – a full two octaves – and while 24th fret necks would become commonplace in the last quarter of the 20th century, it's employment on a Spanish guitar at this time was highly unusual, if not unique, making this a true electric guitar not only in its electronic configuration, but in its playing configuration as well. This extended higher-end range of the electric guitar became much more important to guitar players as the 20th century progressed. For example, David Gilmour, guitarist for the rock group Pink Floyd, uses a Fender Stratocaster (with a total of 21 frets) in his famous guitar solo on the song "Money"[4] for two of the three solo sections, but switched to a double cutaway[5] solid body electric guitar with 24 frets, made by luthier Bill Lewis (Vancouver, British Columbia), for the final section in order to hit the solo's climactic high E (e'").[6]

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[3] The Rickenbacker "Ken Roberts" model described later also has a neck-to-body join at the 17th fret.

[4] *Money* is the first track on side two of Pink Floyd's 1973 album *Dark Side of the Moon*. The album is arguably the band's best-known work, remaining on the *Billboard 200* chart for 741 weeks from 1973 to 1988.

[5] A "cutaway" refers to a section on the treble side of a fretted instrument where the neck joins the body that is literally "cut away" to allow the left-hand easier access for playing the upper frets. Cutaways can be found all types of fretted instruments but are particularly associated with electric guitars. Solidbody electric guitars often have an additional cut away on the bass side, designed to give even more access to the upper frets, as well as providing a more balanced visual aesthetic; these instruments are known by the sobriquet "double cutaway".

[6] Bjorn Riis, "The Bill Lewis Guitar," http://www.gilmourish.com/?p=191. Accessed September 30, 2008.

Figure 5.1 – Gage Brewer's 1932 Electro Spanish Guitar.

The body of the Gage Brewer guitar was almost certainly not made in-house by Ro-Pat-In, but was likely sourced elsewhere. Guitar historian Lynn Wheelwright is of the opinion that the instrument was made from a repurposed tenor guitar body made by the Harmony company of Chicago that was given to the National Company as a

production sample in a bid by Harmony to make the bodies for National's wooden-bodied resonator models such as the "Trojan".[7] Although the guitar appears to have a conventional hollow body, there is actually a piece of wood mounted underneath the top of the instrument to which both the pickup and bridge are attached. Therefore, although relatively conventional looking, the instrument functions essentially as a solid-body guitar, in a manner similar to ES 335, ES 345, and ES 355 model guitars made by Gibson over 25 years later.[8]

It is not known what input, if any, Gage Brewer had into the design of this instrument. Based on the known timeline and probable logistics of Brewer acquiring his guitars from Ro-Pat-In, it seems likely that these were already existing guitars, rather than bespoke instruments made to Brewer's specifications.[9] This contention is also supported by the multiple misspellings of Brewer's last name in the Rickenbacker sales records, since it is probable that the personnel at Ro-Pat-In would have tended to remember the name of a customer who ordered a bespoke instrument, especially at such an important juncture in the company's history.[10]

Alvino Rey

The A25 frying pan, serial number 33, purchased by Alvino Rey sometime in late 1932/early 1933 is described in detail in chapter 3 and needs no further analysis here, but it should be noted that this instrument has some small variances, mostly cosmetic, from what would become the standard configuration of the frying pan model during the mid 1930s. The most obvious difference is on the headstock; Rey's guitar has the name "Electro" hand-engraved, whereas later instruments had a stamped-metal nameplate with the words "Rickenbacher Electro, Los Angeles". These nameplates would become standard on almost all Rickenbacker instruments up until the early 1950s. Somewhat unusually, these nameplates invariably used the variant spelling "Rickenbacher", although all company literature and letterheads used the spelling "Rickenbacker". The reasons for this are not entirely clear. It was not simply a case of not wanting to spend the money on a new die for stamping the nameplates, since lower

[7] Lynn Wheelwright, "Ro-Pat-in Electric Spanish; Granddaddy to the Stars!," *Vintage Guitar*, July 2008.
[8] These guitars are generally known (wrongly from an organological perspective) as "semi-hollow" bodies due to their use of f-holes and other arched-top guitar design features.
[9] Gage Brewer's acquisition of these guitars is further discussed in chapter 8.
[10] Rickenbacker Archives.

end models made by the company during this period that used a similarly shaped decal instead of a nameplate on the headstock also had the spelling "Rickenbacher".

The Stolen Shipment

Probably the most mysterious of the earliest output of the Ro-Pat-In Corporation is a group of bespoke instruments that was likely made around the time the company commenced production. In a short, neatly typed document written in 1960, six years after he had sold the company to F. C. Hall, Adolph Rickenbacher recalled:

> In our darkest moments we received a call from a group of Hawaiian musicians that were ready to order a complete line of electrical instruments – steel and Spanish guitars, mandolins and bass. So we were back in business! We only had a steel guitar at this time, but we took the order. After about 60 days the order was complete and we called our good customers and informed them everything was ready for them the following morning. That evening we checked everything to be sure it was all okay and ready for them to pick up in the shipping department in the morning. But someone beat us to it – the whole outfit was stolen that night, and our whole two months of hard work went out the window![11]

This anecdote is significant in that it shows that the nascent Ro-Pat-In Corporation made and intended to make a full product line of stringed instruments, rather than just concentrating on Hawaiian-style guitars. In addition, it demonstrates that the company understood that its primary market for these new instruments was professional players rather than amateurs and that it was willing to create and customise instruments to meet the demand of those players.[12] It also shows that the Ro-Pat-In/Electro String Corporation experimented with an electric stringed bass instrument from the earliest stages of its existence[13].

THE TRANSITION TO BAKELITE

By late 1935 Electro String began to deemphasise the production of aluminium-bodied frying pans in favour of a new design of instrument made out of Bakelite. Bakelite (its full chemical name is polyoxybenzylmethylenglycolanhydride) was one of the earliest fully synthetic plastics. Developed in New York in 1907 by the Belgian-born chemist Leo Hendrik Baekeland (1863-1944) as a substitute for shellac (made not from the shell, as the name suggests, but from the excretion of lac beetles), Bakelite was, by the early 1920s, easily the most common commercially produced plastic. Bakelite is a resinous plastic made from formaldehyde and phenol, which hardens with the

[11] Ibid.
[12] The importance of this is examined in chapter 8.
[13] The significance of this instrument is further explored in chapter 6.

application of heat. Although Bakelite was used for variety of applications, the fact that it was both heat resistant and electrically nonconductive made it particularly suitable for use in the early electronics industry, for both electrical insulators and cases for electrical equipment. One of the drawbacks to Bakelite is its brittleness; it does not absorb shocks and impact very well. However, it is a very hard-wearing material; during the copper shortages of World War II the United States government actually considered making one cent pieces from Bakelite rather than the traditional copper.[14]

It is unknown when Adolph Rickenbacher's machine shop first started to work in Bakelite, but it is certain that he was doing so by the late 1920s; as noted earlier, Rickenbacher's shop did a significant business in Bakelite products, including producing chess pieces and toothbrushes handles. While the aluminium-body frying pans were still offered after 1936, company literature suggests they had been superseded by the Bakelite models. The move to Bakelite might have been motivated by the fact that the bodies could be made in-house, rather than out-sourced, in the way the frying pan castings had to be. If this was the case, it is likely that the preference for Bakelite would have been driven by Adolph Rickenbacher, who obtained rights to use the material in the manufacture of musical instruments from an English inventor named Arthur Primrose Young.[15] While Rickenbacker's Electro guitars of the 30s and 40s are by far the best-known stringed instruments made from Bakelite, they were not the first; banjo-ukuleles had previously been made out of the material by Gretsch.[16] Although Rickenbacher had to purchase the right to make guitars from Bakelite, this did not mean that he felt hidebound to use Bakelite manufacturing methods others had used before him; it is known that Adolph Rickenbacher improved the Bakelite moulding process by coating the inside of the moulds with Bon Ami scouring powder to keep the newly-pressed instrument parts from sticking. This is confirmed by the existence at the factory today of unfinished bodies of Bakelite instruments from the period which still have scouring powder residue on them. Company lore even suggests that Adolph

[14] In 1943 the US government made the one cent pieces from steel before returning to copper in 1944.
[15] Rickenbacker Archives; Smith, *The History of Rickenbacker Guitars*., p. 13.
[16] Bakelite had been extensively used previously in the manufacture of clarinet bodies and wind instrument mouthpieces. The Gretsch Company, founded in 1883, was, and is, a significant American maker of drums and guitars. The banjo-ukulele had had brief vogue during the 1920s. Smith, *The History of Rickenbacker Guitars.* p. 13.

Rickenbacher may have possibly added the Bon Ami powder directly to the Bakelite mixture before it hardened.[17]

The company's decision to use Bakelite also may have been influenced by George Beauchamp as well as Adolph Rickenbacher; for a short period in the late 1920s Beauchamp appears to have championed the use of Bakelite for the next generation of National resonator guitars.[18] A small, but significant, number of Bakelite-necked National instruments were made during this time. It is not known what influence Adolph Rickenbacher had, if any, on Beauchamp's and National's decision to experiment with Bakelite, but it is not too much of a stretch to suggest that Beauchamp got the idea from seeing the Bakelite products being made in Rickenbacher's machine shop. The necks were not commercially successful, as they tended to warp under the strain of the strings, forcing National to replace the necks under warranty with conventional wooden ones. Very few of these Bakelite-necked instruments are known to survive (especially in playing condition) today.

MODELS OF RICKENBACKER GUITAR FAMILY INSTRUMENTS UP TO 1939

Hawaiian-Style Guitars

Cast Aluminium-Bodied Frying Pan Instruments

A25, A22, A22 Seven String

These instruments have been extensively covered in chapter 3, but to briefly recap, there were three commercially produced aluminium-bodied frying pan models; the 25 inch scale A25, the 22 inch scale A22, and a seven string version of the A22. The A25 was the first of these to be produced, in 1932 the A22 followed in 1933, and the seven string A22 was made in very limited quantities during 1934. All of the frying pan models were officially phased out by 1935 but actually remained available by the company by special order until least the late 1940s. It is interesting to note that in the mid 1950s, after F. C. Hall purchased the Electro String Instrument Corporation from Adolph Rickenbacher, Hall reintroduced the aluminium-bodied frying pan to the company's product line, although this instrument differed somewhat in construction,

[17] Interview with John Hall, 6/7/2006.
[18] Brozman, *The History and Artistry of National Resonator Instruments*, p. 30.

having a back-painted Perspex/Plexiglas fingerboard and a removable masonite back to allow easier access to the electronics.

Bakelite-Bodied Instruments

Model B: B6- 6 string, B7- 7string , B8- 8 String, B10- 10 string

After the aluminium-bodied frying pan, the Bakelite-bodied Model B (see figure 5.2) was the best-known instrument made by Electro String during the 1930s. The earliest model B's were produced in July, 1935 and Rickenbacker began to phase-out sales of the aluminium-bodied frying pans. Although the use of Bakelite on these guitars' construction was their most obvious feature, it was far from being the only innovative aspect of the design. In fact, the design of the model B guitars represents the first known use of many construction and configuration aspects of solid body guitars that continue to be key components of such instruments to the present day. Probably the most significant of these design concepts was the interchangeable neck. While Electro String was not the first, by far, to create fretted stringed instruments with easily detachable necks, it was the first to make such necks interchangeable and easily removed and assembled by a non-specialist. This innovation had several advantages; not only did it allow the factory to repair a bad neck or a cracked body simply by replacing it, it allowed a dealer or a customer to do the same in the field without having to return an entire instrument to the factory. This is exactly the same concept (and reasoning behind it) that Leo Fender would exploit in his design for the Broadcaster/Telecaster guitar in 1950 – over 15 years later. Although it is not known with any certainty, it is likely that Fender would have known about this design through his association with Electro String associate Doc Kauffman, who, of course, was very familiar with the concept.

Another feature of the model B was the hollowed out chambers in its body, which were covered with chromed metal plates (which, at some point around the beginning of World War II, were changed to painted white metal plates). This was almost certainly done to reduce the weight of the instrument, since Bakelite is a heavy, dense material. The earliest model B's had four such chambers; one each on the left and right upper and lower bouts, but soon a fifth was added in the centre of the body between the end of the neck and the pickup. The centre chamber has, in the past, caused a little confusion by obscuring the model B's solid-body nature (some have

asserted that it is actually a semi-hollow body instrument[19]) for some casual observers due to the chamber's (very) slight resemblance to the sound box of a conventional acoustic guitar.

Figure 5.2 – Advertisement depicting the Model B6 Hawaiian Guitar in the *Radio Journal*, May 1936.

The model B had the same horseshoe pickup as its frying pan predecessor. Most models had a single volume control, mounted on the lower treble-side bout, but by 1938 an additional tone control became standard, mounted opposite the volume control on the lower bass-side bout. This addition of a tone control was accompanied by a change in the style of plastic knob used; the earlier single control model B's had the same octagonal knobs as the frying pan models, while the dual control instruments had domed-shape knobs of a type that is now popularly known as "flying saucers".

During the 1930s, Electro String made four different models of Bakelite-bodied Hawaiian guitars; the six-string B6, the seven-string B7, the eight-string B8, and the ten-string B10. The first three are extremely similar to each other in construction (essentially differing only in the number of strings) and are featured in Electro String's 1938 sales

[19] Smith, *The History of Rickenbacker Guitars*. p. 47.

brochure. The model B10 was introduced some time after mid-1939. It was structurally different than the other Bakelite model B's in that it had a much wider neck made of cast metal and used a similarly constructed but structurally different Bakelite body.

Stamped Metal-Bodied Instruments

Silver Hawaiian

Introduced in 1937, the silver Hawaiian model was made from stamped steel,[20] using the same deep-draft metal presses that Adolph Rickenbacher used to stamp the bodies of National resonator instruments. The fret position markers were stamped into the top of the body, which was chrome-plated and highly polished. It featured the same horseshoe pickup and electronics (with the same addition of a tone control in the late 1930s) as the Bakelite model B. Although not an inexpensive guitar, the stamped metal construction of the Silver Hawaiian allowed Electro String to offer the guitar at a much lower price than the Bakelite models; $100, including the amplifier, as opposed to the $140 that a B6 and amplifier combo cost. This instrument was most likely Electro String's first foray into the student market, as an early advertisement for the guitar gives instructions to the potential purchaser on how to hook up the instrument to a radio, bypassing the need for an additional (and costly) amplifier.

Although the Silver Hawaiian and other stamped-metal Hawaiian guitars made by Electro String were not given serial numbers, it is often possible to date them fairly accurately due to the manufacturer's practice of stuffing the hollow metal bodies of the instruments with newspapers to eliminate undesirable resonance and microphonics in the instruments. It is known that some players, in an attempt to mimic the dense material of the Bakelite instruments, would fill the bodies of these stamped-metal guitars with sand.[21]

[20] Richard Smith asserts that these guitars were mostly made from brass rather than steel, but this is almost certainly not the case and is confirmed by the company's advertising as well as the use of a magnet. Ibid. p. 38.
[21] Ibid. p. 38. It is not known if these players used sand that was imported from Hawaiian beaches.

Figure 5.3 – Silver Hawaiian guitar advertisement, 1936 .

Model 59

First marketed around the beginning of 1938, the Model 59 was virtually identical to the Silver Hawaiian except for its pickup, and painted, rather than chromed, finish. The paint was a crinkled finish, the same as was used on Rickenbacker's stamped-metal bodied amplifiers. The instrument was offered in the colours of ivory and black. The pickup on the earliest models was non-adjustable for height and was finished in black crinkled paint, rather than chromed. By the end of the 1930s the Model 59 used the same adjustable and chromed pickup employed on the Silver Hawaiian and had the same volume and tone controls. These later models had a two-tone, shaded, smooth-painted finish. This particular finish is notable as it appears to be the inspiration for the shaded finish used on the early 1940s Hawaiian guitars (described in chapter 4) built by Doc Kauffman and Leo Fender prior to forming the K & F company.

Spanish-Style Guitars

Wood-Bodied Instruments

Electro Spanish Guitar

While their Hawaiian-style guitars of the period are better known, Ro-Pat-In/Electro String produced Spanish-style instruments from the company's very inception. The company's first production electric Spanish guitar was known, appropriately enough, as the Electro Spanish Guitar. First marketed in the last quarter of 1932, the Electro Spanish model was available in a standard six-string configuration as well as a four-string tenor guitar. While the six-string model had a slotted peghead visually similar to that found on National resonator guitars of the period, the tenor version had the more modern style, flat-faced peghead found on most other guitars. Both instruments had their headstocks faced with a white pearloid material. Unlike the earlier Spanish guitar made for Gage Brewer, both versions of this model had a conventional neck-to-body join at the 14th fret. The body of the Electro Spanish had a flat-top soundboard with F holes on each upper bout. It was extremely similar in appearance to the wood-bodied Trojan model resonator guitars made by the rival National company, which is not surprising since the Chicago-based Harmony company made the bodies for both instruments. While the body of the Electro Spanish was not made by Ro-Pat-In/Electro String, the neck of the instrument was almost certainly made in-house. The electronics on the instrument were identical to that of the

aluminium-bodied frying pan models; one horseshoe pickup with a single volume control. The Electro Spanish model appears to have been phased out in 1935 around the time of the introduction of the Ken Roberts model.

Ken Roberts Model

Ken Roberts was a well-known movie studio guitarist and a good friend of George Beauchamp.[22] While at first glance the Ken Roberts model appears to be visually similar to the Electro Spanish Guitar, there are some significant differences. Probably the most important of these is that the instrument has a neck-to-body join at the 17th fret – the same as the Gage Brewer guitar described earlier – rather than the Electro Spanish models' more conventional 14th fret neck-to-body join. The Ken Roberts also has a total of 22 frets as opposed to the Electro Spanish's 19. This combination allows the player a greater range, and more importantly, easier access to those higher notes. The peghead of the instrument is slightly more elaborate than that of the Electro Spanish, but still retains the white pearloid veneer. The body of the Ken Roberts also has F holes, but these are on the lower bouts of the instrument as opposed to the upper bouts as on the Electro Spanish Guitar. The electronics are the same as on the Electro Spanish, except that the volume control on the instrument is mounted in a different place, directly below the pickup. The positioning of the volume control in that location allows the player to use the pinky finger of his or her right hand to use the volume knob as a swell pedal, creating organ-like effects. Although it is not known if he was directly influenced the guitar's design, Leo Fender would use the same positioning of the volume knob – for the same reason – on his 1954 Stratocaster guitar design, almost 20 years later. Yet another important addition to the Ken Roberts guitar was its incorporation of a Kauffman Vib-Rola vibrato tailpiece.

[22] Ibid. p. 45.

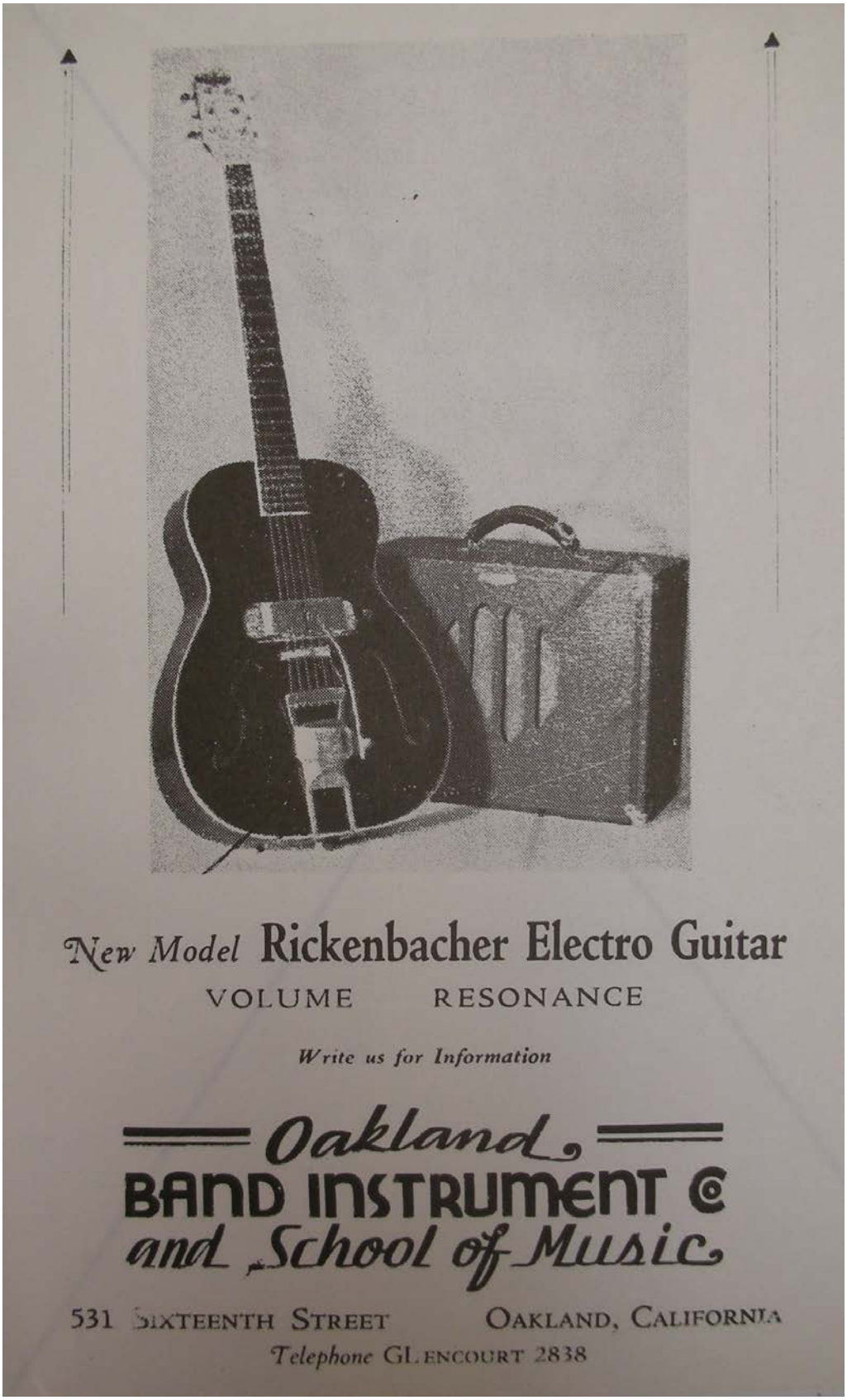

Figure 5.4 – Advertisement for Ken Roberts Model Guitar, 1935.

Artist Model Spanish Guitar

Almost nothing is known about Electro String's Artist Model Spanish Guitar. An inventory in the Rickenbacker archive from November 1936 lists two of these instrument's bodies (which, like all of Electro String's wood-bodied guitars of this time, were not made in-house) at a value of $19 each. In comparison, the same inventories show that the bodies for the Ken Roberts model had a value of $9.50.[23] Jesse Beauchamp, brother of George, states that Electro String used some arched-top guitar bodies from Gibson to fulfil some special orders around this time; it is possible that these are the guitars he is referring to.[24] However, photos exist of the headstock and body of an instrument that is more than likely an example of an Electro Artist Model (see figure 5.7), though this instrument was certainly not made by Gibson.[25]

Figure 5.5 – Probable Electro Artist Model Guitar, 1936.

Bakelite-Bodied Instruments

Model B Spanish Guitar

The model B Spanish guitar was offered in both six and four-string tenor versions. While the model B Spanish guitar is essentially the Spanish-style analogue to the Hawaiian-style model B guitar, there are many subtle, yet significant, differences in construction and design between the two. It is a common misconception that the model B Spanish was simply a model B Hawaiian with a different neck, but this is not the case;

[23] Rickenbacker Archives.
[24] Smith, *The History of Rickenbacker Guitars*. p. 46.
[25] The current whereabouts of this instrument are unknown.

the bodies and necks of the two instruments are not interchangeable. The model B Spanish has a 14 fret neck-to-body join (in contrast to the Hawaiian model's 12 fret neck-to-body join), which places the instrument's pickup much farther forward than on a Hawaiian model. Also, while the necks of the Bakelite Hawaiian instruments had the uppermost part of the fingerboard near the 24th fret slightly ground down to allow better access for the guitar steel, the Spanish model B's had these left intact. The Bakelite-bodied Spanish-style guitars made by Electro String did not have conventional inlaid metal frets, but rather had frets made from Bakelite that were moulded into the neck – the guitar's neck and frets were moulded as one piece. As can be imagined, the use of wound metal strings on the comparatively soft Bakelite frets did not wear very well and most surviving examples of these instruments show much damage to the frets. Interestingly, the factory appears to have been aware of this, as there are instruments known to have been shipped with tags that state that the Bakelite frets will wear as well as conventional nickel silver frets, but in the event they don't the company will be happy to supply a replacement neck of conventional construction for a nominal cost. A final, obscure detail of the design of the model B Spanish guitar is the placement of its volume knob; whilst the model B Hawaiian had a volume knob placed on the lower treble bout (which is the most common location for the volume knob electric guitars from then until the present day), many, if not most, of the earliest versions of Spanish-style model B, including the Vibrola, have the volume knob on the lower bass bout, right about the place where the player's forearm would rest while playing. It is not known why this is the case.

Figure 5.6 – Model B Spanish Guitar, 1937.

N.B. This instrument has the later style of volume knob placement.

Vibrola Spanish Guitar

This is almost certainly the most unusual design manufactured by Electro String during the 1930s, if not in the company's entire history. Essentially the Vibrola was a model B Spanish guitar with the addition of a motorised Kauffman Vib-rola (note different spelling). The motor and the pulleys for the mechanism were encased in a housing the same shape as the guitar that was attached to the back of the instrument. The additional hardware and housing employed on this instrument added a significant amount of weight to an already heavy instrument. The instrument's heaviness, combined with its relatively small size for a guitar, made the instrument somewhat cumbersome to hold and necessitated the use of a small stand, attached to the amplifier, to hold the instrument in playing position.[26] Although it was not a commercially successful instrument, several prominent Los Angeles-based studio musicians are known to have used them, including Perry Botkin, who endorsed the instrument. It has even been asserted that Les Paul used one at some point before World War II.[27]

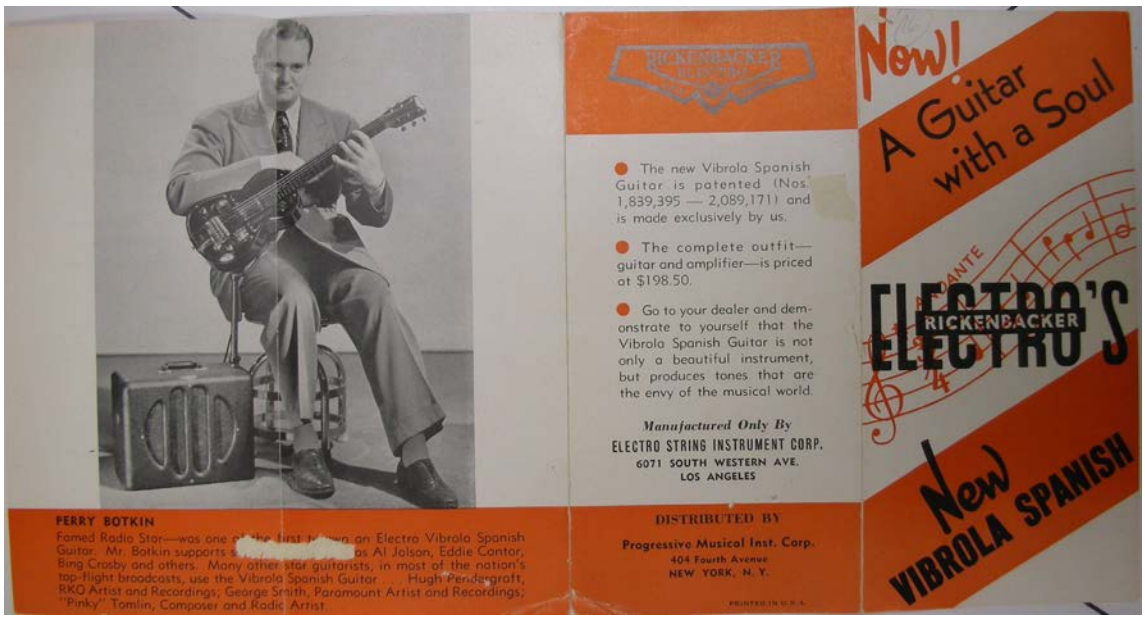

Figure 5.7 – Brochure for the Electro Vibrola Spanish Guitar, 1938.

[26] Stands of a similar configuration were sometimes used by guitarists in the mid-19th century for the same purpose.
[27] Smith, *The History of Rickenbacker Guitars*. p. 48. Les Paul's involvement with early electric guitars is discussed further in chapter 10.

Premiervox

Although little is known about them, it appears that Bakelite-bodied Rickenbacker guitars were marketed in Great Britain under the Premiervox brand during the mid-to-late 1930s (see figure 5.8). It is interesting to note that all of the known examples of the Premiervox instruments are Spanish-style guitars; no Hawaiian-style instruments are known to exist. This is in marked contrast to the American-made Rickenbacker instruments, the vast majority of which are Hawaiian-style. The reasons for this dichotomy are not known with certainty. Most likely the reason is that Hawaiian music, while certainly known in Britain during the 1930s, was not nearly as popular during this time as it was in the United States. It should also be noted that, while it is possible to easily convert one of the Spanish-style Bakelite instruments to Hawaiian-style playing, the reverse is not true. If it was actually made in Britain as opposed to being assembled from imported parts (and there appears to be no reason to doubt this), the Premiervox is almost certainly the first British-made electric guitar, solid body or otherwise.

Whilst here appears to be no direct evidence in the Rickenbacker archives linking the Premiervox to Electro String Instrument Corporation, due to the incomplete nature of the archives, this does not necessarily preclude the Premiervox from having an association with Electro String. Certainly, the design and construction of the Premiervox strongly suggests a Rickenbacker connection, if not outright manufacture. As shown previously, Adolph Rickenbacher had business contacts in England from which he obtained the right to manufacture musical instruments from Bakelite. Although there is no definitive proof, it is likely it was through these connections that the Premiervox instruments came to be made. Since there are very slight differences in the measurements and components of these instruments, the closeness, but not exact conformation, of these Premiervox guitars to the Rickenbacker Bakelite Spanish instruments suggest that these guitars were not made from imported bodies and pickups, as some have suggested, but were wholly-made in Britain.

Figure 5.8 – Premiervox Electric Spanish Guitar.

Collection of Graham Griffiths.

Henri Selmer Electric Spanish Guitar

A possible clue to the provenance of the Premiervox Bakelite Spanish-style guitars is provided by the existence of a very similar guitar branded with the name Henri Selmer & Co. and which gives a London address. This instrument, now in the private collection of Graham Griffiths (London, UK), appears to be extremely similar, if not identical to, the Premiervox instruments. Like the Premiervox, the Selmer instrument is

also a Spanish-style instrument with a round-sectioned neck. This possibly suggests that the Premiervox brand was associated with, if not actually distributed or manufactured by, Selmer. Interestingly, this instrument came in a case with a built-in amplifier – a feature that would famously be associated with certain models of Danelectro/Silvertone electric guitars marketed by Sears Roebuck & Co. some 30 years later.

Figure 5.9 – Henri Selmer & Co. Electric Spanish Guitar.

Collection of Graham Griffiths.

George Beauchamp's Design for an Electric Spanish Guitar with Vibrato

Although it was almost certainly never commercially made, in the Rickenbacker archives there is a patent-style drawing of a model B Spanish guitar with a unique vibrato mechanism (see figure 5.10). Although the drawing is undated, it lists Beauchamp (misspelled on the drawing as "Beachamp") as the inventor and William H. Maxwell as his attorney, and is in the same hand as the drawings in Beauchamp's 1937 frying pan patent (see appendix 2) which makes it likely that the drawing dates from 1937 to 1940, the date of Beauchamp leaving Rickenbacker. There are strong organological and mechanical similarities between Beauchamp's vibrato design and the

guitar vibrato mechanism designed and popularised by Paul Bigsby over 15 years later. Although the drawings for Beauchamp's vibrato are of the type required by the US patent office, it is unknown if Beauchamp actually saw the patent process of his design to the finish. There appears to be no such patent under his name. If Beauchamp had successfully patented his vibrato, it would provide an explanation as to why Bigsby's vibrato patent (US patent number D 169120) only covers its aesthetic design (which are indicated in the US patent system by a "D" prefix) and not its mechanical design.

It is interesting to compare Beauchamp's vibrato design with Doc Kauffman's Vib-Rola vibrato designed slightly more than 10 years earlier. Though Beauchamp's and Kauffman's vibrato were ostensibly similar, they worked in different ways and produced significantly different results. Unlike most modern guitar vibratos, the vibrato arm on the Kauffman Vib-Rola moved parallel with, rather than perpendicular to, the top of the guitar body. The mechanism on Kauffman's vibrato was designed to mimic the left-hand vibrato action of a Hawaiian guitar player's guitar steel. Depressing the lever on the Vib-Rola mechanism varies the pitch in such a way that the top three strings lower in pitch slightly, while the bottom three strings raise in pitch at the same time. Moving the lever in the opposite direction reverses this effect. In Beauchamp's design, depressing the lever (which moves perpendicular to the top of the guitar) lowers the pitch of all the strings simultaneously (although not completely uniformly – the de-tensioned strings sound somewhat out of tune in comparison to their fully-tensioned state). It is not fully clear from the drawing if it was possible to raise the pitch of the strings by pulling upwards on the tremolo arm. Beauchamp's vibrato, with its arm motion perpendicular to the guitar body and its uniform pitch change direction, is much more akin to modern electric guitar vibratos, and would have been capable of producing vibrato effects familiar to modern electric guitar players.

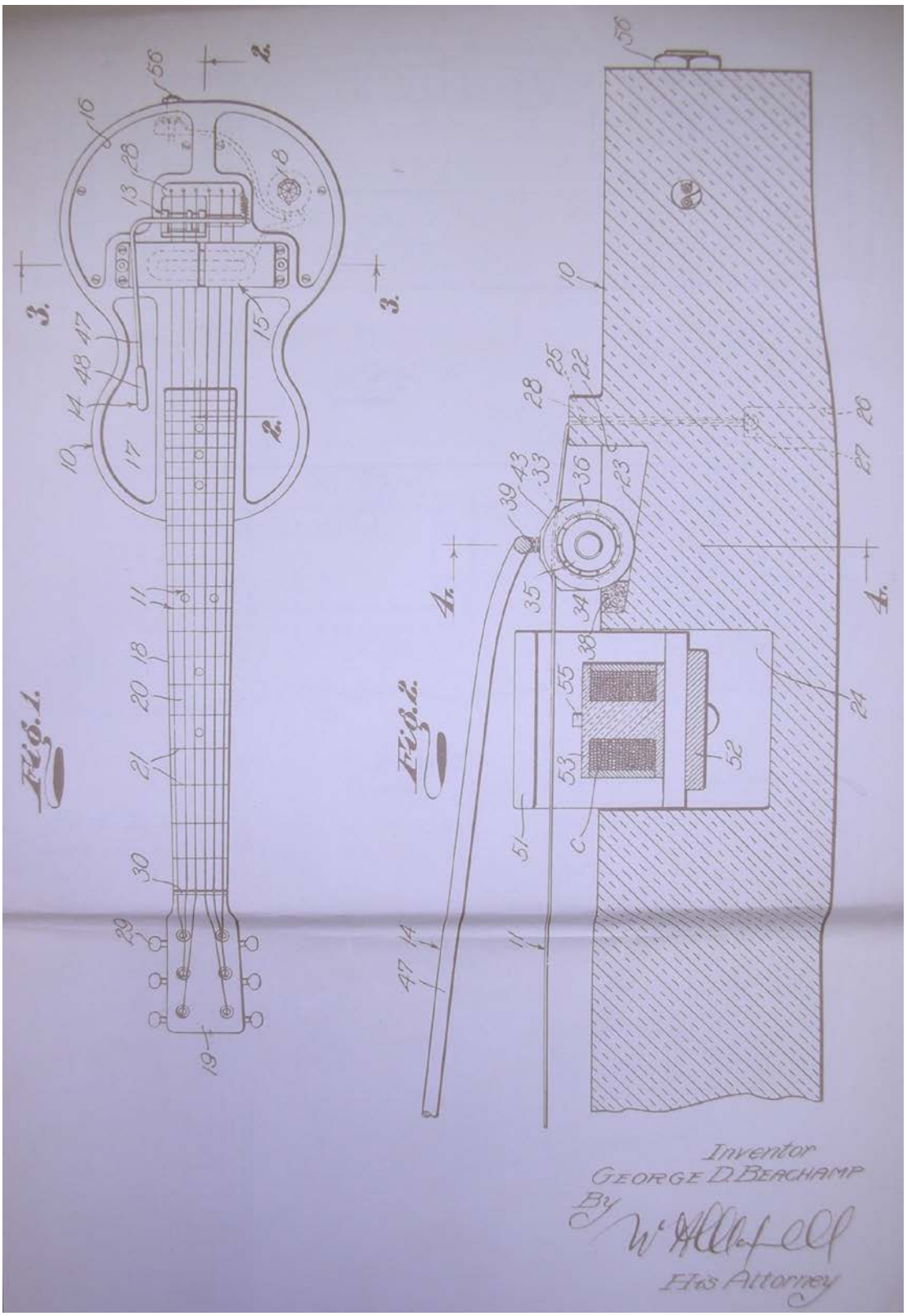

Figure 5.10 – Patent Drawing of George Beauchamp's Design for an Electric Spanish Guitar with Vibrato.

NON-GUITAR INSTRUMENTS OF THE RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

OUT OF THE FRYING PAN AND INTO THE ORCHESTRA

Although guitar-family instruments accounted for the vast majority of the company's output during the 1930s, from the very beginning Ro-Pat-In/Electro String experimented with violin-family and other orchestral instruments; the electric harp made for Harpo Marx (described below) was one of the earliest of the company's commissioned instruments and a mould for a prototype Bakelite violin is listed in an end of year inventory for 1934.

Whilst the conception (not to mention the physical realisation) of these electromagnetic pickup-enhanced orchestral instruments can seem somewhat strange to modern eyes, within the context of the times it made very good sense for electric instrument manufacturers to expand into this area. Although the Spanish-style and Hawaiian-style guitar were popular instruments, the number of guitar players in the 1930s paled in comparison to the number of violin family instrument players. It is easy to see why Electro String and other electric instrument manufacturers saw this as a huge potential market.

RICKENBACKER NON-GUITAR FAMILY INSTRUMENTS UP TO 1939

Violin Family Instruments

Bakelite Instruments

Violin, Viola, Violoncello

As noted earlier, a mould listed for prototype violin made of Bakelite is listed in Electro String' s 1934 end of year report.[1] It is unclear exactly when the company began to market these instruments but this was most likely in the first quarter of 1936; the May issue of the *Radio Journal* shows the Electro Bakelite violin for sale in an advertisement

[1] Rickenbacker Archives.

that also features the Bakelite model B electric Spanish guitar.[2] Although company documents suggest that a viola and violoncello model were developed as well, there is very little information on them and no examples are known to have survived.[3]

Although the pickup and electronic configuration was extremely similar to other Rickenbacker instruments of the time, the violin electronics mostly differing in the smaller size of its pickup, many other aspects of the Bakelite-bodied Electro violin are remarkable and unusual even by today's standards. The violin's body design differs from that of a traditional violin in almost every aspect. There is no scroll; the fingerboard abruptly ends at the top of the instrument (i.e. it is "headless") with a small protrusion with four holes in it which anchor the strings. The strings are tuned by conventional violin pegs which are mounted in a very unconventional position at the lower end of the instrument. There is no "body" to the instrument as such; the only parts of the violin that are not neck are a small extension at the bottom of the instrument which holds the tuning pegs, fine-tuning mechanisms, the bridge, the input jack and volume control knob, and the chin rest. A small aluminium strip of bent metal is attached to the neck at the point where the upper treble bout would be on a conventional violin, to give the player a physical reference point for playing. The pickup is mounted directly to the neck, with its coil hidden under a small plate. The horseshoe magnets of the pickup are mounted in line with each other, with the top prong of each magnet bent upward at the end to allow for the curvature of the fingerboard (see figure 6.1). From a playing standpoint, this placement and the horseshoe design of the pickup (which completely surrounded the strings) almost certainly interfered with the bowing of the instrument.

This economically ergonomic approach to musical instrument design – removing every part of the instrument not needed to make it function or to allow the player to hold it in proper playing position, and eschewing all decoration – was highly unusual for musical instruments of the time, even in an era known for its "streamlined" art deco design aesthetic.[4] This design bears some striking similarities – minimalist black-coloured body, high-tech materials, headless neck, tuning at the bottom of the instrument – to many of the important design features that would be found on the

[2] Ibid.
[3] The existence and possible use of the viola and cello are examined in chapter 8.
[4] Although some industrial designers of the Bauhaus school worked within a similar design aesthetic, it is not known if George Beauchamp was aware of these.

guitars and basses of the Steinberger Company almost 50 years later. It is not known if Ned Steinberger was influenced by the Bakelite-bodied Electro violin's design.

Figure 6.1 – Electro Violin (Bakelite version).

(Rickenbacker collection, JCH0002)

Cast Metal Instruments

Bass Viol

In 1936 Electro String introduced a double bass model (see figure 6.3), marketed under the name "Bass Viol" – the commonly used term for such instruments by American manufacturers for most of the 20th century. The instrument was made from a single piece of cast metal; it is not known for certain what material was used was but is possibly cast iron. The instrument featured an ebony fingerboard which, in common

with most American-made double basses of the time, had a Romberg bevel on the lowest (E) string.[5]

The electronics of the bass viol were of a similar configuration as the other violin-family instruments (and indeed most of the early Ro-Pat-In/Electro String output), having a horseshoe-style pickup with a single volume control. The bass viol's horseshoe pickup had two coils, one under each magnet with the horseshoe magnets mounted at an angle to each other (roughly following the arch of the fingerboard). It is noteworthy that the magnets on the bass viol were larger and thicker than those used on the aluminium-bodied frying pans and other guitar models, apparently made from the same type of bar steel stock as the horseshoe magnets on the original wooden-bodied Frying Pan prototype.

Figure 6.2 – The horseshoe pickup of the Electro Bass Viol (cast metal version with black crinkled finish).

(Rickenbacker collection, JCH0004)

[5] Developed by, and named after, the German cellist Bernhard Heinrich Romberg (November 13, 1767 – August 13, 1841), the Romberg bevel was originally applied to cellos to allow the overly thick C strings then used to vibrate more freely under arco playing. In the early 20th century it was almost universally adopted by American double bass manufacturers. Jazz players of the time (and later Rockabilly players as well) found that the Romberg bevel on the low E string greatly facilitated slap-style playing, creating a more percussive "snap".

The bass viol appears to have been made in two finishes. One was the standard aluminium-coloured Duco paint finish found on the aluminium-bodied frying pan, and the second was the black crinkled paint finish found on the stamped-metal cases of Electro String's amplifiers.[6] Although the instrument had a fully extendable end-pin, the amplifier for the double bass was designed to also function as a stand to hold the instrument in playing position, in a manner much like the amplifier for Doc Kauffman's Vibrola guitar (previously discussed in chapter 4). Not much is known about the electronic circuitry of the accompanying amplifier, but it is known that it featured a massive (for the time) 12 inch speaker, which was possibly adapted from a cinema amplification system.[7]

Figure 6.3 – Electro Bass Viol (cast metal version with black crinkle finish) and amplifier with built-in stand.

[6] This black crinkled finish was also found on some late examples of aluminium-bodied frying pans.
[7] 8 inch speakers were the standard size for the period.

Figure 6.4 – Electro Bass Viol (cast metal version with silver finish).

The T-shaped wooden attachment is an adjustable rest for allowing the player to hold the instrument in the correct playing position. The metal spike at the bottom the instrument extends to raise the bass to playing height when not using the amplifier as a stand.

Instruments With Aluminium-tube Construction

Violin, Viola, Violoncello, Bass Viol

Sometime during 1937 Electro String ceased making the Bakelite-bodied violins and the cast metal bass viol. A new quartet of violin-family instruments were introduced by the beginning of 1938 which were more conventional in appearance, "conventional" being a relative term. In comparison with the Bakelite violins, the second versions all had traditional scrolls with the standard configuration of tuning pegs. The violin and viola had the same style of chin rest found on traditional instruments. However, the appearance of these instruments is still quite striking – the bodies consist of a sectioned aluminium tube, on which the neck, pickup, electronics and other hardware are mounted. In contrast to other Rickenbacker horseshoe pickups, the placement of the magnets on the violin and viola were changed to an angled chevron-like configuration, most likely to help solve the bowing problems found on the Bakelite versions of the violin.

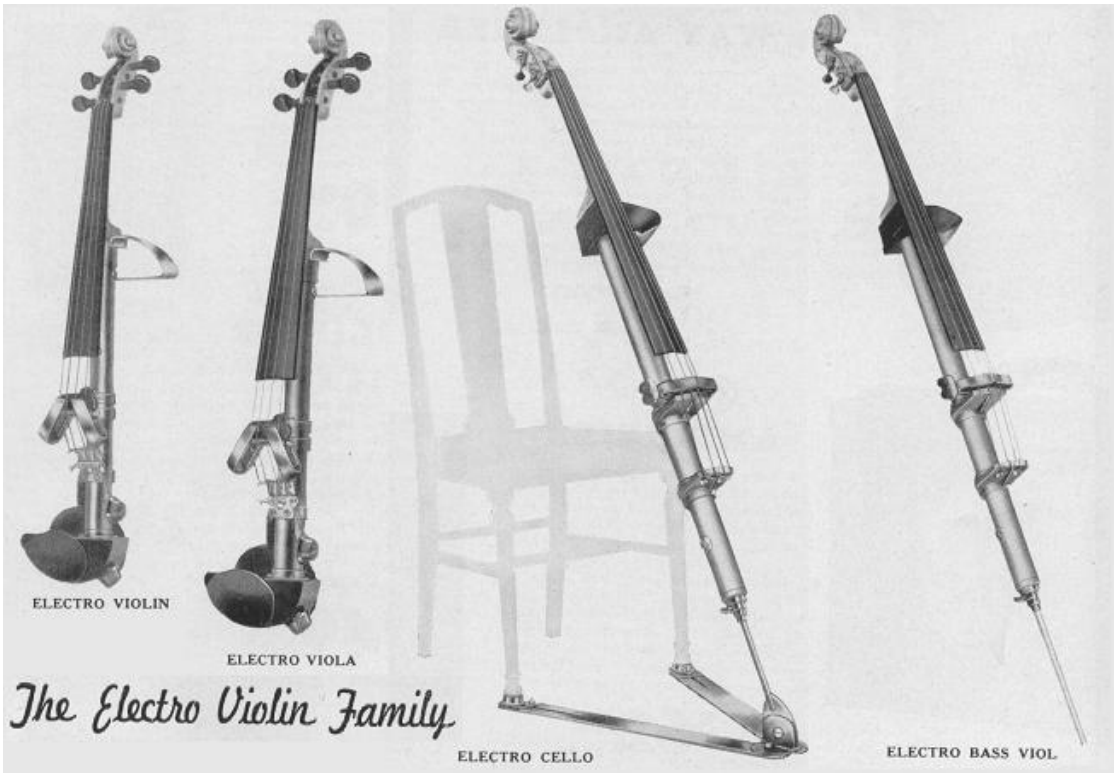

Figure 6.5 – Advertisement for the Aluminium-Bodied Versions of Electro String's Violin Family Instruments, 1938.

It is not known with any certainty why Electro String changed the designs of their violin-family instruments. It is tempting to conjecture, however, that it was an attempt by the company to make their instruments appear more traditional aesthetically, thus broadening their appeal to conservative-minded musicians. In addition, the minimalist design of the second version, with the utilisation of standard violin parts, would have been much more economical to manufacture.

Figure 6.6 – Electro Violin (aluminium version).

(Rickenbacker collection, JCH0003)

OTHER RICKENBACKER INSTRUMENTS UP TO 1939

Mandolin

Introduced sometime in 1934, the Electro mandolin was essentially electrically identical to the wood-bodied Electro Spanish and Ken Roberts model guitars. Made from bodies sourced from the Harmony Company (as were all other early wood-bodied Electro instruments), there are some variances between individual instruments, most likely reflecting the fact that the company did not make many of these and used whatever bodies were available from Harmony at the time. In the late 1950s, Electro String would again make a mandolin model, this time as a solid-body instrument.

Figure 6.7 –Electro Mandolin, mid-1930s.

Fretted Double Bass

Sometime during the early to mid 1930s Electro String created a four stringed bass instrument based on an Eastern European *berda*, a bass instrument used in tamburica music (see figures 6.8 and 6.9). Rickenbacker was not the only company at the time to make *berda*-based bass instruments; Regal marketed a similar bass instrument in the mid 1930s, which was aimed at guitar players who wished to easily pick up a

double bass-style instrument. The Dobro Company is also known to have made at least one similar instrument during the mid 1930s, which was possibly electric as well.[8] This instrument was used by, and probably made specifically for, the Hawaiian band, "The Imperial Hawaiians", led by steel guitar player Al Burghardt and featuring his wife Betty Kahau as a dancer and ukulele player. "The Imperial Hawaiians" were active on the East coast during the late 1930s and are known to have played at least one season at the Steel Pier in Atlantic City, New Jersey, which was an important venue for Hawaiian musicians at the time.[9]

Figure 6.8 – The Imperial Hawaiians, 1939.

Photograph from the *Steel Guitar Progress*, Winter 1939-40. The berda-type fretted bass instrument being played second from the left is almost certainly the same instrument depicted in Figure 6.9. Al Burkhart (far right) is playing a Rickenbacher Silver Hawaiian model guitar. Next to him is a guitar which is possibly an Electro Electric Spanish model. In the centre, playing ukulele, is Burkhart's wife, Betty Kahau.

[8] While the current whereabouts are unknown, this instrument was personally known to the author; for many years it was displayed in various music stores on Sunset Boulevard in Los Angeles, California. The instrument was missing its original resonator mechanism, but due to the size of the mounting hole in the top of the instrument, it is extremely likely that this instrument was electric and originally equipped with the same style of 1935 Dobro pickup described in chapter 10.

[9] Al Burghardt, "Al Burghardt Says," *Steel Guitar Progress*, Winter 1939-1940. p. 10. More on the role of the Atlantic City Steel Pier in promulgating electric stringed instruments is given in chapter 8.

The Electro String fretted bass has a scroll and neck similar to that of a cello, with cello-style tuning pegs rather than double bass-style machine heads. Unlike a double bass, the neck is fretted, and has neck-to-body join at the very unusual juncture of the 8th fret. The instrument has a rather guitarlike construction, having a flat back and, unusually, a flat soundboard with a round sound hole rather than the F holes typical of the double bass.[10] Although the instrument has a flat guitar-style soundboard, the instrument has a profile of a typical viol-shaped double bass. It is significant that, although it is unknown what the factory actually called this instrument (since it was never officially marketed), with its viol-shaped outline and fretted neck, it is much more deserving of the name "bass viol" than the instrument that Electro String sold under that name. The body of the instrument is somewhat smaller than a modern three-quarter size double bass, being slightly larger than a cello. The body of the fretted double bass, like all other wooden instruments made by Ro-Pat-In/Electro String, was almost certainly not made in-house, but instead bought from an outside supplier, most likely the Harmony Company. The electronics of the instrument appeared to be the same as that on other early Ro-Pat-In/Electro String instruments; a horseshoe-style pickup controlled by a single volume knob located slightly below and to the right of the pickup. It is not known how, or if, the pickup and/or electronics of this instrument were configured for bass audio response. It is also not known what amplifier this instrument was intended to be used with.

The path of how an Eastern European bass stringed instrument ended up being played in an electrified form by a Hawaiian musician in New Jersey is not clear. However, instruments of this type appear to have been favoured by Hawaiian groups on the East Coast. Whilst Hawaiian ensembles of the early 20th century could be fairly large, they were almost always composed entirely of singers and accompanied by a very small number of musicians on ukulele and steel guitar.[11] On the West Coast, the most common configuration for a Hawaiian ensemble was the trio, often consisting of steel (Hawaiian-style) guitar, Spanish-style guitar, and ukulele. In the large nightclubs and other venues on the East Coast, however, larger groups appear to have been the norm

[10] Although the configuration of the *berda* was far from standardised, a body of this type was not uncommon at the time.
[11] "Hawaii; a Primer: Special Panama Pacific International Exposition Edition," ed. Paradise of the Pacific Press (Honolulu, 1914).

and very often employed a musician playing a bass instrument, possibly to conform more closely with the standard instrumentation of a dance band.

Figure 6.9 – Electro Fretted Double Bass.

This instrument is currently displayed at the Museum of Making Music in Carlsbad, California.

Not much is known about the Imperial Hawaiians; besides their appearances at the Steel Pier, a late 1930s Camden, New Jersey, newspaper advertisement/article mentions them as playing at the Ha-Del Cafe in South Merchantville.[12] A newspaper article from 1949 shows Al Burghardt and his wife Betty Kahau playing at a party at a Chinese restaurant in St Petersburg, Florida.[13]

Harpo Marx's Electric Harp

One of the most intriguing instruments made by Electro String was also most likely their first non-guitar creation; an electric harp commissioned by the famous comedian and harpist Harpo Marx. A company ledger shows that $200 was taken in payment from Marx in early January, 1933. It is not clear, however, whether this was payment in full for the instrument. Although Harpo seems to have typically played Lyon and Healy instruments, being particularly associated with the Lyon and Healy model 23, as well as the Lyon and Healy model 17, the harp used as a foundation of this instrument was a modified Wurlitzer "Starke Model" model G pedal harp.[14] The Wurlitzer company began making orchestral harps in 1909,[15] advertising them as "the costliest harp in the world".[16] The serial number on this instrument, no. 1380, indicates that it was not new at the time of its conversion (a serial number from late 1930 would have been in the mid 1500s) but most likely from the mid to late 1920s.[17] The 1924 Wurlitzer catalogue shows the model G as the company's smallest (both in number of strings and in string length) and least expensive concert-size offering,[18] at $850 being approximately half of the cost of the most expensive of Wurlitzer's 45-string orchestra-size models (the company also offered 46 and 47 stringed instruments). Whilst these were commercially successful during the 1910s and 1920s, Wurlitzer's harp making operation fell victim to the depression, with the last instruments produced around 1933.

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[12] Philip A. Glass, "Making the Rounds," *Camden Courier-Post*, February 12 1938.
[13] "Our Town Today," *The Evening Independent*, April 25 1949.
[14] Emil O. Starke, a former employee of Lyon and Healy, was director of harp manufacturing for Wurlitzer. N.B. this particular instrument appears to have non-standard decoration on its column, possibly from a Wurlitzer model I harp.
[15] The Wurlitzer Company had previously made two models of coin-operated self playing harps. Curiously, these instruments seem to have had their greatest commercial success in the bars and brothels of San Francisco during the 1910s due to a local ordinance that outlawed player pianos.
[16] Mark Palkovic, "The Harps of the Rudolph Wurlitzer Company," *American Harp Journal* (1986).
[17] Ibid.Wurlitzer is known to have made a total of approximately 1500 harps. The earliest instruments had no serial numbers and instrument serial numbers appear to have begun with the number 500.
[18] Wurlitzer offered one smaller-sized instrument, the 43 stringed model I.

Wurlitzer harps were well-regarded in their day (and on a par with rivals Lyon and Healy) and restored examples continue to be used by professional harpists.

Figure 6.10 – 1933 Electro/Wurlitzer Model G Harp made for Harpo Marx (with soundboard/cover removed).

It is not known if Ro-Pat-In purchased this harp or acquired it from Harpo Marx for conversion. Since the cost of the instrument new before modification was over $850, it is somewhat unlikely the $200 paid by Marx to Electro String covered the cost of the donor instrument. The soundboard and internal bracing of the instrument were removed, so that the sound box of the harp became a cavity for containing the electronics. This cavity was covered by two wooden plates which mimicked the appearance of the harp's original soundboard, and in fact may have been repurposed from that soundboard. The electronics of the harp were simple, yet massive; each of the 45 strings of the instrument had its own individual pole piece, with two pole pieces to a

pickup – 23 pickups in all (the pickup for the highest string having one pole piece only). These pickups were wired to a single volume control, which then went to a quarter inch output jack – both mounted on the right hand side of the instrument and operated by the player's right hand. The harp was amplified by the same amplifier that Ro-Pat-In sold for use with its frying pan guitars.

Whilst it is known that the harp was made, since pictures of the completed instrument exist, is not known if Harpo Marx ever actually took delivery of the harp. It was certainly not in his possession when he died in 1964; his 1959 will makes no mention of it, yet there are references in the document to several other harps, one of which was given to the state of Israel.[19] It is not clear how Harpo Marx came to order the instrument, but it is known that George Beauchamp had connections within the motion picture industry. Interestingly, former Beauchamp partner-turned-rival John Dopyera patented a harp design in 1930, based on his tri-cone resonator guitars, (US patent no.175 0881).[20]

Electric Piano

At some time in the early 1930s Electro String made a prototype of an electric piano. It appears to have been mentioned in an early brochure which said to "watch for announcements" about it.[21] Other than the fact that it evidently sat in the front office at the factory at 6071 Western Avenue for a number of years, almost nothing is known about this instrument.[22] The existing 1930s end of year accounts and inventories for Ro-Pat-In/Electro String make no mention of the instrument, or any purchases, such as piano actions, which can be directly tied to the development of such an instrument. It is not known what the fate of this electric piano was; later company records do not indicate if this instrument was in the possession of Electro String at the time of its sale to F. C. Hall in late 1953.

[19] Will of Adolph (later changed to Arthur) "Harpo" Marx, (November 23, 1888 – September 28, 1964), Will dated 1959 with codicils added in 1961 and 1963. Probate court, County of Riverside, California
[20] It is likely that Dopyera's design was never commercially produced. Smith, *The History of Rickenbacker Guitars*. p. 26.
[21] Ibid. p. 56.
[22] Ibid. p. 56.

PATENTING THE HORSESHOE PICKUP

The process of patenting a new invention is rarely straightforward, but the case of George Beauchamp's patenting of the electric guitar/electromagnetic pickup seems to have been particularly fraught with setbacks and difficulties. Beauchamp was no stranger to the patenting process; while at National Stringed Instrument Corporation he patented both a single-cone resonator guitar and a design for a metal finger pick. While the process of patenting the horseshoe pickup was ongoing, he would also patent two versions of an electric violin, an electric bass viol, and possibly a design for a vibrato tailpiece. Although Beauchamp's patent application was for an entire "electrical stringed musical instrument", the most significant part of the patent was the design for the electromagnetic pickup, and this is where most of the contention and difficulty in obtaining the patent was encountered.

To understand Beauchamp's, and Electro String's, difficulty in patenting the electric guitar, it is helpful to examine the reasoning behind the patent process in the United States. In United States patent law, a potential patent must meet the following criteria:

- It must be patentable, regarding which, the US patent code (Section 101 of Title 35 U.S.C.) states: "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."
- It must be novel or represent "new art": one or more characteristics of it must be new.
- It must be non-obvious: that is to say there should be a demonstrable inventive aspect to the patent.

- It must be useful: this is typically defined as the patented item having the capability of being used – in other words, it should actually work.[1]

The concepts of "new art" and "novelty" are key when considering the patent process. "New art" refers to an invention that is entirely new and does not build upon previous inventions or technologies. As can be imagined this is extremely rare, if not completely unheard-of, as almost all inventions are built upon "prior art", that is to say, previously known technology. Beauchamp's design is based on the idea of a vibrating medium in an electro-magnetic field creating an electrical signal. This description could also cover Alexander Graham Bell's 1876 telephone patent. Therefore, following this line of logic, to the United States Patent Office, the two devices were essentially the same, with the electric guitar simply substituting a metal string for a telephone diaphragm.[2]

THE FIRST PATENT ATTEMPT

Beauchamp's first patent application for the electric guitar, serial number 615995, was filed on June 8, 1932. This was approximately 3 months before the first instruments were made by Ro-Pat-In in August of that year. The patent application was filed by Arthur F. Larrabee, who had handled Beauchamp's previous patent applications for a design for a metal finger pick and for the single-cone resonator guitar design (discussed in chapter 2) at National Stringed Instrument Corporation. It is noteworthy that Larrabee's law offices, at 416 8th Avenue (Suite 401) in downtown Los Angeles, were only a block and a half from Broadway, which at the time was the heart of the music business district.

Very little documentary evidence of the first patent attempt survives in the Rickenbacker archives in comparison to the second, successful patent attempt (which was handled by William H. Maxwell), but there is at least one extant document which illustrates the difficulties faced by Beauchamp in this first effort. This is a letter from Larrabee to Beauchamp dated December 6, 1933, in which Larrabee discusses the latest amended claims of Beauchamp's patent attempt.[3] This letter appears to represent the seventh such amendment to the claims since the patent was filed. At this point in the

[1] The reasoning behind this requirement is to prevent the patenting of items that are purely theoretical or fantastical, such as perpetual motion machines.
[2] Richard Smith notes the same idea. Smith, *The History of Rickenbacker Guitars*. p. 17.
[3] Rickenbacker Archives.

application process, Beauchamp's patent's biggest difficulty seems to have been its overbroad claims; much of Larrabee's missive is concerned with restricting and redefining Beauchamp's claims in much more precise and limited terms. This is not surprising, since the basic electrical principle behind Beauchamp's invention – that any ferrous material vibrating within a magnetic field is capable of generating an electrical signal – was well known and hardly unique to Beauchamp.[4] Larrabee seems to have attempted to establish the novelty of Beauchamp's design by emphasising the non-resonant body it employed. Larrabee ends the letter by stating his belief that the patent application is now ready for successful submission. It is clear that this was not the case since the next attorneys' letter to Beauchamp regarding the patent office's response to the application is from new patent attorney William H Maxwell. Maxwell, like Larrabee, also attempted to establish novelty by more precisely defining Beauchamp's invention, but unlike Larrabee, Maxwell focused on the placement of the strings in Beauchamp's pickup design. It is clear, however, that this new tack was also unsuccessful and so Maxwell, rather than continuing the prosecution, started afresh; a new application, serial number 728717, was filed by Maxwell on June 2, 1934.

THE SECOND PATENT ATTEMPT

Maxwell appears to have been much more thorough and aggressive in the prosecution[5] of the Beauchamp patent than was Larrabee. It is possible that the one of the reasons Beauchamp changed attorneys from Larrabee to Maxwell is that Maxwell was much more prominent and "high-powered" than Larrabee. Maxwell's offices certainly suggested an extremely high status; during the time that Maxwell represented Beauchamp and Electro String in the 1930s, he had offices in three different high-status locations, each one more impressive than the last. The first, suite number 804 in the I. N. Van Nuys Building on the corner of 7th and Spring, within a more upscale area of downtown in comparison to Larrabee's offices. Maxwell's next office, at 555 Flower Street, Suite 830, was a significant step up; it was in the Richfield Building, the headquarters of the Atlantic Richfield Oil Corporation. Built in 1928 and demolished in 1968, the Richfield Building was a striking example of the art deco style, having an

[4] N.B., the significant aspect of Beauchamp's design was its configuration – using the string as the direct vibration source – and its application to a fretted stringed instrument.
[5] "Prosecution" is the term used in the United States for the part of the patent application process involving the interaction of a patent attorney with the patent office. The term should not be confused with patent litigation.

exterior festooned with black and gold terracotta tiles. The combination of black and gold was meant to be a visual pun on the company's product; oil, which was often known colloquially in the American Southwest as "black gold". To drive home the oil analogy even further the building was topped with a huge tower in the shape of an oil well which spelt out the company's name. At night, beams of light would shine from the top of this tower in the manner of an oil gusher.

Figure 7.1 – Postcard of the Richfield Building, Los Angeles, 1928.

Maxwell's third address was yet even more prestigious; the Rowan Building, on the corner of 5th and Spring Streets. While the Rowan Building was older (1911) and not as haute couture as the Richfield Tower, it represented the pinnacle of status in the Los Angeles legal profession at the time, as it was home to many of the city's oldest and most established "white shoe" law firms.[6] When Maxwell's firm moved into the building in 1937, it was noteworthy enough for there to be a reception to celebrate the event, to which the upper management at Electro String were invited.[7]

One of the difficulties that Maxwell faced in prosecuting the Beauchamp patent was that the department of the patent office handling the application (inventions in different fields were handled by specialised departments) was changed in the middle the process. This meant Maxwell had not only to completely restate his case to a new patent examiner, but to do so within a department with entirely different standards and criteria concerning patentability and prior art, and this after already having re-filed the application and starting the process from the beginning. To complicate matters further, the new patent examiner appears to have completely disallowed the previous prior art search for the application, and filed an action concerning Beauchamp's application shortly before Maxwell was to meet with the examiner to review Beauchamp's case. Not only was the new action a surprise for Maxwell, it genuinely threatened to permanently derail the patent application. Maxwell expressed his frustration with the situation and lays the blame firmly on the patent office in a letter to Beauchamp dated June 20, 1936:

> The new action that has been made by the Examiner cites six new references, one of which is a British patent and, in effect, the office action opens up the entire case for amendment just as though it had not been acted upon or prosecuted at all in the past. I regret very much that the office should have acted upon the case in this manner, as it puts us to a great deal of work and expense that should have been avoided. It is the practice in custom of the Patent Office to cite the entire body of pertinent prior art patents against an application upon the first action, in order to allow the applicant to fairly consider the merits of his application and the merits of the references. As you will note we have had actions in this case and have had a considerable number of prior art patents cited by the Examiner. I have in the past very carefully analysed the prior art which was cited and spend *(sic)* a great deal of time preparing the amendment which was filed January 21, 1936. If the Patent Office had given us a fair and complete action the amendment that I filed should have put the application in condition for final allowance.
>
> One reason for the manner in which the application has been handled is due to the fact that it has been transferred from one division to another, and the Examiner that now has it has made a search in addition to the one originally made and has dug up a new group of patents which he considers pertinent.

[6] http://www.rowan-lofts.com/history.html. Accessed 17/6/2012.
[7] This invitation is preserved in Rickenbacker's archives. Rickenbacker Archives.

> I have not made a careful study of the new prior art that has been cited but if the maximum protection is to be gained through this application these references should be carefully analysed and the entire body of claims in the case should be reviewed and amended in light of the references and a new argument presented. All this will take considerable time if done properly as it will be practically a repetition of the review of the case that was made, prior to the amendment of January. I realise that this may appear to you to be an unjust burden upon you. However, I want you to understand that it is a matter over which I had no control and the work that is now to be done is due mainly to the body of new prior art that has been cited by the Patent Office.
>
> From enquiries that I have made while in Washington I found that the division having charge of the application at this time is strict in the manner of allowing claims and it is very likely that the type of claims that I presented are much broader than the patent *(sic)* Office will allow. It is possible that by materially reducing the scope of the claims presented a favourable action can be obtained. I want you to understand that I have been prosecuting this application not with a view of obtaining just a patent for you, but with a view of obtaining the broadest possible claims in order to get maximum protection. If you wish me to cut the prosecution of this application short I can reduce the scope of the claims and materially reduce the work necessary in further prosecution. I do not wish to do this, however, without an instruction from you and without your having a full knowledge of the circumstances of the case.[8]

Although there does not appear to be a reply from Beauchamp to Maxwell's letter in the Rickenbacker archives, it is clear that Beauchamp and Electro String decided to pursue Maxwell's recommendation for fully re-prosecuting the application, which of course, ultimately prevailed some months later.

PROVING IT WORKED

Another difficulty Beauchamp had in obtaining his patent was that, apparently, the US patent examiner assigned to the application did not believe that the electric guitar actually worked, which as noted above, is a necessary condition for the granting of a United States patent. It should be remembered that, at the time of the filing of the second patent application, the frying pan had been on the market (and presumably working as claimed) for close to two years.

One of the better known anecdotes regarding the early electric guitar[9] is that, in order to prove that it actually worked, Electro String sent famous Hawaiian-style guitarist Sol Hoopii to Washington DC to play for the Examiner.[10] Whilst the truth of this is slightly less dramatic, it is no less strange, and vividly demonstrates the type of hurdles Maxwell had to overcome in obtaining Beauchamp's patent. In actuality, there were two demonstrations in Washington DC for the patent examiners some months

[8] Ibid.
[9] If any anecdote regarding the early electric guitar could be said to be well known.
[10] Smith, *The History of Rickenbacker Guitars*. p. 18.

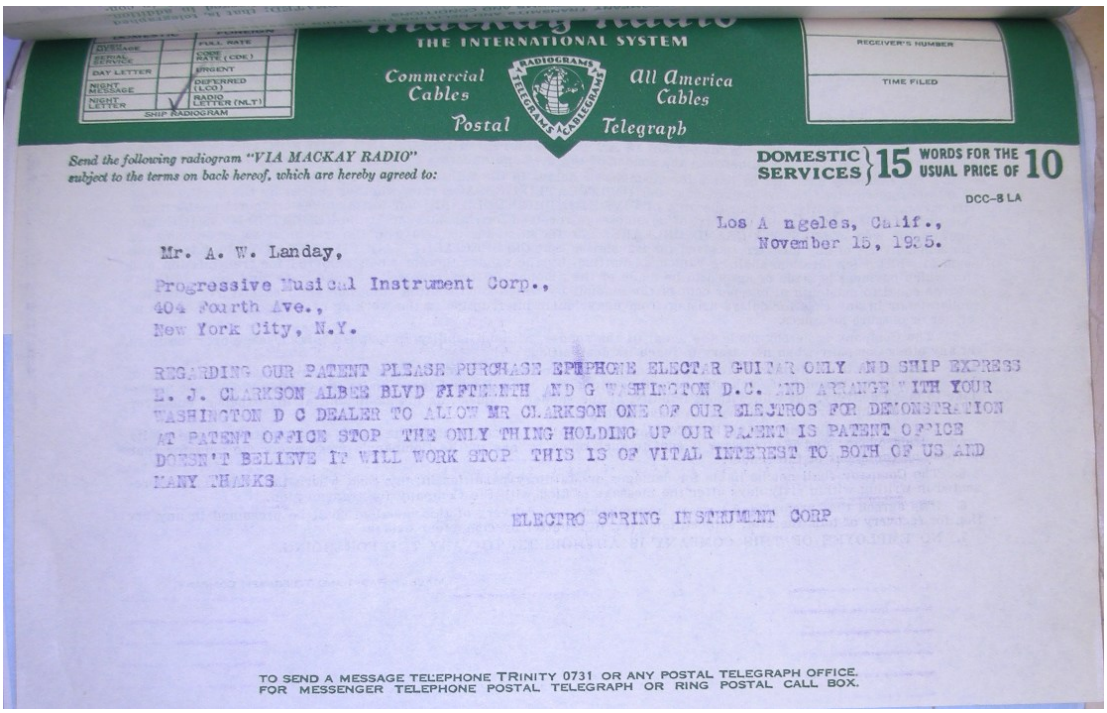
apart. The first occurred in the spring of 1935 and the musician making the demonstration was possibly William H. Maxwell himself:

> … you will recall that we played the instrument that I had with me at that time and demonstrated the instrument to the Examiner handling the case. The Examiner and Chief Clerk, Mr. Brearley, were both very much impressed with the instrument which, by the way, we had to demonstrate down in the basement. Following the demonstration, I had a long interview with the Examiner, at which time he agreed to allow claims such as I discussed with them and such as I later embodied in the amendment which was filed in the case. The Examiner, instead of acting favourably on the claims that he agreed to allow, transferred the application to another Division and you will note that the action now at hand, being the first action by the new Examiner, indicates that the Examiner questions the operativeness of the instrument.[11]

As previously noted, the reasons for the change of examiner in the Beauchamp patent are unclear but it is extremely unlikely that it was as a result of Maxwell's musicianship or lack thereof. In November 1935 the application process appears to have stalled yet again and Electro String believed that another presentation for the patent examiner would be beneficial. This performance was somewhat more elaborate; not only was it arranged to demonstrate one of the Electro String Instrument Corporation's Hawaiian guitars, the company also sent a telegram (see figure 7.2) to the company's New York-based jobber, Progressive Musical Instrument Corporation, instructing them to purchase an Epiphone "Electar" Hawaiian guitar to demonstrate as well. The reasoning behind the purchase of the Epiphone was to demonstrate to the examiner that Beauchamp's design not only worked, but worked so well that it was being copied by other manufacturers; the pickup design of the Epiphone Electar was extremely similar to Beauchamp's horseshoe design.[12] In addition to purchasing an additional instrument, Electro String hired a professional musician to demonstrate the instruments, as it was felt that a professional performance would be more likely to favourably impress the examiner. It is not known who this professional musician was, but it was almost certainly not Sol Hoopii, since a telegram dated November 20, 1935 (see figure 7.3), from Electro String to the company's New York-based jobber, Progressive Musical Instrument Corporation, gives instructions to hire a Hawaiian-style guitar player (presumably a local one).

[11] Rickenbacker Archives. Letter from William H. Maxwell to E.J. Clarkson, Washington DC dated November 21, 1935.

[12] This was so much the case that non-experts often have difficulty telling them apart when not installed in an instrument. Epiphone's instruments are discussed further in chapter 10.



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Send the following radiogram "VIA MACKAY RADIO" subject to the terms on back hereof, which are hereby agreed to:

DOMESTIC SERVICES 15 WORDS FOR THE USUAL PRICE OF 10

DCC-8 LA

Los A ngeles, Calif.,
November 15, 1935.

Mr. A. W. Landay,

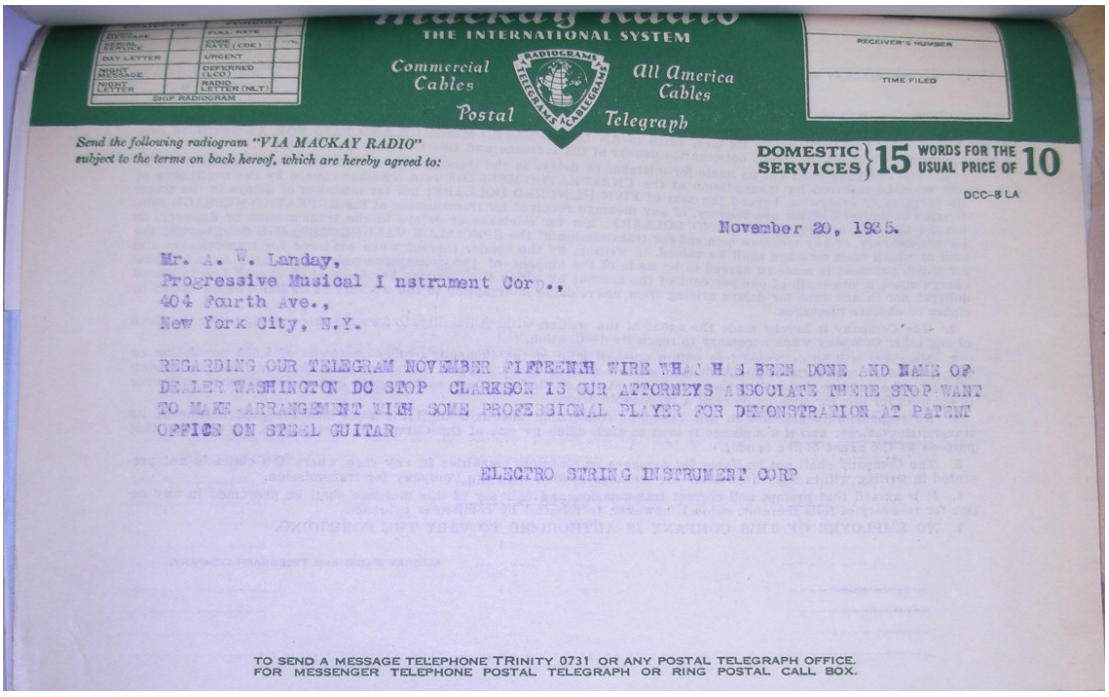
Progressive Musical Instrument Corp.,
404 Fourth Ave.,
New York City, N.Y.

REGARDING OUR PATENT PLEASE PURCHASE EPIPHONE ELECTAR GUITAR ONLY AND SHIP EXPRESS H. J. CLARKSON ALBEE BLVD FIFTEENTH AND G WASHINGTON D.C. AND ARRANGE WITH YOUR WASHINGTON D C DEALER TO ALLOW MR CLARKSON ONE OF OUR ELEJTROS FOR DEMONSTRATION AT PATENT OFFICE STOP THE ONLY THING HOLDING UP OUR PATENT IS PATENT OFFICE DOESN'T BELIEVE IT WILL WORK STOP THIS IS OF VITAL INTEREST TO BOTH OF US AND MANY THANKS

ELECTRO STRING INSTRUMENT CORP

TO SEND A MESSAGE TELEPHONE TRINITY 0731 OR ANY POSTAL TELEGRAPH OFFICE.
FOR MESSENGER TELEPHONE POSTAL TELEGRAPH OR RING POSTAL CALL BOX.

Figure 7.2 – Telegram from Electro String authorising the purchase of an Epiphone electric Hawaiian guitar for its upcoming patent demonstration.



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Send the following radiogram "VIA MACKAY RADIO" subject to the terms on back hereof, which are hereby agreed to:

DOMESTIC SERVICES 15 WORDS FOR THE USUAL PRICE OF 10

DCC-8 LA

November 20, 1935.

Mr. A. W. Landay,
Progressive Musical I nstrument Corp.,
404 Fourth Ave.,
New York City, N.Y.

REGARDING OUR TELEGRAM NOVEMBER FIFTEENTH WIRE WHAT HAS BEEN DONE AND NAME OF DEALER WASHINGTON DC STOP CLARKSON IS OUR ATTORNEYS ASSOCIATE THERE STOP WANT TO MAKE ARRANGEMENT WITH SOME PROFESSIONAL PLAYER FOR DEMONSTRATION AT PATENT OFFICE ON STEEL GUITAR

ELECTRO STRING INSTRUMENT CORP

TO SEND A MESSAGE TELEPHONE TRINITY 0731 OR ANY POSTAL TELEGRAPH OFFICE.
FOR MESSENGER TELEPHONE POSTAL TELEGRAPH OR RING POSTAL CALL BOX.

Figure 7.3 – Telegram from Electro String authorising the hire of a Hawaiian guitar player for its upcoming patent demonstration.

Yet this second personal performance for the patent examiner was not enough; Maxwell also hired to scientists from an independent laboratory to state in signed affidavits that the electric guitar did in fact work. These affidavits by D. P Loye, E. W. Templin and the somewhat ironically named H.C. Silent state that on January 15, 1936 they witnessed the demonstration of Beauchamp's electric guitar at the laboratories of Electrical Research Products, Inc. at 7026 Santa Monica Boulevard, Los Angeles, California. In his affidavit, Templin noted that the instrument was fully electrical and non-acoustic in nature;

> …upon every plucking of the string with the instrument connected with the amplifier, musical tones as above-mentioned came from the amplifier; that when the instrument mentioned was disconnected from the amplifier and the strings thereof plucked, the tones given off were only those radiating directly from the instrument, and were weak, being substantially softer and weaker than the tones ordinarily given off by an ordinary stringed musical instrument…[13]

This affidavit appears to have been satisfactory proof to the patented examiner as far as the utility of Beauchamp's invention was concerned. However, Maxwell's and Beauchamp's problems with the application were still not over. It appears there was still some delay on the part of the patent office in approving the application, and Electro String was very aware of the damage that these delays were causing to its business. Maxwell complained about the delay in an August 25, 1936, letter to the patent examiner in which he states:

> The careless piecemeal actions on the part of the Patent Office in connection with this application are causing the applicant great and irreparable damage. The applicant, through a licensee, placed his invention upon the market several years ago and at that time, as far as he is aware, he was the first to introduce an electrical amplifying stringed musical instrument to the trade. From time to time since applicant's (sic) invention appeared on the market various competitors have introduced similar imitating devices until today there are in the neighbourhood of twenty competing devices on the market, some six or eight of which are being manufactured and distributed by concerns doing nation wide (sic) business.
>
> ...it appears futile to continue prosecuting the application in the manner that it has been prosecuted heretofore. In light of the considerations just outlined applicant requests that the Examiner give this application prompt consideration and that the next action be either a final allowance or a final rejection.[14]

Although it took another year to do so, the United States Patent Office eventually relented, granting Beauchamp and Electro String Instrument Corporation patent number 2,089,171 on August 10, 1937. Whilst a patent application is by its very nature a difficult and lengthy process, George Beauchamp's difficulties in obtaining US

[13] Rickenbacker Archives.
[14] Ibid.

patent number 2,089,171 appear to have been particularly convoluted and time-consuming. It is tempting to speculate that this difficulty with the legal process of patenting the electric guitar would later influence and colour Electro String's initially aggressive and subsequently laissez-faire attitude regarding litigation in defending its patents against competitors.

BRINGING ELECTRIC INSTRUMENTS TO MARKET

From the vantage point of the early 21st century, looking back on 80 years of jazz and rock and roll music, there seems to have been an inevitability about the rise of the electric guitar. However, it must be remembered that in the mid-to-late 1930s this was hardly the case; when Al Frost, the president of the National Dobro Corporation wrote in 1939 "The electric guitar is here to stay",[1] it was more hubris than prescience. Although the surviving records of the Ro-Pat-In/Electro String Corporation make no mention of a cohesive marketing plan during the 1930s, it is clear that the company was actively engaged in advertising and promoting its instruments.

THE EARLY ELECTRIC GUITAR MARKET

Unlike today, where the majority of electric guitars are sold to amateurs, the nascent electric guitar market was squarely aimed at professionals. While electric Hawaiian guitars became the standard instrument for professional Hawaiian-style players by the late 1930s, electric Spanish-style guitars, especially non-archtop models, remained something of a novelty for professional players until after World War II. There were, of course, exceptions, Charlie Christian (who played a Gibson ES150 arch-top Spanish guitar) being famously amongst them, but for the most part professional Spanish-style players of the 1930s preferred unamplified instruments. Although there were some models of Rickenbacker instruments that were aimed towards the lower end of the market, it would not be until after the 1930s that the company would make true budget-priced instruments for the student market, and even then only Hawaiian-style guitars.

The sales strategy adopted by Ro-Pat-In/Electro String can be broadly divided into three main categories: 1) individual sales to early adopters, 2) jobbers, and 3) public awareness efforts/marketing to the wider public.

[1] Frost Archive. Letter to the Dopyera brothers, December 22, 1939.

THE EARLY ADOPTERS

Gage Brewer

As noted in chapter 4, the first documented sale by Ro-Pat-In/Electro String was to Wichita, Kansas, musician Gage Brewer. Brewer also has the distinction of having made the first documented public performance on the electric guitar.[2] Company sales records show that Brewer bought his guitars (an electric Spanish and aluminium-bodied frying pan model) on 21 September 1932. Brewer immediately saw the promotional possibilities of the new instruments – an article in the Wichita Beacon of October 3, 1932, published only a little more than a week after Brewer acquired the instrument, announces his acquisition of the guitars and features a photo of him holding his frying pan. A promotional letter sent out by Brewer on October 28, 1932, announces a Halloween masquerade ball at the Shadowland Pavilion, a nightclub owned by Brewer. In the letter he announces the debut of the instruments, but interestingly, never actually names them:

> In the orchestra we are at this time introducing the world's newest and most sensational instruments. A new invention which is startling to the music world, making possible a combination of natural personal technique and electrical perfection. We are indeed fortunate to be able to present these instruments to the public as they will not be on the market for several months, we assure you that if you've not already heard these remarkable instruments that we have a real treat in store for you.[3]

Although his use of these early Ro-Pat-In instruments would have a significant impact on his career, Gage Brewer does not seem to have made the same impact on the people working at Ro-Pat-In; company records showing the end of year sales for 1932 misspell Brewer's name as "Brusser" in several places, suggesting that the company had difficulty remembering the name of the early adopter of the electric guitar from Wichita.

[2] The author is indebted to Eric Cale, director of the Wichita-Sedgwick County Historical Museum, Wichita, Kansas, for the following information on Gage Brewer.
[3] Collection of the Wichita-Sedgwick County Historical Museum.

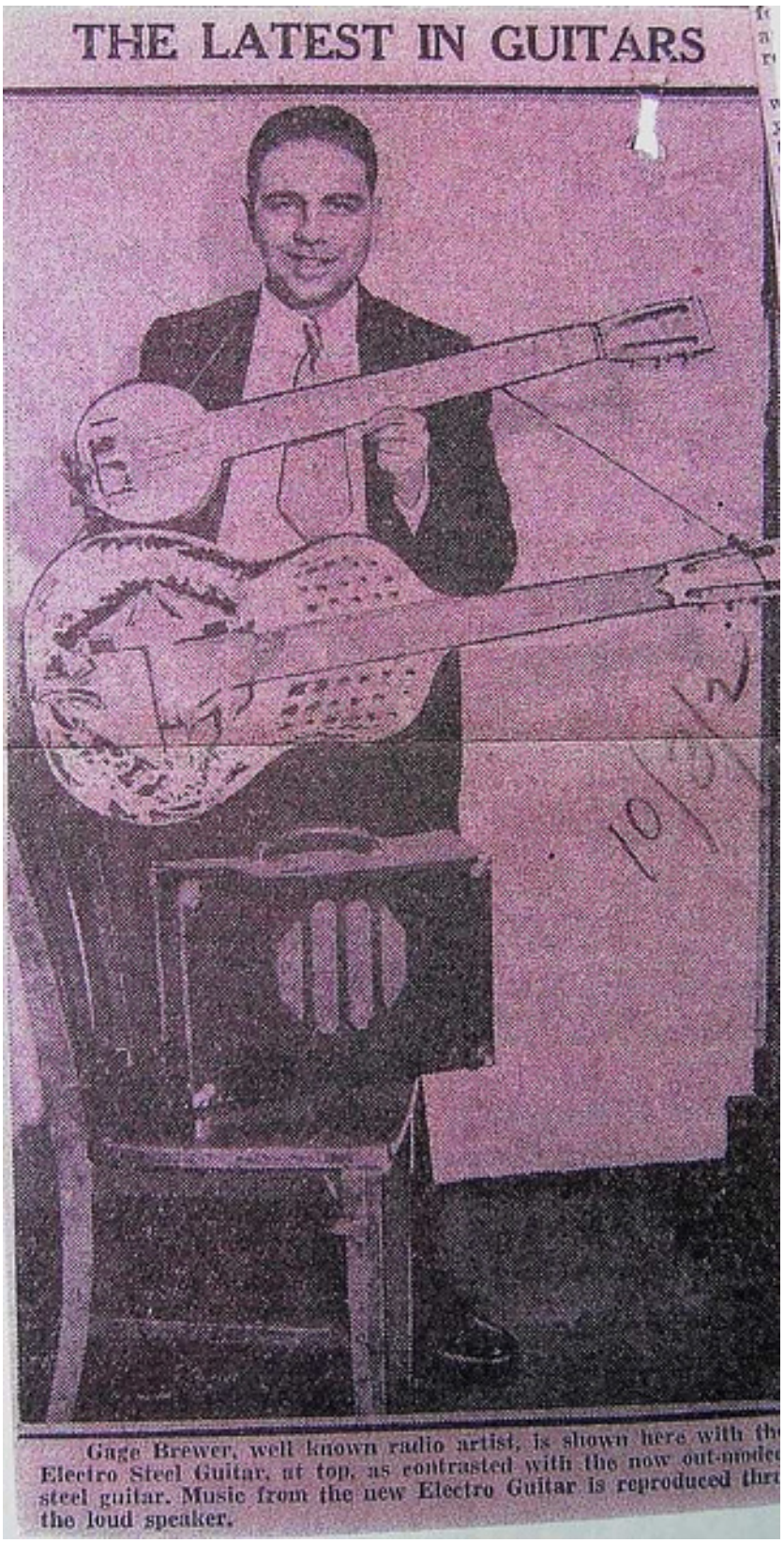

Figure 8.1 – Gage Brewer displaying his Electro frying pan (as well as his National tri-cone resonator guitar) in the Wichita Beacon, October 2, 1932.

Jack Miller

The second documented professional musician to use a Ro-Pat-In/Electro String instrument was Jack Miller. Miller appears to have been a friend of George Beauchamp's and it has been suggested that he worked for Electro String,[4] although this is not supported by the company archives. During the mid 1930s Miller wrote a series of short articles for Down Beat magazine promoting and explaining the electric guitar. In the May 1936 issue of Down Beat, Miller ruminated on the advantages of the new instrument and claimed to be the first to have played the electric guitar professionally:

> When I first saw a rough sample of an amplified Steel Guitar (on the coast) a few years ago, I immediately foresaw the value and possibilities of such an instrument. I was thoroughly sold on the idea. The first by, of course, was that it was "loud" enough to eliminate the force Steel Guitar players have to use in picking of the instrument. That meant one could concentrate on a nice "soft touch" in picking the strings to get a smooth tone, for a Steel Guitar has often been "abused".
>
> I own the FIRST one of these instruments made and used it in the Prologue at Grauman's Chinese Theatre in Hollywood. That was before there was a volume control put on the guitar. Sometime later, at my request, the seven-string Electric Guitar was built. I have the first one of those made.[5]

While factory sales records confirm that Miller was an early purchaser of the frying pan, the records are also clear that it was Gage Brewer and not Jack Miller who bought the first instruments. The factory records also show that Miller never actually completely paid for his guitar and amplifier. Later documents show that Electro String eventually wrote off the money he owed, making Jack Miller Electro String's first uncollected bad debt.

THE JOBBERS

In order to understand the significance of jobbers to the marketing strategy of Ro-Pat-In/Electro String, a brief explanation of the distribution logistics of the American musical instrument manufacturing scene of the 1930s is helpful. During this period, it was extremely rare, if not unheard-of for manufacturers to handle their own sales and distribution. Sales to music stores were made by one of two entities; the "manufacturer's agent", or the jobber.

[4] Smith, *The History of Rickenbacker Guitars*. p. 13.
[5] Jack Miller, "The First to Play Electric Guitar," *Down Beat*, May 1936. p. 5.

The manufacturer's agent, or travelling salesman[6] was the most common of the two types of musical instrument distributors. An agent would typically handle several "lines" (products or manufacturers) which may or may not have been related to each other (such as brass instruments, or violin family products). For example, Jack Levy, who was an agent for both National String and Ro-Pat-In/Electro String, was also a representative for Cundy-Bettoney woodwinds, Zildjian cymbals, and F. E. Olds & Son brass instruments. With the exception of Cundy-Bettoney, all of these were high-end lines, suggesting that Levy was in the higher echelons of the trade.[7] Salesmen such as Levy were not employees of the manufacturers, but independent middlemen between the manufacturer and the music store. An agent would be given by the manufacturer the right to sell a line of products in a particular territory, which could be as small as a city or as large as the whole country.

Wholesalers were preferred by many smaller musical manufacturers due to the fact that they would oftentimes buy the product from the manufacturer – thus completing the sale from the manufacturers' perspective – and store it in warehouses before reselling it to music stores. Another perceived advantage that a jobber/wholesaler had over a manufacturer's agent was prestige; since the wholesalers were often somewhat substantial companies, associating with them made a small manufacturer look more substantial as well.

Musical instrument manufacturers typically used both manufacturer's agents and jobbers at the same time, due to the practice of having multiple sales territories for products. Thus, while a large territory such as the Chicago area might have been serviced by a jobber, a small territory might have been held by a manufacturer's agent. However, this was not always the case – there are many examples where large territories would be held by manufacturer's agent.

Important jobbers that were used by Ro-Pat-In/Electro String included Progressive in New York, Continental Music in Chicago, and Coast Wholesale in San Francisco/Los Angeles, thus having a major distributor on both coasts and in the Midwest. These jobbers took out ads in trade publications to advertise both Electro String's instruments and the fact they were available from that particular jobber.

[6] This is the type of person that the American cliché of the "travelling salesman" refers to, rather than a person, such as a peddler, who sold to the general public.
[7] Frost Archive.

Progressive Musical Instruments seems to have been particularly keen to market the new electric guitars, taking out large ads in the industry magazine *Music Trades*, and even purchasing the cover of the magazine in November 1935.

Figure 8.2 – The cover of *The Music Trades*, November 1935.

BRINGING THE ELECTRIC GUITAR TO THE WIDER PUBLIC

While Ro-Pat-In/Electro String's primary focus was on selling instruments, the company also understood the value of public awareness in creating a market for the nascent electric guitar. In the summer of 1936 a number of Electro String's products, including both guitars and violin-family instruments, were put on display at the Steel Pier in Atlantic City, New Jersey (see figure 8.3). Opened in 1898, the Steel Pier was one of the largest and best-known amusement complexes on the upper East coast of the United States. While it is still open today, the Steel Pier's heyday was during the first half of the 20th century. A wide range of entertainment was on offer there during the 1930s, including high diving horses and "Rex the Wonder Dog", a waterskiing canine. From 1935 to 1938 the Steel Pier was the venue for the Miss America pageant. However, the Steel Pier was best-known during the 1930s as a music venue, with many of the important popular musical acts of the day playing the during the summer season.[8] One of the attractions on the pier was a "Hawaiian Village" (see figure 8.3) which featured Hawaiian bands and dancers.[9] The Hawaiian Village was the brainchild of William F. Aldrich, who had spent a number of years in Hawaii and had been promoting Hawaiian music and bringing Hawaiian musicians to the mainland since the mid-1920s.[10] During the summer of 1936 Aldrich appears to have booked a band which featured Electro String's instruments and arranged for an accompanying display of Rickenbacker products. In a letter to George Beauchamp, dated September 3, 1936, Aldrich writes:

> However we do have a wonderful display for the Electro instruments, and they are getting a lot of advertising. At least a million people have seen it this summer and we answer lots of questions. We always refer the people interested to Progressive and hand out their pamphlets.
>
> We will be going on the road in a few weeks now around the First of October and then I will take the instruments with me and make displays in each city where we play. From that source I expect to make some sales and will of course make some profit for myself, and I also expect to establish some dealers for Progressive for which they will pay me a commission.
>
> Every day we have new programes *(sic)* on the Pier and they are made in 50,000 lots for each day, and more for Saturday, Sunday, and Holidays. I am sending you a couple of these so that you will see what they look like and also see the Electro Orchestra advertised thereon. Also one days *(sic)* newspaper advertisement of the attractions on the Pier. (See figure 8.4)

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[8] http://www.steelpier.com/history-steel-pier.aspx. Accessed 3/17/2011.

[9] The fretted *berda*-style double bass described in chapter 6 was used by the Imperial Hawaiians, one of the Steel Pier bands.

[10] http://elkslodge616.com/about/history/biographies/hawaii-entertains-at-san-francisco-elks-lodge-opening-2/. Accessed 3/17/2011.

Although it is likely that Aldrich came to know of the Rickenbacker instruments through his Hawaiian music connections, the display appears to have contained a full range of Electro String products, including the brand-new violin family instruments. It is also extremely likely that the Electro Orchestra referred to in the letter included these violin-family instruments.

Figure 8.3 – The Hawaiian Village at Atlantic City's Steel Pier, c1930.

The company also saw the value of celebrity association; on April 26, 1937, George Beauchamp wrote on behalf of Electro String to the famous Hollywood studio Paramount Pictures[11] suggesting a tie-in for the upcoming film, *Waikiki Wedding*, starring Bing Crosby. Electro String suggested a cross-promotion where they would promote the film in their brochures in exchange for being able to use a photo of Bing Crosby in Electro String's advertising. While the desire of a maker of Hawaiian-style guitars to be associated with the film with the name of *Waikiki Wedding* is self-explanatory, Bing Crosby's connection with Electro String was somewhat more tenuous, being only that one of the bands that Crosby had previously recorded with, Dick McIntire and his Boys, had previously used Electro instruments on Crosby sessions.[12]

[11] Rickenbacker Archives.
[12] Ibid.

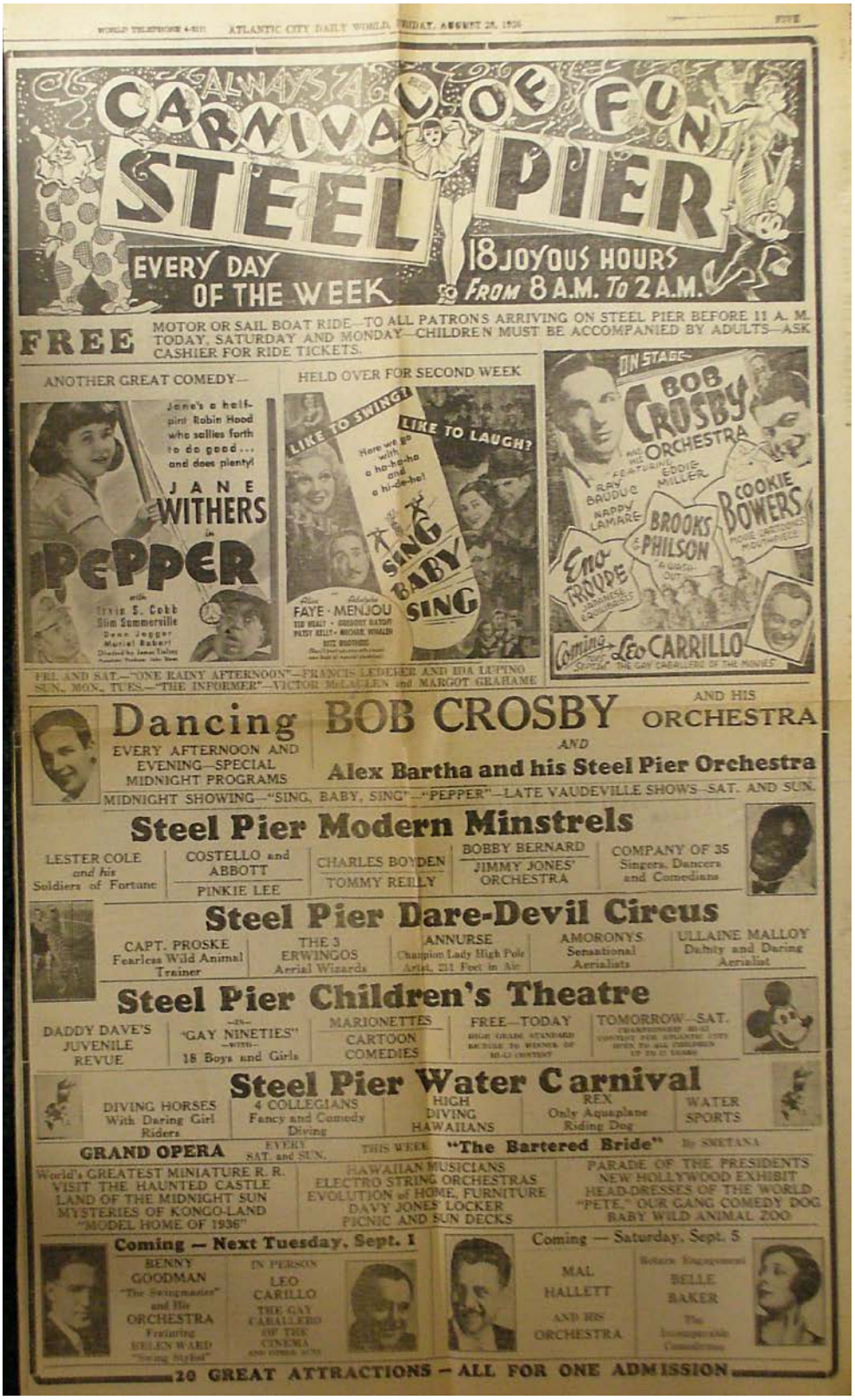

Figure 8.4 – Advertisement for the attractions at the Steel Pier, Atlantic City New Jersey in the Atlantic City Daily World, August 28, 1936.

Note the listing for "Electro String Orchestras" at the bottom centre page.

THE "MIESSNER MATTER"

The period from c. 1936 to the beginning of the Second World War saw a great acceleration in the manufacturing and marketing of electric musical instruments; it was during this time that amplified instruments of all kinds became no longer the exclusive province of the inventor and the experimenter but began to be utilised by working musicians. Electric instruments, whether they amplified an acoustically produced tone or had their sound wholly generated by electrical means, would give musicians new-found creative freedom by controlling timbre, volume and expression to a degree, and in a manner, previously impossible. One of the most notable proponents of these new electric instruments was Benjamin Franklin Miessner who, in 1930, founded a company, Miessner Inventions, Inc., to develop and licence electronic musical instruments of Miessner's and others design.[1] Almost completely forgotten today, Miessner appears to have been, in many ways, a pivotal figure in the development and propagation of electrical musical instruments during this time – not always for positive reasons. Miessner Inventions were possibly unique amongst musical instrument concerns in that they produced no actual instruments themselves, but rather developed musical instrument technologies that they then licensed to others.[2] Beginning with a design for an electric piano, Miessner and his company created and attempted to license a number of different musical instrument technologies. Although the company appears to have had some success with its musical instrument designs, Miessner Inventions became as noted for its litigation as its innovation by waging an aggressive campaign to intimidate companies making electric instruments into purchasing licensing agreements, despite it often not being clear that Miessner's patents directly covered the technologies being used by the makers. This chapter will discuss what is known of Miessner, his company and their patents, consider the validity of Miessner's claims, and examine the impact of Miessner Inventions Inc. on the nascent electrical musical instrument market, especially with regard to electric stringed instruments.

[1] B. F. Miessner Archive.
[2] Ibid.

Figure 9.1 – Benjamin Franklin Miessner in his workshop, c. 1930.[3]

Thomas Rhea in his 1972 PhD thesis "The Evolution of Electronic Musical Instruments in the United States",[4] devotes a chapter to Miessner's electronic piano design which was then adapted as an article in the magazine Contemporary Keyboard in 1978. Other than that, almost nothing has been written about Miessner, his company, or his instruments. However, Miessner's extensive personal archives exist and are preserved in the special collections at Purdue University.[5] These were acquired by the University after Miessner's death in 1976 and were catalogued in 1989. Since then, this material has remained completely unexamined and even its existence for the most part was unknown.[6] The archive consists of 40 banker's boxes of material covering almost all aspects and the entire span of Miessner's life, from his school notebooks to records of his business dealings in his 70s. They also show that Miessner not only meticulously documented his own musical business interests, but also the development of electric

[3] Ibid. box 10.
[4] Thomas LaMar Rhea, "The Evolution of Electronic Musical Instruments in the United States" (Thesis (Ph D), George Peabody College for Teachers, 1972).
[5] B. F. Miessner Archive. box 10.
[6] According to the staff at Purdue, the persent author was the first researcher to examine any of this material.

musical instruments by others; thus the Miessner archive can be considered an invaluable resource, not only of Miessner's inventions and activities, but of the development of electric musical instruments as a whole.

B. F. Miessner was born in Huntingburg, Indiana, July 27, 1890. His self-written biographical sketch states that he received training in radio operation and technology while in the US Navy.[7]

Miessner's autobiographical sketch deserves more comment here, in that it gives insight into Miessner's motivations, *modus operandi*, approach to his business and his sense of importance concerning his inventions. A telling example of this occurs on the very first page; Miessner notes that while in the Navy, he developed a form of contact for crystal detectors on early radio sets (popularly known as "cat whiskers"). The language Miessner uses implies that this was the first such device invented, which was not the case.[8] He also notes with pride that "the invention was considered of such great importance in the detector art that it was bought by the Wireless Specialty Apparatus Company of Boston, a subsidy of the United Fruit Company. It has recently[9] been the subject of a number of suits brought by the Wireless Specialty Apparatus Company against manufacturers and dealers in crystal detectors, particularly against the Kreage and Woolworth five and ten cent stores".[10] Miessner goes on to say "it is understood that the suits have been settled favourable to the Miessner patent".

In 1911 Miessner began working with radio pioneer John Hays Hammond, Jr[11] on the development of a radio-controlled torpedo for the US government. During this time Miessner also created a device which he called an "electric dog", which was capable of following a light moving in front of it. After his time with Hammond, Miessner studied at Purdue University, but never completed his degree. Miessner's professional interest in electrified music seems to have begun in 1920 when he became an acoustical engineer for the Brunswick Phonograph Company. During the 1920s he worked for several different electronics firms designing radio circuits and loudspeakers.[12] Miessner

[7] B. F. Miessner Archive. box10
[8] Greenleaf Whittier Pickard, "Means for Receiving Intelligence Communicated by Electric Waves,"(United States Patent Office 836,531 filed August 30, 1906 issued November 20, 1906).
[9] This appears to have been written in the early 1930s.
[10] B. F. Miessner Archive. box 10
[11] No relation to Laurens Hammond of Hammond organ fame or electric violin inventor F. C. Hammond.
[12] B. F. Miessner Archive.

seems to have learned early the importance of both exploiting and protecting his designs; by the end of the 1920s he had dozens of radio-related patents to his name and the sale of some of these patents to RCA during this period made Miessner very wealthy.

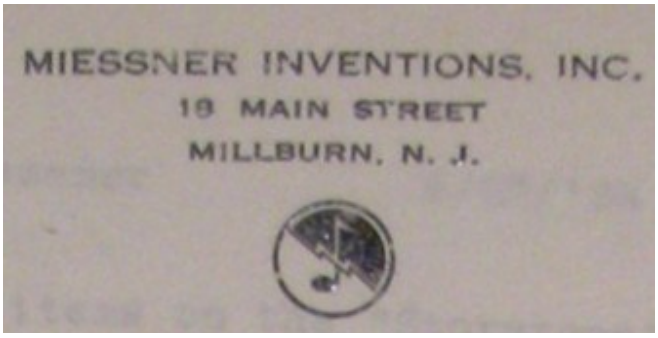

Figure 9.2 – Company letterhead of Miessner Inventions, Inc. c. 1935.

In 1930 Miessner created his namesake company, Miessner Inventions, Inc. in Milburn, New Jersey, for the express purpose of developing musical instrument designs. As previously stated Miessner's company was unusual in that it produced no actual musical instrument products to sell, but rather created and acquired musical instrument designs which it then licensed to others. Miessner's partner in this venture was attorney Charles T. Jacobs who served with the firm as both a patent lawyer and an electrical engineer. As a start-up venture, Miessner Inventions appears to have been very well-financed; their end-of-the-year balance sheet shows cash reserves of over $175,000.[13] From an examination of Miessner's archives, it becomes clear that Miessner's invention business was as much business as invention; the working practice of Miessner Inventions was very different from that of the popular image of the lone inventor tinkering in his workshop. Unlike Thomas Edison, who carefully fostered such an image, Miessner seems to have based his company around Edison's working method of hiring people to develop products and technologies that Miessner would then take credit for and exploit. This is not to say that Miessner's input into the inventions developed by his company were not significant – it is clear from his correspondence with his employees that Miessner always had a direct and guiding hand in all that was going on at the company. The working practices of Miessner's business were somewhat unusual; although Miessner can in no way be described as an "absentee owner", he did apparently direct much of the day-to-day workings of the business from afar. It was

[13] Ibid. box 39, folder "Miscellaneous Correspondence"

Miessner's habit to spend summers in Canada and winters in Florida – he appears to have owned homes in both places. Voluminous correspondence exists between Miessner and his employees – most often his shop foreman, Fred Merrill – in which he would be informed of even the most minute goings-on at the office and would send his comments and instructions in return.[14]

Initially the focus of the company was on promoting a soundboard-less, amplified electric piano that had been developed by both Miessner and Jacobs. Company promotional material stated that "by means of timbre control arrangements, this instrument may be made to play with output tones closely resembling a piano, harpsichord, banjo and other string instruments, or like many orchestral wind instruments."[15]

Miessner was tireless in his efforts to promote his electric piano (which is described in greater detail later in this chapter). He wrote articles, gave lectures, and presented papers at conferences to publicise the instrument.[16] He was even able to organise a concert at Radio City Music Hall featuring the piano, as well as a series of promotional radio shows that were broadcast nationally.[17] It is unclear, however, if Miessner's piano design was ever manufactured on a commercial scale.

Other instruments developed by Miessner during the 30s include the Orgatron, an early electric organ design that was first manufactured by the Everett Piano Company, and later by Wurlitzer,[18] and an electric timpani which consisted of tuned strings amplified by pickups and played with timpani sticks in the manner of a hammer dulcimer. String instruments included an electric violin and electric cello. He also developed an electrostatic (rather than electromagnetic) pickup designed to be retrofitted to guitar. One of the more unusual instruments mentioned in the Miessner archive is an electric harmonica. It is not known exactly how this instrument worked, since there appears to be no drawings or plans for it in the Miessner archive, but it is known that Miessner developed a pickup designed for free reed instruments and the electric harmonica most likely used this.[19] Another instrument that Miessner had high

[14] Ibid. boxes 9, 11, 39, among others.
[15] Ibid.
[16] Ibid.
[17] Ibid.
[18] The National Music Centre, Calgary, Alberta, has examples of both instruments.
[19] B. F. Miessner Archive. box 39, folder "Correspondence with Victor Morris, Frederick D Merrill 1938"

hopes for during the 1930s was his design for an electric carillon. Again, like the electric harmonica, it is not certain exactly how this instrument worked, but it appears that it produced its sound through purely electrical means rather than being an electromechanical mechanism for playing physical bells.[20]

By about 1935, litigation against musical instrument manufacturers appears to have become an important part of Miessner Inventions's business model. Until the end of the 1930s, advertisements were placed in music trade publications putting electric instrument manufacturers on notice that they were in violation of Miessner's patents. It interesting that Miessner appears to have reserved his particular litigious vehemence for manufacturers of electric stringed instruments, especially guitars. In order to get manufacturers to purchase licences to make electric guitars, it was necessary to threaten them with what would happen if they didn't comply with Miessner's demands. In addition to the possibility of losing legal rights over their products, Miessner played upon electric guitar manufacturers' fear of a protracted lawsuit. Although it appears that while some of the electric guitar companies were fairly confident of winning any legal action brought by Miessner, the expense of a protracted lawsuit would make it a pyrrhic victory. George Beauchamp, President of Electro String Instrument Corporation, the manufacturers of the Rickenbacker frying pan, in a letter to his patent lawyer dated December 18, 1936,[21] summed up what was probably the feeling of most manufacturers when confronted with the possibility of a Miessner legal action:

> ...naturally we want to get this matter cleared up as soon as possible, and would prefer if at all possible to operate independent of any licence to Miessner or anyone else. On the other hand we have to consider what such a procedure would cost us as compared to the expense attending the less desirable alternative based on our present and possible future production.

A typical example of Miessner's attempt to assert his rights over electric guitar manufacturers can be seen in the following excerpt from a letter written by Paul Tutmarc of the Audiovox company to Miessner in 1937[22] looking to represent Miessner's design for an electric organ:

> Gentlemen: –
>
> We are interested in obtaining representation in this territory for electronic instruments, especially an electronic organ. As this field is quite clear in Seattle, except

[20] Ibid.
[21] Rickenbacker Archives.
[22] B. F. Miessner Archive. box 11, folder "Organ and Piano Co. Inquires". Paul Tutmarc and Audiovox are further discussed in chapter 10.

> for a few Hammond sales, we believe a competitive instrument will sell. Churches, schools, etc are positively crying for an instrument of this type, and the types now available are not satisfactory. Please, if you are interested, reply immediately, giving full details in your letter.

Miessner gives a rather perfunctory reply to this request and then goes on to add:

> We note that you are manufacturers of electrical fretted instruments, and we wish to point out that you undoubtedly are infringing many of the patents covering these. Unless you obtain a license to use these patents you, of course, are illegally using our inventions and therefore liable to suit. We suggest therefore that you take a license from us; a copy of this licence is enclosed for your information.
>
> Very truly yours, Miessner Inventions, Inc.[23]

It should be emphasised here that Miessner's tone was slightly more conciliatory to manufacturers who wrote to him in acquiring about licences, but still was direct and to the point. In a letter dated January 10, 1940, responding to such an enquiry, Miessner responds:

> ...as a generality these licenses require a minimum royalty payment of $500 each year, or more. For that reason we would like to learn something of the nature of your proposed operations. The distribution of such instruments is a real problem and we wonder what sales arrangements you propose to make.
>
> Please be assured we are interested in obtaining the licensees but at the same time we wish to assure ourselves of the stability of a new manufacturer.[24]

In addition to the individual lawsuits faced by electric guitar manufacturers, at least one individual was aware of the aggregate danger faced by manufacturers from the Miessner threat: patent attorney William H. Maxwell, in a letter to George Beauchamp dated November 19, 1937, gives the following summary and commentary on Miessner's claims:

> Gentlemen,
>
> I have a letter from Miessner Inventions, Inc., a copy of which is enclosed herewith. You will note that Mr Miessner is making the most generous offer that you assign your patent to him and he, in turn, will grant some kind of licence back to you, and that he feels that this is a most liberal offer. In fact the letter would insinuate that it is somewhat of a concession.
>
> It appears to me that the numerous letters and threats received from Miessner over a long period of time indicate that Miessner is, in fact, simply trying to bluff his way along, and the fact that he has obtained a number of licensees indicates that he has worked the bluff on a number of concerns. I wish to call your attention to the fact that as time goes on Miessner will by this method become stronger, as he will probably add licensees to his list, and they in turn will pay tribute to him and, in effect, build up a war chest by which he can carry on litigation.[25]

[23] Ibid.
[24] Ibid.
[25] Rickenbacker Archives.

While most companies resisted Miessner, Miessner Inventions did have some successes in acquiring licensees. Probably the most notable of these was Epiphone; almost all Epiphone electric guitars from the mid to late 1930s carried a rather large notice on them stating that they were licensed from Miessner Inventions. The physical layout of this license notice deserves further comment. The notice took the form of rectangular metal tag, with the name Miessner inventions and listing a series of patents under which the attached instrument was presumably manufactured. However, when examining the patents, it becomes clear that the patents listed do not necessarily have any connection with the licensed instrument. This is because the license tags that Miessner gave to his licensees were originally developed for use by the Hammond organ company, who manufactured one of Miessner's keyboard designs under licence.[26] The patents listed on the tags refer to specific applications of that design. Miessner then appears to have used the same tags for other licensees no matter what the application was. Others who made guitars under a Miessner licence included Kay Musical Instruments, and the inventively-named Fretted Instrument Manufacturers.

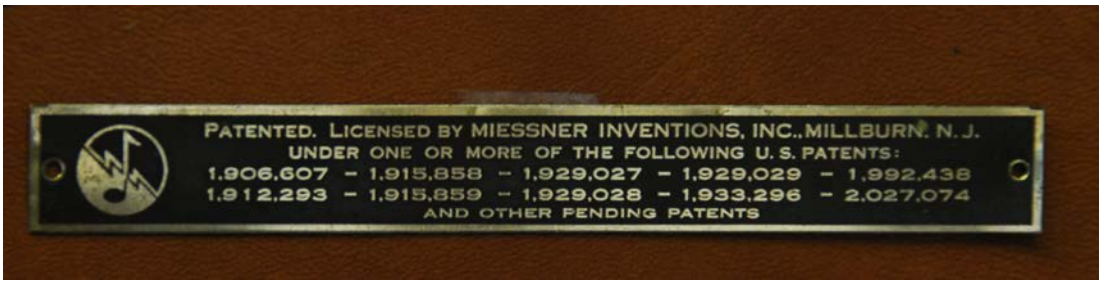

Figure 9.3 – Licence tag used by Miessner Inventions, Inc. in the late 1930s.

It must be emphasised here that for all of Miessner's litigation, Miessner Inventions' main activity was the development and promotion of electric musical instruments, particularly keyboards. While there is much evidence in the Miessner archive regarding the active threatening of lawsuits against musical instrument manufacturers, it is unclear how many, if any, ever went to court and what kind of impact this had on Miessner's company financially. Whatever the outcome, however, it is clear that by the early 1940s Miessner had ceased the aggressive seeking of licensees through the threat of litigation. While it is demonstrable that Miessner antagonistically pursued electric guitar manufacturers, it is not clear why he suddenly stopped his

[26] B. F. Miessner Archive.

litigious approach by the late 1930s. In a letter to Miessner dated 1949 his patent lawyer comments on this:

> The fact that infringement notice was given to a number of manufacturers in 1936 and that the matter was then permitted to drop raises the problem in laches which further limits the selection of claims on which suits may be predicated.[27]

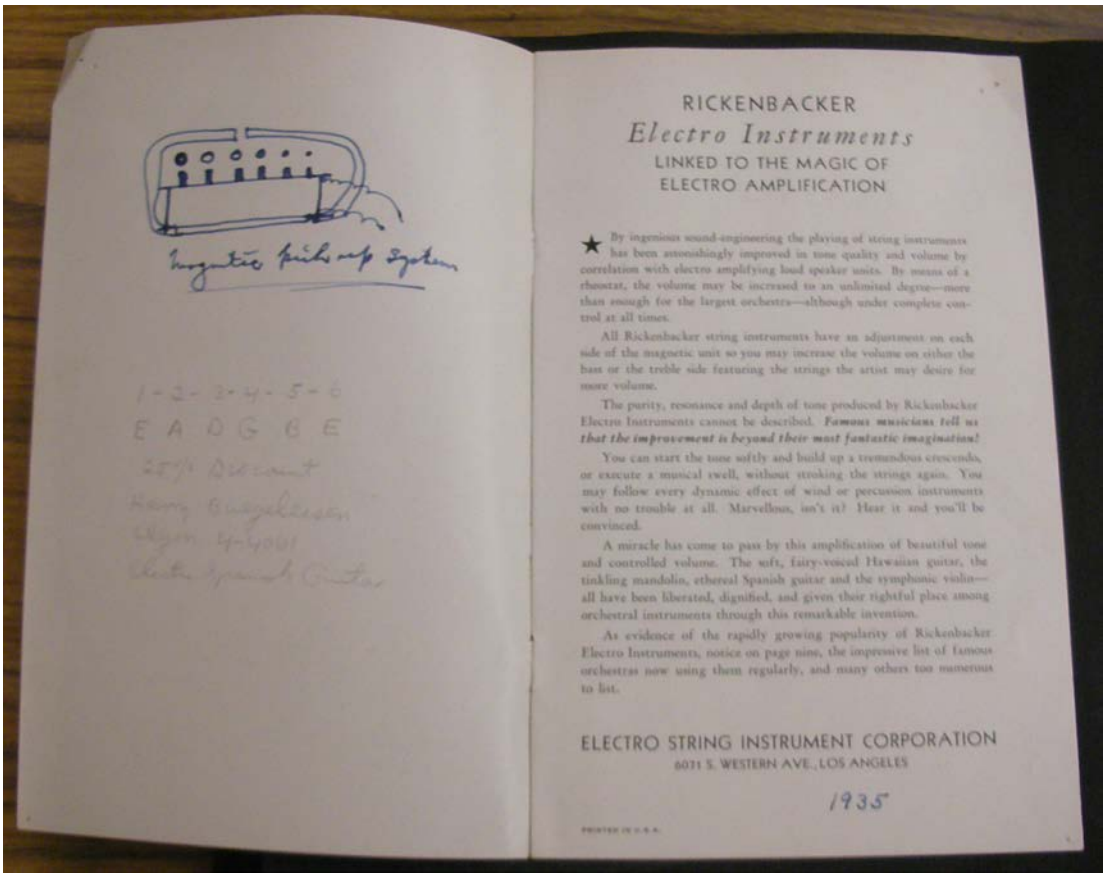

Figure 9.4 – Rickenbacker promotional brochure with drawing and annotations by B. F. Miessner.

Another strange aspect of Miessner's litigation records is the noticeable absence of references to Electro String Corporation in his archives. It is known that Miessner threatened to sue Electro String, due to correspondence found in the Rickenbacker archives,[28] but intriguingly no reciprocal correspondence exists in Miessner's papers. In fact, in contrast to many other manufacturers of electric guitars, there is very little mention of Rickenbacker/Electro String in the Miessner archive. One intriguing item in

[27] Ibid. Letter from law offices of Cooper, Byrne, Dunham, Keith and Dearborn to Benjamin F. Miessner, November 9, 1949. box 9, folder "Loose Notes 1938" N.B. "Laches" is a legal term meaning an unreasonable delay pursuing a right or claim in a legal action in a way that prejudices the opposing party.
[28] Rickenbacker Archives.

Miessner's papers is a scrap book which contains an early Rickenbacker sales brochure with a sketch (see figure 9.4), almost certainly by Miessner, of the workings of the horseshoe pickup.[29] This dearth of Rickenbacker related material is probably not due to a simple lack of record keeping on Miessner's part; Miessner was almost obsessive in documenting his business life, and the period between 1930 and the beginning of the Second World War is particularly well documented, it being the period of his greatest professional activity.

While communication with Electro String may be lacking in Miessner's archives the same is not true regarding Miessner in the Rickenbacker archives. On December 30, 1936, Electro String's patent attorney William H. Maxwell wrote a letter to George Beauchamp saying that he was going to examine the Miessner files in Washington in response to the legal threats by Miessner. Maxwell also says he has heard from Miessner and that Miessner has enthusiastically invited Maxwell to confer with him regarding potential patent infringements. This suggests that Miessner probably did not believe he was bluffing, and truly thought he had a legitimate claim. The letter also suggests that Maxwell, not surprisingly, disagreed with this conjecture, but that Maxwell would not debate the matter with Miessner.

In a letter dated January 28, 1936, Maxwell detailed the results of his communication with Miessner, outlining a plan of action, along with the estimated cost of $200-$400 to make a study of the matter. Maxwell further comments that this is quite expensive, and shows awareness that this was likely to be a generally costly and protracted legal matter.

However, it appears that in some ways Electro String and the Rickenbacker guitar were blind spots – wilfully ignored or not – on Miessner's part. This apparent blindness in reference to Rickenbacker seems to have manifested itself again after the war; in 1949, when Miessner commissioned a feasibility study for resuming litigation against electric guitar manufacturers, Rickenbacker/Electro String was again conspicuously absent. It is not clear why Miessner seemingly ignored Rickenbacker/Electro String, not only as a potential target of litigation, but as a manufacturer in general. The distance between New Jersey and Los Angeles does not seem to be a factor; as Miessner did not hesitate to threaten the Seattle-based Audiovox

[29] B. F. Miessner Archive.

company when he became aware of their activities. It does not appear to be due to differences in the design of Rickenbacker guitars – most of the companies that Miessner threatened with litigation were producing instruments directly based on designs created by Electro String. It does not seem to be due to the size of the Electro String company; Miessner made no distinction between threatening smaller companies (again, like Audiovox) or much larger outfits such as Gibson.

While Miessner appears to have been something of a bully, he was not a charlatan. It seems highly unlikely that Miessner would have been so consistently willing to enter into possibly protracted litigation if his claims had no basis in fact. So, how valid were Miessner's claims? Although Miessner appears to have based his legal actions on several of his company's patents, there is one in particular that appears to be the most directly relevant to his legal action against electric guitar makers. Interestingly, this patent, US patent 1906607, did not belong to Miessner, but to his partner and patent lawyer, Charles Jacobs, and was part of the design for the Miessner-Jacobs electric piano.[30]

The patent drawings of the piano clearly show what is called in the text a "translating device" and described as a bar magnet surrounded by a coil of wire with its short end positioned just underneath a vibrating magnetic medium, such as a string. This is an accurate, if greatly simplified, description of an electromagnetic pickup, of the same basic type as used on modern electric guitars. As this patent was originally filed on April 20, 1931 – several months before the earliest known use of an electromagnetic pickup on a guitar – it would at first seem that Charles Jacobs has a strong claim to having invented the electromagnetic pickup. However, Jacobs' claim may not be as straightforward as that, and here the facts take a rather surprising and suggestive turn.

This apparent electromagnetic pickup is by no means the major component of the device as presented in the patent. The greater part of the patent concerns itself with the amplification and positioning of the translating devices rather than the construction and specification of the devices themselves. On closer examination, the language of the patent concerning the translating device appears to be rather ambiguous, for while a bar magnet surrounded by a coil of wire is shown in the patent, it appears not to be

[30] Charles T. Jacobs, "Method and Apparatus for the Production of Music,"(United States Patent Office 1,906,607 filed April 20, 1931 issued May 2, 1933).

designated as an integral part of the patent claims, but rather presented as only one possibility as a translating device. While the majority of the patent is incredibly specific concerning the placement and processing of the electrical signal created by the translating devices, it is not so with the devices themselves. Jacobs, and by extension Miessner, may have believed that they could not specifically patent these translating devices because they had already been invented by someone else. For an upright bar magnet surrounded by a coil of wire as a producer of an electrical signal generated by a moving ferrous string is essentially the same system employed by another, earlier, electric piano, the Neo-Bechstein developed by Siemens and Telefunken in the late 1920s.

As previously noted, Miessner not only documented his own musical instrument-related endeavours, but actively researched the work of others. Miessner took a particular interest in the work of German inventors of electric musical instruments. One of Miessner's scrap books from the early 1930s documents the development of the Miesnner-Jacobs piano. This scrapbook contains many articles and newspaper clippings, in both English and German, showing not only that Miessner was aware of the Neo-Bechstein electric piano, but also that he almost certainly travelled to Germany in the early 1930s, possibly as early as 1931, to examine it personally. It is also known, from other documents in the Miessner archives, that by the mid 1930s Miessner owned an example of the Neo-Bechstein, which he kept at his New Jersey laboratory.[31] Here, then, is a possible reason for the ambiguity in Jacobs patent and hence Miessner's patent infringement claims.

Beginning in 1949 and into the early 50s, Miessner Inventions began another, more comprehensive series of lawsuits against electric guitar manufacturers, including big names like Gibson and soon to be big names like Fender. By this time, the electric guitar, both technologically and socially, was on the cusp of a period of rapid change and expansion. This time around lawsuits were brought against both manufacturers who had never bought licenses and those, like Epiphone, that had bought them and allowed them to lapse. In preparation for his legal action, Miessner bought current models of electric guitars from Gibson and others for examination and paid for a patent search covering all American electrified musical instruments up until that time:

[31] B. F. Miessner Archive.

> We have made a survey of the fretted stringed instrument industry and as a result thereof have had reason to suspect that certain elements of the industry either manufacturer or distribute electric guitars, mandolins and the like under their own exclusive trade name. Consequently we made specific enquiry into the activities of the following:
>
> - ✓ The Danelectro Corp.
> - Carl Fisher Musical Instrument Co.
> - ✓ Gibson, Inc.
> - ✓ Fred Gretsch Manufacturing Co.
> - ✓ Kay Musical Instrument Co.
> - Martin Band Instrument Co.
> - ✓ Epiphone, Inc.
> - ✓ Fender Electric Instrument Co.
> - Regal Musical Instrument Co.
> - H. & A. Selmer Co.
> - United Guitar Corp.
> - Davis Wexler & Co.
> - Fretted Instrument Co.
> - The Harmony Co.
> - Harpton Manufacturing Co.
> - Thorens Co.
> - ✓ Valco Manufacturing Co.
> - Gretsch & Brenner
> - Morris Lipsky Music Co.
> - C. F. Martin & Co., Inc
> - G. LeBlanc Co.
> - New York Band Instrument Co.
> - St Louis Music & Supply Co.
> - Sorkin Music Co.
> - Southland Music Merchandise Corp.
> - Targ & Dinner Co.
> - ✓ Vega Co. [32]

The list is interesting in that it provides a snapshot of which companies might have been considered major players by Miessner in the electric guitar market of the time. It is not known what the checkmarks in the original document indicated, but it seems likely that these were firms that Miessner considered particularly important in some way.

[32] Ibid. box 9.

So why did Miessner Inventions choose to sue electric guitar companies at this time? Miessner's reasons are not clear; possibly it may have been a last ditch effort by Miessner to capitalise on his early 1930 patents, which were just about to run out. It is not known what the exact outcome of this new onslaught of litigation was, but it seems clear that Miessner was no more successful in establishing his cartel than he had been in the 1930s. By this time, the electric guitar market had moved on; the Miessner patents were running out of time and their claim to legitimacy running out of steam.

During the 1930s patent lawyer William H. Maxwell designated the ongoing threat of litigation by Miessner as the "Miessner matter".[33] While Miessner's actions appear to have never developed into a full-blown lawsuit, for many, if not most, of the manufacturers of electric guitars during the 1930s, this threat was a cause of constant concern and consternation.

Many aspects of Miessner's activities are not yet well understood, and fall outside the scope of this thesis; it is therefore difficult at this juncture to fully place Benjamin Franklin Miessner and Miessner Inventions fully within the context of the nascent electric guitar market. However, one thing is clear; while the stream of litigation created by Miessner may have had a temporary dampening effect, it ultimately failed to have a significant impact on the rise of the electric guitar.

[33] Rickenbacker Archives. Letter to George Beauchamp from M. Davenport on behalf of W. H. Maxwell, December 21, 1936

COMPETITORS OF THE RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

The Rickenbacker/Electro String electric guitar did not commercially develop in a vacuum; the company had many competitors in the nascent electric guitar market of the 1930s. From a technological perspective, the instruments marketed by Rickenbacker's competitors ranged from extremely close technological knock-offs of George Beauchamp's design to pickup systems that worked on very different principles than Beauchamp's. Due to the confusion that has surrounded the development of the electric guitar, some of these instruments have been suggested as candidates for the title of the first electric guitar. A brief overview of some of the more important competitors, both commercially and technologically, of Rickenbacker/Electro String is useful in helping to put Rickenbacker and their instruments in context. N.B. the Stromberg-Voisinet "Electro" amplified stringed instruments of 1928 discussed in chapter one were never a direct competitor of Rickenbacker, having disappeared from the market by the middle of 1929.

Competitors of Ro-Pat-In/Electro String's electric stringed instruments appeared within months after the frying pan entered the market. It is important to note, however, that while the competitors of the frying pan were creating instruments that were intended to achieve the same end result – that is, the electrical amplification of the instrument's sound – not all of the competition achieved this in the same manner. The competitors of Ro-Pat-In/Electro String can be broadly divided into three categories:

1. Commercial competitors using an electromagnetic pickup derived from Beauchamp's design.
2. Commercial competitors using other pickup systems.
3. "Homebrew" instruments; instruments made non-commercially (which were overwhelmingly of the Beauchamp type).

The following lists, while extensive, are not comprehensive. While many of the companies involved in the nascent electric guitar market are known, few are well documented and much research remains to be done.

COMPETITORS USING BEAUCHAMP-DERIVED DESIGNS

By far the largest category of competitor of Ro-Pat-In/Electro String were those that used pickup systems derived, if not wholesale copied, from Beauchamp's horseshoe pickup. The reasons for this are not particularly surprising. As previously noted, the difficulties Beauchamp had in patenting the frying pan opened the door to copies and knock-offs of his design, since until the granting of the frying pan patent in 1938, it was not clear that Beauchamp's design was in fact patentable. The competitors of Ro-Pat-In/Electro String using Beauchamp-derived pickups can be further divided into two categories; those that used pickups that physically resembled the horseshoe pickup and those whose pickup designs, while based on Beauchamp's technology, had a different physical configuration. It should again be noted that, while Beauchamp's pickup design was the one that eventually achieved dominance in the marketplace (a dominance which continues to this day), the physical configuration of Beauchamp's pickup design, consisting of two horseshoe magnets facing each other which completely surround the vibrating strings, is not typical of most modern pickups.[1] Over time, pickups with a physical layout of the magnet and coil completely underneath the strings, rather than surrounding them, have proven to be the most popular design for electric stringed instrument pickups. One should not, however, be fooled by the lack of physical similarity to Beauchamp's pickup into thinking that this makes the Beauchamp-derived pickups made by Ro-Pat-In/Electro String's competitors somehow different in function from the horseshoe pickup.[2]

The following is a brief overview of the commercial competitors of Electro String using electromagnetic pickups derived from Beauchamp's design, listed by date of introduction.

[1] Electro String/Rickenbacker used this design on instruments until the mid-1960s and even today employs a pickup design on its electric basses which aesthetically mimics this configuration.
[2] Indeed, the same caveat should be stated regarding pickups made by Electro String's competitors that were not based on Beauchamp's design; sometimes these can have strong physical similarities to Beauchamp-design pickups and yet work on different principles.

Dobro, 1933

Considering the Dobro Company's history, especially in regard to George Beauchamp, the fact Dobro entered the electric guitar market so quickly is particularly surprising. While the National Stringed Instrument Corporation appears to have rejected the idea of electric stringed instruments when first suggested by then company director Beauchamp, the Dobro Corporation (which was formed by John Dopyera with his brother after leaving National) appears to have taken to the idea right away.[3] The Dobro company's first foray into electric stringed instruments was in early 1933 with a design they licensed from Arthur J. Stimson. Known as the "All Electric", the instrument's designed used the vibration of a metal bar attached to the bridge to drive the pickup. This pickup worked in a manner that was not dissimilar to the Stromberg-Voisinet "Electro" pickup design of 1928. The design was problematic and was soon abandoned by the company. In late 1933 Dobro introduced their second electric guitar design to the market, also licensed from Stimson, and also known as the "All Electric"(see figure 10.1). The second Stimson design used by Dobro, while a physically different configuration than the Beauchamp design, worked on the same principles. However, Stimson's second pickup design was notable for its use of two coils (as opposed to Beauchamp's single coil), one mounted at each end of the horseshoe magnet. Since each end of the horseshoe magnet has a different polarity (North and South) and the coils were wired in series, this, in essence, gave the Stimson pickup the noise-cancelling properties of a humbucking pickup. Designed by Gibson Guitars employee Seth Lover during the mid-1950s, the humbucking pickup is one of the best-known styles of modern electric guitar pickups. Its use of two coils wired in series (as opposed to wired in parallel) was designed to cancel some of the noise inherent in pickup designs using a single coil. The resulting sound, which is less bright than that of single coil pickups, has become the defining sound of Gibson-style instruments and has found favour with many players.

Later in the 1930s Dobro, like their competitors Electro String Instrument Corporation, spent much effort in developing and marketing electric violins. These instruments, in common with all electric violin-family instruments developed during this period, failed to have a significant impact on the marketplace. Although Dobro's

[3] As noted earlier, understanding the relationships between the various companies the Dopyera brothers were involved in can be confusing.

reputation today rests firmly on their acoustic resonator guitars, by the late 1930s the company appears to have focused heavily, if not almost exclusively, on electric stringed instrument production. It would not be until the 1960s, when the resonator guitar (played with a guitar steel as in Hawaiian playing) began to be generally used in country and bluegrass music, that the Dopyera brothers would again concentrate on making resonator-style stringed instruments.

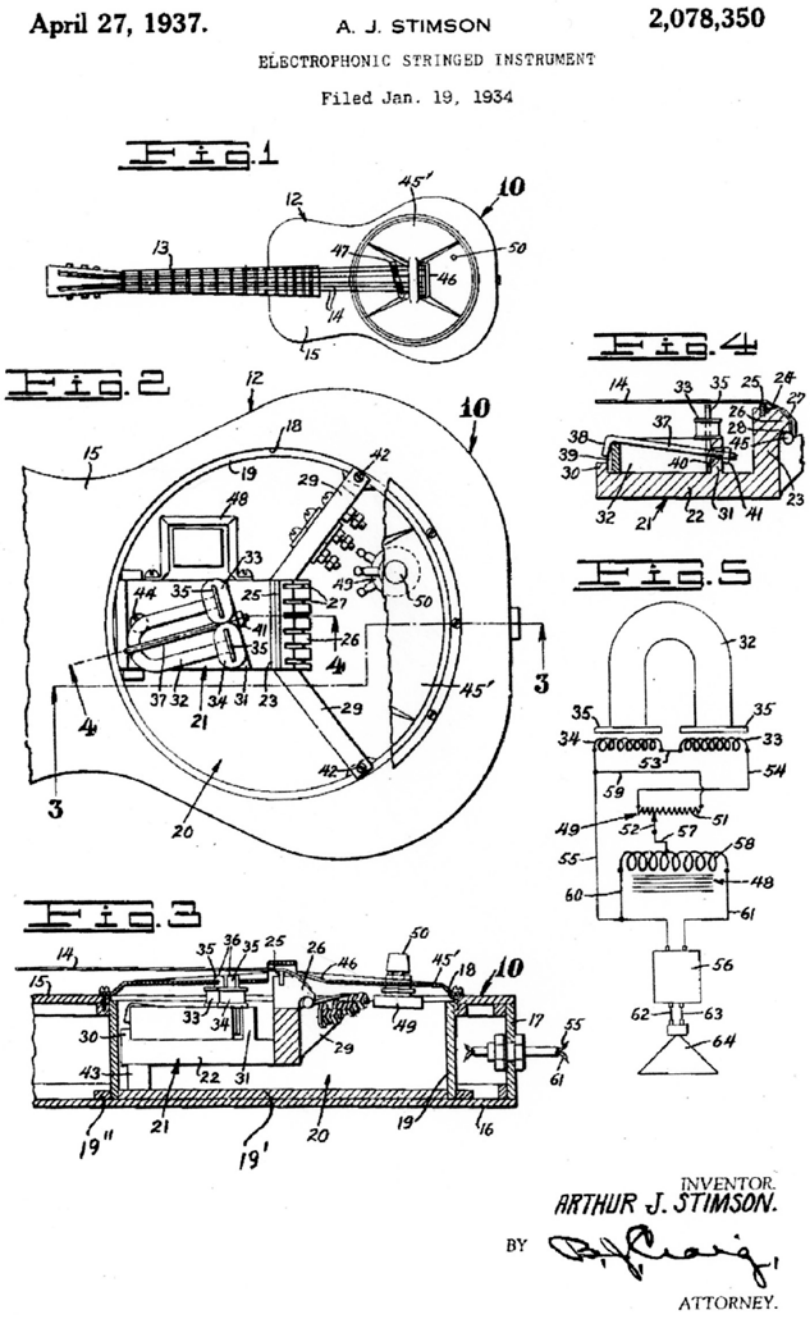

Figure 10.1 – Patent for Arthur J. Stimson's 1933 pickup design, manufactured by Dobro as the second version of their "All Electric" Hawaiian guitar.

Audiovox, 1935

The Audiovox guitar is one of the more intriguing competitors of the early Electro String Instrument Corporation. The instruments were manufactured by Seattle musician and music store owner Paul Tutmarc (see figure 10.2). Audiovox's range of instruments was broadly similar to Electro String's, concentrating on Hawaiian-style instruments, with at least one model each of electric guitar and electric bass guitar. At least one double-neck electric Hawaiian-style model was made during the 1930s, featuring an unusual combination of short scale and long scale necks (most double-neck Hawaiian instruments had necks of the same scale length). The pickup design on the Audiovox instruments is extremely similar, if not identical, to the second Arthur J. Stimson design used by Dobro from the mid-1930s onwards. Interestingly, Bud Tutmarc, Paul's son, has suggested that Stimson collaborated with Paul Tutmarc on pickup design (it is not clear which pickup design is meant), which he then licensed to Dobro without giving Tutmarc credit.[4] Although it is been suggested by some that Tutmarc had been working on his electric guitar before Beauchamp, this is almost certainly not the case.[5] While Tutmarc's assertions to being the inventor of the electric guitar are spurious, he does have an excellent claim to being the creator of the first electric bass guitar, having been featured in a local newspaper and selling them commercially possibly as early as 1935.[6] As a side note, Audiovox bass guitars were depicted in Coast Wholesale jobber's catalogues as late as the early 1940s[7], and there is a possibility that Leo Fender may have been inspired in the creation of his 1951 "Precision Bass" guitar by Tutmarc's bass guitar.

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[4] Bud Tutmarc, "The True Facts on the Invention of the Electric Guitar and Electric Bass," http://www.tutmarc.tripod.com/paultutmarc.html. Retrieved 21/9/2007.

[5] Peter Blecha, *Wired Wood: The Origins of the Electric Guitar* ed. Robert Palmer, Explorations of American Popular Music (Seattle: Experience Music Project, 1996). p. 7. Tutmarc, "The True Facts on the Invention of the Electric Guitar and Electric Bass."

[6] There had been earlier instruments, however, both fretted and un-fretted, based on instruments of the double bass family. By the mid 1930s several companies had developed such electric stringed bass instruments, including Rickenbacker, Dobro and Gibson. Although an in-depth discussion of the differences between these instruments and Tutmarc's bass guitar is outwith this thesis, one of the main differences is string length, with Tutmarc's bass having a string length comparable to that of the guitar (and thus allowing the use of a guitar-playing technique, in a manner similar to what an electric bass player employs today) and the others having a string length more or less comparable to that of the orchestral double bass.

[7] Coast Wholesale's market area encompassed the entire West Coast of United States, from San Diego to Seattle.

Although Tutmarc was a tireless promoter of his instruments, and despite their being distributed by a major wholesaler, Audiovox instruments were never made or sold on a large-scale, with many sales being made to Tutmarc's own music students through his store. Very few these instruments are known to exist today.

Figure 10.2 – Paul Tutmarc with Audiovox Instruments, mid-1930s.

The instrument in the centre is a model 736 "Bass Fiddle" (electric bass guitar).

Epiphone, 1935

The New York City-based Epiphone company had started out making acoustic guitars, primarily archtops, much like those made by the Gibson company. For much of the middle of the century, they were probably Gibson's biggest rival in the market.[8] Epiphone entered the electric guitar market in earnest in the third quarter of 1935, just a few weeks before Gibson's introduction of their electromagnetic pickup. The very first

[8] During the mid 1950s Gibson would actually buy Epiphone and establish a separate dealer network in parallel with its Gibson network of music stores, thus in essence creating competition with itself. Although Gibson would have great success marketing electric guitars under Epiphone name, the main reason Gibson bought the Epiphone company was to acquire its manufacturing capabilities for violin family instruments for the school orchestra market.

Epiphone electric guitars were solid-body Hawaiian-style instruments marketed under the name of "Electrophone". Around November 1935, the electric instrument line was renamed "Electar" and at the beginning of 1936 the line was expanded to include Spanish-style guitars, banjos and mandolin-family instruments. It is clear that Epiphone was very committed to the marketing of these new electric string instruments; advertisements placed by Epiphone in *The Music Trades* and *The Purchaser's Guide to Musical Instruments* from 1936 onwards feature the new electric guitars exclusively, to the point of omitting all mention of the company's acoustic instruments, which they still continued to manufacture.

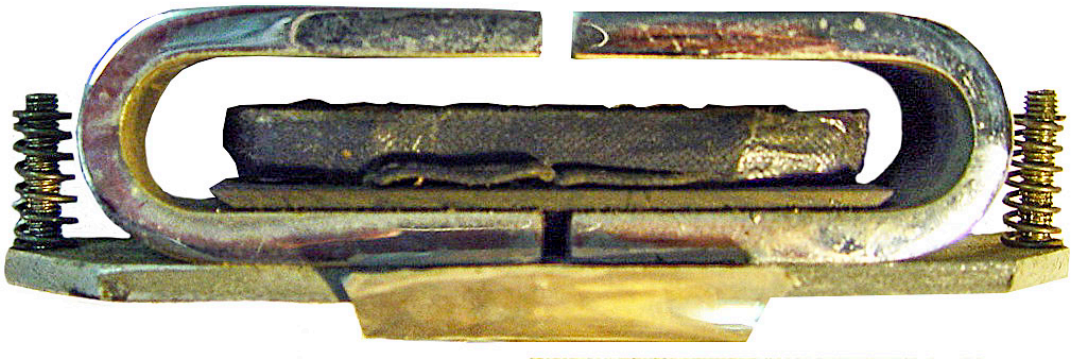


Figure 10.3 – Epiphone horseshoe-style pickup, mid-1930s.

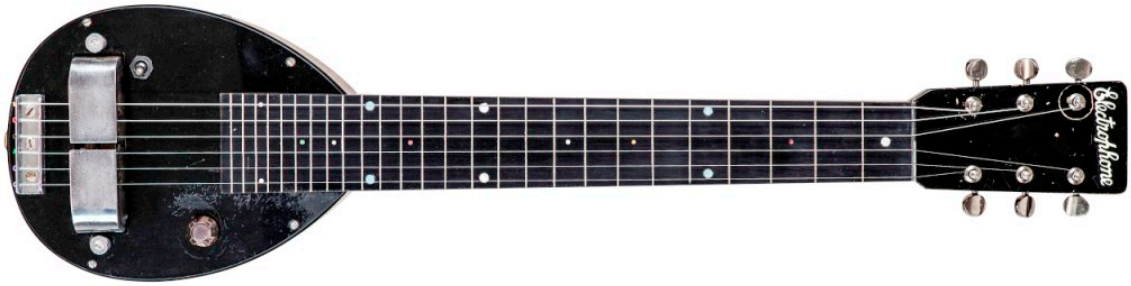


Figure 10.4 – Epiphone "Electrophone" electric Hawaiian guitar, 1935.

The pickups manufactured by Epiphone during this time are almost exact duplicates of the horseshoe pickups made by Electro String, so much so that many people then and now confuse the two. It is this close similarity that probably explains why Electro String requested an Epiphone Hawaiian guitar for their patent demonstration in Washington DC in November 1936; Electro String was probably trying to drive home the point that their business was being damaged by unauthorised

copying due to the patent office's reluctance to grant Beauchamp his patent on the frying pan.

Epiphone was one of the few companies to capitulate to Miessner Inventions Inc.'s demands for obtaining licensing rights from Miessner to manufacture electric guitars. As such, almost all electric stringed instruments made by Epiphone during the late 1930s carried a small metal plate indicating that the instrument was manufactured under licence from Miessner. It is tempting to speculate that the similarity of Epiphone's pickup to those made by Electro String (being for the most part virtually identical) is what led Miessner Inventions to initiate legal proceedings against Electro String Instrument Corporation.

Gibson, 1935

Although they first attempted to enter the electric stringed instrument market in 1933 (as noted in the next section on competitors using other pickup systems), it was with their first electromagnetic guitar pickup (popularly known today as the "Charlie Christian" pickup[9]) that Gibson first found success in the electric stringed instrument market. From the outside of the instrument, the Charlie Christian pickup looked very different from the horseshoe pickup, and much closer to modern single-coil pickup designs. However, the Charlie Christian, like the Rickenbacker horseshoe pickup, still employed two large horseshoe magnets in its design, although these were not nearly as big as those used on the Rickenbacker horseshoe pickup. The magnets were mounted out of sight underneath the soundboard of the guitar (although the three mounting screws could be seen from the top) and were angled in a "V" shape towards the pickup coil, with the top of the coil and the pole pieces protruding through the soundboard of the instrument.

The Charlie Christian pickup was first used on the EH150 Hawaiian guitar (see figure 10.5), the instrument becoming available around October of 1935. By the end of the year the pickup unit was being offered separately as an add-on unit for both Hawaiian and Spanish guitars. Although this pickup is most commonly associated with the ES150 Spanish guitar, the first Spanish-style guitar on which it was used, this

[9] The name "Charlie Christian" was never used by Gibson until reproductions of the pickup were made in the late 20th century. The pickup does not appear to have had a model name before then, but the term "Charlie Christian pickup" has been in common parlance since at least the early 1960s.

instrument did not debut until December 1936. The pickup unit was offered on a mandolin and a banjo model by the end of 1937. It is noteworthy that the first electric instruments offered Gibson were decidedly on the lower end of the price range; it would not be until after World War II that Gibson would begin to offer electric versions of its well–known higher priced guitars, such as the L5 and the Super 400.

Figure 10.5 – Gibson ES-150 electric guitar, c. 1936.

Regal, 1936

Established in 1908, the Chicago-based Regal Musical Instrument Co. was, by the 1930s, one of the largest American manufacturers of stringed instruments, concentrating on instruments priced in the middle of the market. Regal produced instruments and instrument parts for other companies as well, including wooden resonator guitar bodies for both National Stringed Instrument Corporation and Dobro Corporation. In 1936 Regal manufactured an electric guitar pickup with an unusual

design, consisting of two assemblies of six individually wound coils wired in series. Each of these two coil assemblies were mounted on a long thin bar magnet, in a manner that was physically similar to Gibson's humbucking pickup design of the 1950s. This configuration created what was, in essence, a 12-coil humbucking pickup. The pickup is also notable for its metal cover, which is made in such a way as to completely enclose the magnetic coils, thus shielding them from electromagnetic interference, which in turn reduces signal noise from the pickup, making it much quieter. It is not known to what extent these pickups were manufactured or marketed, but it is likely that they were made in extremely limited quantities, as only two examples are known to exist. Regal ceased making electric guitars some time in 1941, around the time of United States' entry into World War II.

Figure 10.6 – Regal electric guitar pickup, 1936.[10]

[10] The exemplar shown here is from the collection of Lynn Wheelwright and is one of only two known examples of this pickup.

Slingerland, 1936

Although best known for making drums and other percussion instruments, the Slingerland Company also manufactured a line of guitars prior to World War II. Although at first glance it may appear somewhat strange for a drum company to enter the nascent electric guitar market, there was a certain logic to the company's reasoning; while drums were always the company's main focus, banjo-family instruments – due to their similar construction to drums – were a natural extension of Slingerland's product line and guitars were thus a natural extension to the company's banjo line. Slingerland used the name "Songster" for a variety of their higher end stringed instruments (the name "Maybelle" was typically used for lower-end instruments) including flattop and arch-top guitars. The Slingerland Songster electric guitars came in two models; the model 401 Spanish-style guitar, and the model 400 which was designed for Hawaiian-style playing. The pickup used on the model 400 and 401 featured individual coils for each string (in contrast to the single coil used in the Electro String and Epiphone designs) and a very large horseshoe magnet (larger than the horseshoe magnets used on the early Electro String designs) that was mounted with the pole ends of the magnet perpendicular to the coils. The use of more traditional materials (wood) and a more readily understood design vernacular in comparison to the Bakelite and metal construction of the early Rickenbacker electric Spanish guitars have led to the oft repeated, yet mistaken, assertion that the model 401 was the first solid-body electric Spanish guitar.

Figure 10.7 – Slingerland "Songster" model 401 electric Spanish-style guitar and its massive six-coil pickup, late 1930s.

COMPETITORS USING OTHER PICKUP SYSTEMS

Less numerous, but still significant, were manufacturers that marketed rival pickup systems which worked differently than Beauchamp's. Although these other pickup systems functioned differently in their sound-producing mechanisms, they still utilized the same general electromagnetic principles.

ViViTone, 1933

Lloyd Loar is often mentioned as having worked on electric instruments at Gibson guitars during his tenure there in the early 1920s. In fact, it has been said that one of the reasons for his departure from Gibson was Gibson's refusal to market a line of electric instruments that he had developed. These accounts all appear to stem from an assertion made by long-time Gibson guitar historian Julius Bellson in a self-published book on the history of Gibson guitars:

> In 1924 Gibson electric instruments were shown to teacher agents,[11] who together with the public, were not yet ready to accept this great revolutionary discovery. Differences of opinion in regard to marketing, and the type of instruments to make, resulted in a change of top management personnel in 1924. [Lloyd Loar] then formed the ViViTone Company with headquarters at 300 – 400 West Kalamazoo Avenue, and manufactured electrics. These were quality instruments that were born 20 years too soon. The demand was not there and the venture proved unsuccessful.[12]

An electric viola exists that is said to have been made during his tenure at Gibson. An examination of this viola shows it to be very similar in construction to the ViViTone electric violin of the mid 1930s at the National Music Museum in Vermillion. Particularly telling is the use of potentiometers in both instruments of a type that were made by the Chicago Telephone Supply (CTS) company in relatively limited quantities during the mid 1930s. The case for the Viola being made before 1924, the date of Loar's departure from Gibson, is made more difficult due to the fact that the potentiometer itself didn't exist until the late 1920s and doesn't appear to have been commercially available until the early 1930s.

[11] At the time many Gibson instruments were sold through a network of music teachers.
[12] Julius Bellson, *The Gibson Story* (Self-published, 1973). p. 31.

The ViViTone design works electrostatically, with pressure from the bridge of the instrument driving an armature which in turn generates an electrical signal from a magnetic coil. One of the characteristics of Lloyd Loar's pickup design is a relatively weak signal output compared to other pickup systems of the time. This weak signal output necessitated the use of more powerful amplifiers in order to create an instrument volume of comparable loudness with other systems.

Figure 10.8 – ViViTone electric tenor guitar, mid-1930s.

Note the unusual use of spruce wood (typically used for soundboards) and f holes on the back of the instrument, indicating its intended use as an acoustic, as well as an electric, instrument.

In the last 30 or so years, Lloyd Loar has obtained an almost legendary status amongst early 20th century guitar aficionados. This is mostly due to his employment by Gibson in the early 1920s, overseeing the production of the company's high-end instruments, in particular its arched-top guitars and "F" style mandolins. In particular, the famous F5 model mandolins made by Gibson in the early 1920s, whose labels were signed by Loar after final inspection, are counted amongst the most revered (and expensive) stringed instruments of the 20th century. However, in contrast to the high regard in which the Gibson acoustic instruments associated with Loar's name are held, the electric stringed instruments created by Loar and his ViViTone company during the 1930s had little commercial success when they were created and have not seen their reputation increase since then.

Gibson, 1933

It is often thought that Gibson was a latecomer to the electric stringed instrument market, but this is not true; Gibson had a pickup on the market only a few months after the Rickenbacker Electro was first generally commercially available. Although more famous for their electromagnetic "Charlie Christian" pickup of 1935 (described above), the first pickup introduced by Gibson was a piezo pickup (which worked in a manner similar to a contact microphone)[13] that was first advertised in May of 1933 (see figure 10.9). This pickup was not sold as part of a guitar, but rather as a separate accessory. It was almost certainly not made by Gibson in-house, but was a rebranded item made by another manufacturer, possibly Lyon and Healy.

[13] For a description of the workings of a piezo pickup, see the section below on Sound Projects instruments.

Figure 10.9 – Advertisement for Gibson electric guitar, 1933.

Volu-tone, 1935

One of the more unusual configurations for electric guitar pickup has to be that made by the Schireson Brothers during the mid-to-late 1930s and marketed under the name of "Volu-tone". The Volu-tone pickup design was unique in that although it was electromagnetic, there was no actual permanent magnet incorporated into the pickup's design. Instead, the pickup utilised the magnetised strings of the instrument (which, like those used on all electromagnetic pickup designs, were ferrous) to activate the coil and produce an electrical signal. The pickup unit consisted of a large, flat coil of wire which was mounted in a rectangular housing with a very low profile, that was designed to fit on a guitar between its strings and its top without the need for cutting a mounting-hole. Although the unit was available pre-installed on both Hawaiian and Spanish-style guitars, the Schireson Brothers appear to have concentrated on marketing the Volu-tone primarily as an add-on accessory for guitars by other makers. It is known that Martin guitars referred customers wishing to amplify their Martin instruments to Schireson Brothers throughout the late 1930s.[14]

Figure 10.10 – Volu-tone electric guitar advertisement, mid-1930s.

[14] It is also known that Martin made some tentative enquiries into marketing their own electric guitar using technology developed by Benjamin Franklin Miessner .

A feature of the Volu-tone pickup system which has made it somewhat notorious was the method by which the instrument strings were magnetised. The Volu-tone amplifier had three inputs; microphone, instrument, and Volu-tone pickup (see figure 10.11). The input for the Volu-tone pickup was connected to a switch, that when activated, sent 400 volts of direct current (DC) at the connecting cable into the guitar pickup, creating a temporary electromagnet, which would in turn magnetise the guitar's strings, allowing the pickup to function. While instructions on the back of the amplifier specify that two seconds of charging should be sufficient to magnetise the string (as well as advising caution on the part of the player), it takes little imagination to recognise the possible danger that this system might entail.[15] Although the company did market a non-electrical magnet for magnetising the guitar strings for musicians who did not own a Volu-tone amp, it is perhaps not surprising that the Volu-tone system failed to become a permanent fixture in the marketplace. However, while the Volu-tone pickup seems not to have been particularly commercially successful, the Volu-tone amp did have its proponents; famous steel guitarist Jerry Byrd was known to favour using a Volu-tone amp with his Rickenbacker B6 lap steel.

Founded in 1902 as a manufacturer of bicycle parts, the Schireson Bros Company had by the mid-1920s expanded into manufacturing and importing musical instruments. These instruments were rarely marketed under the Schireson Bros own name, typically being labelled with the company's "Hollywood" brand name. Schireson brothers were also importers and distributors of Latin American instruments, especially stringed and percussion instruments, made in Mexico.[16] During the 1920s and 30s ukulele-family instruments were a major part of the company's production. In the late 1920s the company began to produce a wood-bodied single-cone resonator guitar much like those made by National Stringed Instruments and Dobro. While aesthetically very similar to those instruments, the Schireson Bros design employed an aluminium cone mounted in the opposite manner to that of the National and Dobro designs, with the cone appearing concave relative to the front of the guitar. Attaching the cone in this manner meant that the bridge of the instrument could not directly rest on the

[15] Death by electric guitar electrocution is thankfully rare, but it has happened; Scottish guitarist Les Harvey (brother of "Sensational" Alex Harvey) of the band Stone the Crows was electrocuted on stage (due to an improperly earthed guitar and microphone) on May 4, 1972.
[16] Steven Joseph Loza, *Barrio Rhythm : Mexican American Music in Los Angeles*, Music in American Life (Urbana: University of Illinois Press, 1993). p.79.

aluminium cone, but instead had to be attached to the cone via a dowel of wood. This reportedly had a negative impact on the sound. The combined National Dobro Company sued the Schireson Bros in the early 1930s for patent infringement, a suit which National Dobro won in 1937, forcing Schireson Bros to destroy their stock of resonator instruments, making these guitars quite rare today. Although the company ceased production of the Volu-tone pickup by the beginning of World War II, the company continued to manufacture and distribute electronic amplification equipment under the Volu-tone name and continues to do so today, making it one of the oldest continuously-operating audio products companies in existence.

Figure 10.11 – Volu-tone electric guitar amplifier, mid-1930s.

In the right-hand picture, the third input from the left was capable of sending 400 V DC back to the guitar pickup by means of the switch to the right of the input.

Sound Projects, 1938

The Chicago-based Sound Projects Company is one of the more enigmatic of the businesses discussed in this chapter. Very little is known about the company; they appear to have done little or no advertising until the 1960s (by which time they had changed their name to "Lectrolab") and almost all the information known about Sound Projects is based on the company's surviving instruments. Sound Projects began producing their first electric guitars around 1938. Both an electric Hawaiian and an

electric arch-top Spanish-style guitar were produced, both with the brand and/or model name of "Troubadour".[17]

Figure 10.12 – Sound Projects "Troubadour" model electric Hawaiian guitar, late 1930s.

Although the Troubadour electric Hawaiian guitar, with its small cast-metal body and slotted headstock, at first glance appears very similar to Rickenbacker's frying pan, the Troubadour's pickup is not electromagnetic, as Beauchamp's design is, but piezo-electric. Although piezo (from the Greek, *piezein*, meaning to squeeze or compress) pickups are outwith this thesis, they are worthy of short explanation here. Unlike electromagnetic pickups, in which the signal is created by a ferrous string disturbing an magnetic field which in turn creates an electrical current, the signal in a piezo pickup is generated by acoustic or vibrational pressure (typically from an instrument's bridge, saddle or soundboard) which in turn creates a piezo-electrical charge. First recognised in the 1880s, piezo-electric principles were used in the development of sonar by the French during the First World War, and by the late 1920s were the basis of many phonograph cartridges. These phonograph pickups typically used carbon crystal technology to produce the electrical signal and most piezo-electric pickups today use a similar technology. The pickups on the Sound Projects instruments, however, utilise interwoven sheets of very thin copper to create a form of voltaic pile. Notably, the pickup has only one wire leading from it, the circuitry being completed by a physical attachment to the pickup's brass mounting plate. Compared to electromagnetic pickups, piezo pickups have a much weaker output and are typically used with a preamplifier. Although there is no particular organological reason for doing so, piezo pickups are rarely used as a substitute for electromagnetic pickups, and are

[17] George Alexander, "Lectrolab Guitar Amplifiers " https://lectrolab.wordpress.com/. Accessed 7/7/2011

more typically used for the amplification of otherwise completely acoustic instruments, most commonly on flattop acoustic guitars. However, there are some exceptions to this; guitars such as the Parker Fly utilise piezo pickups in conjunction with electromagnetic pickups to allow the instrument to create sounds similar to an acoustic guitar as well as more conventional electric guitar sounds.[18]

The Sound Projects Company was in business until least the mid 1960s. Throughout the company's business life it appears to have aimed their products squarely at the mid to lower end of the market, concentrating its efforts on local distribution.

NON-COMMERCIALLY MADE "HOMEBREW" INSTRUMENTS

The third category of competitors to Ro-Pat-In/Electro String is one that has been generally overlooked and/or ignored by writers of guitar history; that of "homebrew"[19] or non-commercially made instruments. In contrast to the variety of systems employed by some of the competitors of Ro-Pat-In/Electro String, the vast majority of these amateur-built instruments (or at least those that survive) are either copies of, or derived from, George Beauchamp's design. The reasons for this are unclear, but it is possible to speculate on several scenarios which would explain this. One possibility is that the surviving home-made instruments tend to be of the Beauchamp electromagnetic type simply because this is the design that became established commercially in later years. It does make sense that players would tend to use and preserve instruments that were compatible with later amplification systems. Another likelihood is that the type of person who created these instruments was simply interested in creating a working piece of gear, rather than in electrical experimentation. In such a case, imitating the most widely known and commercially successful pickup technology seems obvious. This imitation of Beauchamp's designs in the 1930s stands in stark contrast to the type of electronically-tentative home-made electric string instruments that were typical of the 1920s. This is probably the key difference between "homebrew" instruments of the 1920s and those of the 1930s and beyond; the makers of the 1920s were interested primarily in electrical experimentation, while later amateur

[18] Although the Parker Fly is the best-known modern example of a guitar with this kind of configuration, instruments combining electromagnetic and piezoelectric pickups date back to at least the early 1960s, a notable instance being the National Glenwood 99 model (which was also famous for being the shape of a map of the United States).
[19] "Homebrew" is probably the most commonly used term to describe these amateur-made instruments.

makers were primarily interested in creating functioning and reliable musical instruments, often for personal (and sometimes professional) use.

Figure 10.13 – "Homebrew" electric Hawaiian-style guitar, late 1930s.[20]

The pickup on this instrument is similar to a Rickenbacker/Electro String horseshoe pickup. Note that this instrument uses the same aftermarket "Perfect" brand nut for raising the string action as is used on George Beauchamp's original wooden "Frying Pan" prototype.

Although they may not have varied much in electrical design, these home-built instruments (not surprisingly) vary significantly in build quality. While some of these instruments are undeniably crude, others are of such good design and construction that they are mistaken for commercially manufactured instruments. While this is perhaps not unexpected for instruments made of wood – excellent amateur woodworkers are not uncommon – it is perhaps more surprising when these home-made instruments are made from cast or machined metal, similar to metal-bodied instruments manufactured by National or Electro String.

Possibly the most famous "homebrew" instrument of all time is the "Log" built by Les Paul sometime in 1940-41 (see figure 10.14). Few individual guitars have as much mystique - and are as misunderstood - as this instrument. At various times it has been touted as the first solid-body electric guitar, the first electric guitar of any description, an arch-top acoustic, and a semi-hollow body guitar. All of these descriptions are incorrect. Much of the confusion regarding the organological nature of the "Log" stems from the perceived uncertainty (which has been dealt with at length earlier in this thesis) of what constitutes an electric guitar. It is also probable that Les Paul's later iconic status as the namesake of (but not inventor or designer of) the Gibson Les Paul model guitar has

[20] This instrument was likely made in Australia, and is now in the collection of Lynn Wheelwright.

added to the confusion. Certainly Les Paul did little during his lifetime to clarify things or disabuse the notion that he was the inventor of the electric guitar. This is not, however, to denigrate Les Paul's many achievements in the field of music technology. He was one of the first to use multi-track recording techniques and it is no exaggeration to say that modern audio recording, from the largest professional studios to the smallest bedroom studios using a laptop computer, owe a huge debt to Les Paul. It is interesting to note that although the "Log" sports a neck from a Gibson L series guitar, Les Paul is said to have built the guitar at the Epiphone factory in New Jersey. This is supported by the fact that the non-acoustic "wings" attached to the instrument which give it a conventional guitar shape were created from an Epiphone guitar.

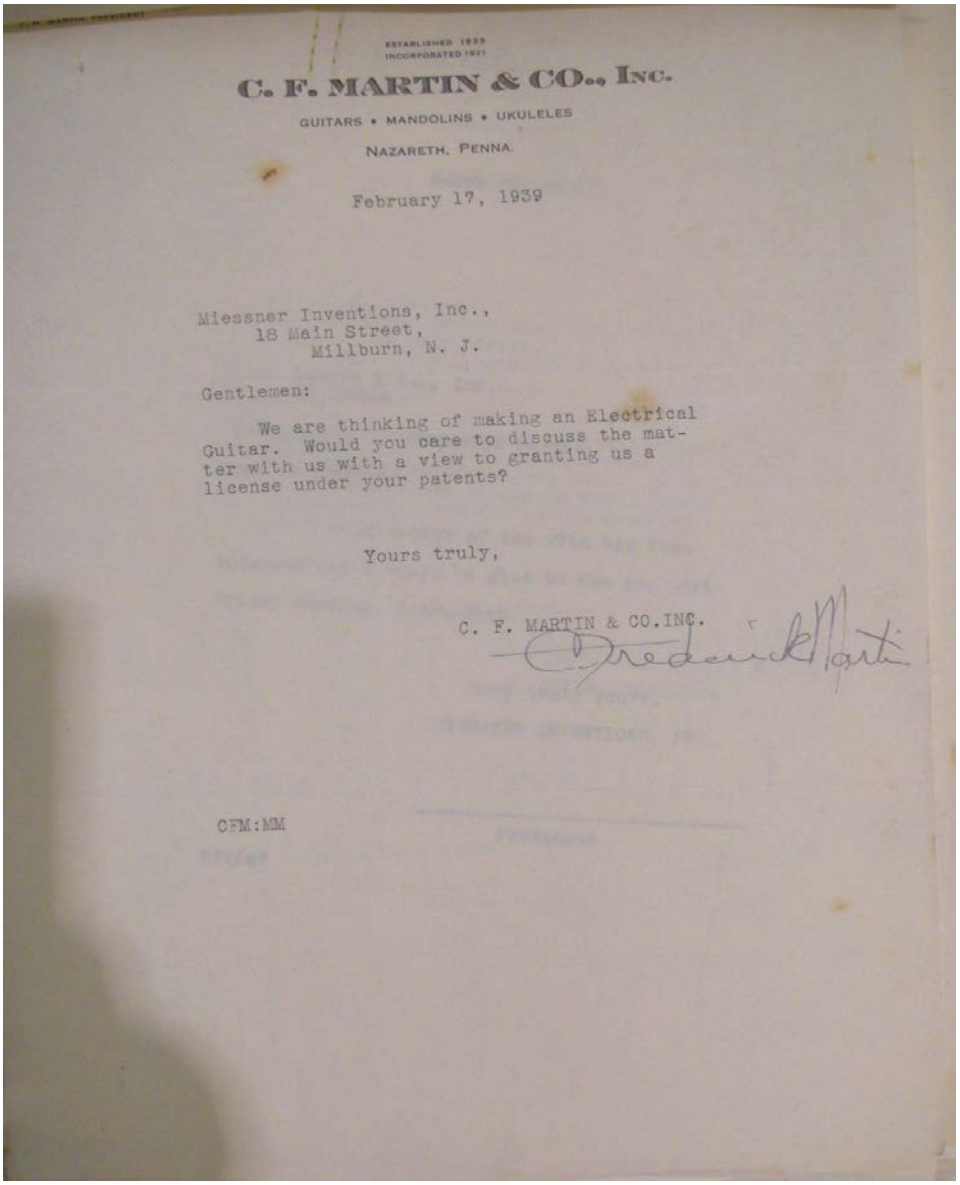
Figure 10.14 – Les Paul's "The Log" electric guitar, 1940-41.

There is one aspect of these home-made electric guitars that deserves a final thought; judging by the many extant examples, the electric guitar, and in particular the electric Hawaiian guitar, was almost certainly the most popular instrument for amateur makers to build during the mid-20th century. The reasons for this are not hard to discern – the Hawaiian guitar lends itself to being built in a way that can be as simple or as complex as the maker likes. Add to this the readily available parts offered by wholesalers from the 1930s, which allowed the builder to create professional sounding instruments, and it is easy to see the appeal of the electric Hawaiian guitar to amateur builders.

An in-depth comparison of the tonal and/or commercial success of these competitors of Electro String Instrument Corporation is beyond the scope of this thesis; however a few general comments are appropriate. Although it appears from the perspective of the early 21st century that there was a singular inevitability to the success of Beauchamp's pickup design, an examination of the historical record shows that this is far from true. Although Beauchamp's design became dominant in the marketplace, this was not due to a lack of effort on the part of others in developing and manufacturing other pickup designs. Not only has the physical configuration of Beauchamp's pickup – string driven, using magnets and wire coils – become the standard means of electrifying a guitar, the characteristic timbre and sound quality of Beauchamp's design has become the standard of what most people would understand to be the *sound* of the electric guitar. The fact that the vast majority of "homebrew" instruments were based on Beauchamp's design, rather than the many competing configurations, suggest that it was this characteristic tonal quality of the Beauchamp pickup that ultimately caught the public imagination.

As can be seen from the foregoing, all the major American guitar manufacturers of the mid-to-late 1930s, as well as many minor manufacturing concerns, were interested in marketing an electric guitar. There is, however, one very notable manufacturer missing from this list; the Martin guitar company. It is generally assumed that Martin had no interest in the electric guitar because it did not fit its marketing demographic – musicians who used flattop Spanish-style guitars typical of the folk, and country and western genres. However, this viewpoint oversimplifies the true state of affairs. In the 1930s, guitarists in all genres of American music tended to be much more flexible in their choice of instruments than they are today. While country and western music is now very much associated with the type of flattop acoustics made by Martin, this was not always the case; "Mother" Maybelle Carter, of the Carter family, was famous for playing an early arched-top Gibson L5, and many other early country and western musicians played similar instruments. During the 1930s Martin made a concerted attempt to break into the arched-top guitar (the style of instrument used by used by swing, jazz and dance band guitarists) market, introducing several different models, all of which were ultimately commercial failures. More significantly, in 1939 the Martin company wrote a letter to Benjamin Franklin Miessner enquiring about the possibility of licensing

Miessner's pickup technology for manufacture.[21] A meeting between Martin and Miessner was scheduled for 31 March, 1939, at Miessner's offices in Milburn, New Jersey (which was approximately 70 miles due east of the Martin factory in Nazareth, Pennsylvania). The outcome of that meeting (if it occurred as scheduled), is not preserved, but it is known that Martin ultimately decided not to pursue the electric guitar market during this time.[22]



ESTABLISHED 1833
INCORPORATED 1921

C. F. MARTIN & CO., INC.

GUITARS • MANDOLINS • UKULELES

NAZARETH, PENNA.

February 17, 1939

Miessner Inventions, Inc.,
18 Main Street,
Millburn, N. J.

Gentlemen:

We are thinking of making an Electrical Guitar. Would you care to discuss the matter with us with a view to granting us a license under your patents?

Yours truly,

C. F. MARTIN & CO. INC.

C. Frederick Martin

CFM:MM

Figure 10.15 – Letter from C. Frederick Martin to Benjamin F. Miessner, February 17th 1939.

[21] Benjamin Franklin Miessner Archive, Purdue University, West Lafayette, IN.
[22] Although the Martin company would later, unsuccessfully, attempt to launch electric guitar lines during the mid 1960s and late 1970s.

SUMMARY AND CONCLUSION

This thesis has considered all major aspects of George Beauchamp's role in the development of the electric guitar up to the end of the period of litigation against electric guitar manufacturers by Benjamin Franklin Miessner in 1939. The thesis also considers the historical context of the development of the electric guitar and other electric and electrified stringed instruments from the 1740s to 1931.

CHAPTER ONE – ELECTRIC AND ELECTRIFIED STRINGED INSTRUMENTS BEFORE 1931

Electric musical instruments have a much longer history than is generally recognised, with the earliest example (the *Denis d'or* of Václav Prokop Diviš) dating from the 1740s. However, early electric instruments employed electricity as part of the operational mechanism rather than a means of amplification. The first known application of electricity to a fretted musical instrument was by the American ex-naval officer George Breed, whose 1890 patent describes the use of the Lorentz force principle as a means of setting a string in motion and keeping it in constant vibration. Breed's patent contains a design for an electrified guitar, which utilises a large electromagnet, two separate electrical circuits, and a clockwork mechanism to function. Breed also describes the use of his invention as a keyboard instrument, and a means of multichannel telegraphic communication.

It has often been assumed that the desire for increased volume by musicians was the driving force behind the development of the electric guitar, but the historical record indicates that whilst increased volume was recognised as a benefit once the electric guitar had been invented, novelty, rather than loudness, appears to have been the primary factor motivating its invention. The earliest attempts at inventing the electric guitar were not by professional musicians but rather by experimenters. The earliest stages in the development of the electric guitar were very much intertwined with the developing sound-reproduction technology for telephones, whilst electrical amplification technology as developed for the motion picture industry was also important. By the late 1920s three key aspects needed for the invention of the electric

guitar had been developed; the amplifying valve (vacuum tube), the paper-coned loudspeaker, and the more-common availability of mains power in many parts of the United States.

The first electrically amplified stringed instrument to be marketed was the Stromberg-Voisinet "Electro", which was on sale for a short time around the end of 1928. Whilst no example is known to survive, a pickup unit that is almost certainly from one of these instruments does. This pickup functions in a manner different from George Beauchamp's 1931 design in that it uses the instrument's soundboard as the armature whilst Beauchamp's pickup uses the instrument's strings as the direct source of the vibrations that create the electrical current in the pickup's magnetic field.

The German Neo-Bechstein electric piano of 1928 has a pickup which uses the string as an armature to drive the pickup, a design that is very similar to Beauchamp's. It is not known if Beauchamp was aware of this instrument.

CHAPTER TWO – "THE MYSTERIOUS MR BEAUCHAMP"

Although he was the inventor of the electric guitar and a key figure in the development of the resonator guitar, George Beauchamp has heretofore not been as well known as other inventors associated with the American guitar. Originally from Texas, by the early 1920s Beauchamp was living in Los Angeles with his family, making his living as a house painter and playing the Hawaiian guitar professionally in vaudeville acts.

In 1926 Beauchamp commissioned Los Angeles luthier John Dopyera to build him an instrument with a Victrola-like horn. A second instrument commission by Beauchamp led to Dopyera developing the tri-cone resonator guitar. Beauchamp and Dopyera, along with Dopyera's nephew Paul Barth and Beauchamp's cousin-in-law Ted E. Kleinmeyer, formed the National Stringed Instrument Corporation in 1927 to manufacture Dopyera's invention. Adolph Rickenbacher made the stamped-metal bodies of the resonator guitars in his machine shop. Although the company was initially successful, in 1929 Dopyera left due to a personal dispute and soon after formed a rival company, the Dobro Corporation. In 1931, John Dopyera's brother Louis acquired control of National Stringed Instrument Corporation and forced Beauchamp and Paul Barth out of the company. At the end of 1934, National and Dobro merged to become the National Dobro Corporation.

CHAPTER THREE – GEORGE BEAUCHAMP AND THE DEVELOPMENT OF THE "FRYING PAN"

Little is known about George Beauchamp's experience and training in electronics before his work on the "frying pan" electric guitar. The earliest known drawing by Beauchamp of a pickup design differs significantly from the horseshoe pickup design that was used on the frying pan. Beauchamp first tried to interest National Stringed Instrument Corporation in making the instrument, but following a lack of success there, went into partnership with Adolph Rickenbacher and others to form the Ro-Pat-In Corporation. Former National employee and friend of Beauchamp, Harry Watson, carved the wooden bodied prototype, anecdotally reputed to be from an old fencepost. Various construction details of the wooden bodied prototype show that it was designed to be used as both a Hawaiian-style and Spanish-style guitar. The term "frying pan" in fact refers to two different instruments; the original wood-bodied prototype, and the aluminium-bodied production models. The production instruments came in three different models; the A25, A22 and the A22 seven string model.

CHAPTER FOUR – THE EARLY RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

The Ro-Pat-In Corporation was incorporated on October 15, 1931. The founding partners were Adolph Rickenbacher, George Beauchamp, Paul Barth and C. L. Farr. All but Farr had been involved with Beauchamp at National Stringed Instrument Corporation. It is unknown what activities, if any, the company engaged in between its incorporation and April 1932, when the company is mentioned in the minutes of National Stringed Instrument Corporation. The minutes show that National's sales manager Jack Levy was also the sales manager for the new Ro-Pat-In company and that the instruments were originally called "Elektro" (rather than the later spelling of "Electro"). It is unknown what the name "Ro-Pat-In" actually stood for. Company records show that Ro-Pat-In started to tool up for the production of the first frying pan models in August 1932. Although it is been assumed in the past that the aluminium-bodied frying pans were cast in-house, company records indicate that the castings were outsourced to three different companies. Sometime during 1933 the company changed its name from Ro-Pat-In to Electro String Instrument Corporation.

Although he was never employed by the company, Clayton Orr "Doc" Kauffman was a key person in the early Electro String Instrument Corporation,. Electro String produced and marketed his Vib-Rola vibrato tailpiece, which it used on some of the company's guitar models. The company also produced his Vibrola model electric guitar, which featured a motorised Vib-Rola tailpiece that mimicked the vibrato of a Hawaiian-style guitarist.

Early 1933 saw the beginning of a period of intense activity and growth for the Ro-Pat-In/Electro String Instrument Corporation, including the introduction of many new models. In 1935, Electro String's patent lawyer, William H. Maxwell was successful in trademarking the name "Electro" for use on the company's instruments. In 1937 the company directed Maxwell to initiate legal proceedings against various companies that Electro String felt were infringing on its impending patent of the electric guitar.

CHAPTER FIVE – GUITAR FAMILY INSTRUMENTS OF THE RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

The earliest known instruments sold by Ro-Pat-In are an A25 frying pan and an electric Spanish guitar bought by Wichita KS musician Gage Brewer. The electric Spanish guitar differs significantly from later Ro-Pat-In/Electro Stringed instruments and has certain features that make it remarkably akin to modern electric guitars. The company made three models of hollow-bodied electric Spanish guitars, using wooden guitar bodies supplied from other manufacturers.

By late-1935 Electro String had begun to de-emphasise aluminium bodied instruments in favour of newer models made from Bakelite. Adolph Rickenbacher obtained the rights to make musical instruments out of Bakelite from a British inventor, no doubt due to his machine shop having previously made items out of the material. Bakelite Hawaiian guitars were made by the company in six, seven, eight, and ten string models and a similarly-styled model Spanish guitar was also produced. These Bakelite electric Spanish guitars were sold in the United Kingdom under the name "Selmer" and "Premiervox".

CHAPTER SIX – NON-GUITAR FAMILY INSTRUMENTS OF THE RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

Although they are best known for their guitar family instruments, from the very beginning Ro-Pat-In/Electro String also developed non-guitar family instruments. During the 1930s, the company marketed two different series of violin family instruments. The first were made of Bakelite and incorporated many unusual design features, such as lacking a scroll and having the tuning pegs mounted where the tailpiece normally would be. A matching double bass instrument made from cast metal was also produced. The second series of violin family instruments were made in the late 1930s, after the discontinuation of the first type, and featured aluminium-tube construction. These instruments featured conventionally shaped scrolls and necks.

Other instruments produced by Ro-Pat-In/Electro String included an electric mandolin, and an electric fretted *berda*-style double bass. In early 1933, an electric pedal harp was created for the comedian Harpo Marx.

CHAPTER SEVEN – PATENTING THE HORSESHOE PICKUP

The prosecution of George Beauchamp's electric guitar/horseshoe pickup patent was particularly problematic. There were two different patent attempts, the first in 1932 and the second in 1934. Just before the second patent attempt, Beauchamp replaced his original patent lawyer, Arthur F. Larrabee with William H. Maxwell. Part of the challenge in acquiring the patent was that the patent examiner did not believe the device actually worked. To prove that it did, Maxwell arranged for demonstration of the electric guitar for the patent examiner. Maxwell also acquired affidavits of the electric guitar's efficacy from an independent laboratory. Beauchamp was finally granted his patent on August 10, 1937.

CHAPTER EIGHT – BRINGING ELECTRIC INSTRUMENTS TO MARKET

The early market for electric guitars was aimed very much at professional players, especially players of Hawaiian-style instruments. At first, Ro-Pat-In/Electro String's marketing approach concentrated on sales to early adopters of the instrument and persuading jobbers/wholesalers to carry the company's products in their catalogues. Ro-Pat-In/Electro String had their instruments placed with major distributors in the West Coast, East Coast, and Midwest markets. The company also tried to create public

awareness for the new electric instruments by sponsoring a display at the Steel Pier in Atlantic City New Jersey and by proposing a promotional tie-in with the Bing Crosby movie, *Waikiki Wedding*.

CHAPTER NINE – THE "MIESSNER MATTER"

Almost completely forgotten today, Benjamin Franklin Miessner was a pivotal figure in the development of electric musical instruments during the 1930s. His company Miessner Inventions, Inc. created designs for electrical musical instruments which were then licensed to other companies to be produced. During the mid-1930s Miessner embarked upon a series of threatened litigations against electric guitar manufacturers, including Ro-Pat-In/Electro String, claiming infringement of his patents, even though it is now clear that Miessner's patent did not actually cover Beauchamp's electric guitar technology. While Miessner was successful in forcing some manufacturers (notably Epiphone) to pay licensing fees, he was ultimately unsuccessful in pursuing his claims against the nascent electric guitar industry.

CHAPTER TEN – COMPETITORS OF THE RO-PAT-IN AND ELECTRO STRING INSTRUMENT CORPORATIONS

Within five years of the frying pan's introduction in 1932, the Ro-Pat-In/Electro String instrument Corporation had many competitors. Electro String's competition can be broadly divided into three categories; 1) Commercial competitors using electromagnetic pickup derived from Beauchamp's design, 2) Commercial competitors using other pickup systems, and 3) "Homebrew" instruments – that is, instruments made non-commercially (the majority of which were of the Beauchamp type). Rival instruments were made by many well-known companies of the time including Gibson, Epiphone, and ViViTone. The only major guitar company not to introduce an electric guitar during this time was C.F. Martin & Co. The category of home-brew instruments is often overlooked, but during this period there were many home built examples of electric guitars – especially Hawaiian-style instruments – made during this period. Homebrew instruments, whilst amateur-made, were not always obscure; a well-known (albeit slightly later) example of a homebrew instrument is Les Paul's "Log" of 1940-41.

CONCLUSION: THE ELECTRIC GUITAR WITHIN THE CONTEXT OF THE TWENTIETH CENTURY AND BEYOND

From the vantage point of the early twenty-first century, the commercial victory and broad adoption of the electric guitar in general, and George Beauchamp's design for electric guitar pickups in particular, can easily be seen as inevitable. Certainly, at first glance, the weight of electric guitar sales seems to bear this out; in 1999, 835,620 electric guitars (with a retail value of almost $500,000,000 US) were sold in the United States, compared with 812,975 acoustic guitars.[1] Almost all of these electric guitars have pickup systems directly descended from Beauchamp's design. In addition, approximately 20% of the acoustic guitars sold in 1999 included pickups as well, although almost all of these acoustic guitar pickups were of the peizo and/or microphone type, rather than electromagnetic. What this seems to suggest, is that Beauchamp's design was not only responsible for creating a specific instrument – the electric guitar – but also popularising the concept that otherwise-acoustic instruments needed the ability to be readily amplified. Today's musicians demand that their guitars, whether acoustic or electric, can "plug in". The very ubiquity of this ability of musical instruments to be amplified has in recent times given rise to the term "unplugged" as a synonym for acoustic music – even though, somewhat ironically, it is often the case the acoustic instruments involved are still plugged in to an amplifying and/or recording system.

This thesis has considered the development of the electric guitar up to the period immediately preceding the Second World War. The story of where the electric guitar went from this point is ostensibly well known in the popular view; adopted by nascent rock 'n' roll musicians in the 1950s, the electric guitar became inexorably bound up with the rise of rock and youth culture of the 1950s and 60s, becoming an electromagnetic battle-standard for the decade's popular music and counter-culture society. Many of the musically defining moments of the 1960s – the Beatles on the Ed Sullivan show – Pete Townshend smashing his Rickenbacker at the Railway Hotel – Bob Dylan "going electric" at the Newport Folk Festival – Jimi Hendrix playing the "Star-Spangled Banner" at Woodstock – get much of their perceptual acuity from being visually centred on the electric guitar. Since then, the symbolic aspect of the electric guitar has transcended its musical boundaries, generally becoming a signifier of

[1] http://www.musictrades.com, "Total Guitar Sales, 1999". Accessed September 21, 2006.

contemporary popular culture. In recent times, one does not have to look very far to see the everyday semiotic use of the electric guitar; objects like jewellery, radios, clocks – even kitchen spatulas and bathroom sinks – have been made in its likeness; T-shirts and other clothing are emblazoned with its image, and a worldwide restaurant chain, the Hard Rock Cafe, not only employs an electric guitar in its corporate logo, but decorates its establishments with electric guitars and basses purportedly used by famous musicians. Electric guitars even fuel videogames; two extremely popular game titles of the early 21st century, *Guitar Hero* and *Rock Band*, are based on the premise of virtually playing the electric guitar, with the game controllers very closely modelled on specific guitars by famous manufacturers. It is no exaggeration to say the electric guitar has embedded itself in popular culture, especially as a symbol of rock 'n' roll (and its associated rebellion) in a way that few musical instruments have.

Figure 11.1 – Electric guitar-shaped sink (l) and spatula (r).

While all the foregoing is true, it is also profoundly misleading. The trajectory of the electric guitar post-World War II as it is commonly understood is mistaken on both musical and organological levels. On a musical level, the emphasis on the electric guitar as a rock 'n' roll instrument neglects its vast impact on other genres of music, such as jazz and country music. Popular iconography aside, is easy to forget that these instruments were not only adopted by rock 'n' roll musicians, but by almost every genre of popular music of the late 20th century. Country music especially, is an often neglected genre when considering the impact of the electric guitar. And yet, the twang of the

electric guitar and the plaintive wail of the steel guitar[2] are two of the best-known components of country music. It is often forgotten that two of the most well-known and widely manufactured electric guitar designs – the Fender Telecaster and Stratocaster – were not made for rock 'n' roll, but created specifically for Country and Western musicians; indeed, Leo Fender, who designed the instruments, is actually reputed to have disliked rock 'n' roll.

From an organological perspective, the story of the electric guitar as a primarily rock 'n' roll instrument overlooks the fact that there have been four significant and thriving branches of electric guitar technology in the second half of the 20th century; in addition to the electric guitar, the electric bass, the lap steel/pedal steel guitar, and other electric strings, especially violin-family instruments, have all been widely manufactured and commercially successful. While the electric guitar itself tends to be uppermost in the public consciousness, it is arguably not the most pervasive; that distinction rightfully goes to the electric bass guitar. Although its first iteration, the model 736 "Bass Fiddle" by Paul Tutmarc's Audiovox Company in the mid 1930s, was not commercially successful, the electric bass guitar has gone on to have a huge impact in popular music. It's well known how in 1951 Leo Fender created an electric bass guitar, roughly based on his Telecaster electric guitar design, but with a string length that was longer than the guitar's (but still shorter than that of a double bass). Fender named the instrument the "Precision Bass", due to the fact that its frets made note pitches precise, unlike an un-fretted double bass. Within 10 years, electric bass guitars had replaced double basses in most American popular music ensembles and within 20 years were commonly played worldwide. It is easy to see why; the instrument was smaller and much more portable than a double bass, and yet was capable of being much louder. It was also easily learned, and its left-hand technique did not require the precise intonation of a double bass. It could be argued that the success of the electric bass actually outstrips that of the electric guitar. Modern musical ensembles worldwide, no matter what their musical style or instrumentation – electric or acoustic – will often be accompanied by the electric bass, whose playability, practicality and portability have made it one of the most widely accepted new instruments of the 20th century.

[2] Country musicians almost always use the term "steel guitar" rather than "Hawaiian guitar". See Terminology and Conventions.

The Hawaiian-style guitar is the instrument most often ignored in the modern electric guitar's history. Although the Hawaiian guitar was the impetus for the electric guitar's invention, in the second half of the 20th century it has played second fiddle to its Spanish cousin. But while Hawaiian music no longer holds the prominence in popular culture it once had, electric Hawaiian playing has by no means disappeared; it is not uncommon for electric guitar players to play their Spanish-style instruments with a slide. More significantly, the mid-1950s saw the development of the pedal steel guitar. The pedal steel guitar is, in essence, a Hawaiian-style guitar which has a mechanism (operated by foot pedals, hence the instrument's name) that allows the player to change the pitch on individual strings to enable multiple tunings on the same instrument. The mechanism on these pedals can also be exploited to create a distinctive glissando effect on chordal suspensions and anticipations. Since its genre-defining use on Webb Pierce's 1954 hit "Slowly", the pedal steel guitar has been one of the elemental sounds of country music.

Lastly, other electric stringed instruments, especially those of the violin family, have had a small-but-notable impact in the latter part of the 20th century. Although there was a concentrated effort by several manufacturers during the 1930s to manufacture and market electric violin-family stringed instruments, these models never took off in any significant way. And yet, they never fully went away, either. Dissatisfaction with the limitations of microphones in live performing situations led violinists to adopt instruments with permanently attached pickups and by the end of the 20th century solid-body violin designs, often with fanciful, non-traditional shapes in the manner of their electric guitar relatives, became commercially available and increasingly common in popular music.

Much research remains to be done on all aspects of the electric guitar in the 20th century. As noted in the introduction to this thesis, much of the research that has been done to-date has concentrated on instruments from major manufacturers from the second half of the century. That research, while factual, has been uncritical and somewhat journalistic and would benefit from re-examination. One related topic that is worthy of further research is the history of California-based electric guitar makers and their interconnectivity; while accounts have been written on California-based manufacturers such as Rickenbacker, Fender and others, no one has considered the California electric guitar industry as a whole, exploring the myriad intertwining

relationships between manufacturers, both large and small. A second topic deserving exploration is the history of the development and dissemination of the electric bass. While the electric bass is typically considered primarily a subset of the electric guitar, there are many aspects, both organological and cultural, that make the electric bass distinct from its electric guitar forbears. The history of audio amplification, as it relates specifically to musical instruments, is yet another potential area of research that remains largely untouched.

For an instrument that is little more than eighty years old, the electric guitar has more than its share of mythology and misconceptions. The situation has not been helped by the fact that the electric guitar has developed into not only a symbol of modern popular culture, but a universal symbol of music, in much the same way as the Greek lyre was in previous times. The modern view of the electric guitar as a jazz or rock 'n' roll instrument – in other words, a Spanish-style guitar – has tended to obscure the fact that the Hawaiian-style of guitar playing – and thus the Hawaiian-style guitar – was a greater driving force behind the early electric guitar's development than the Spanish-style instrument. George Beauchamp's 1931 Frying Pan perfectly encapsulates this Spanish/Hawaiian dichotomy at the heart of the story of the early electric guitar. In designing a guitar that was capable of functioning as both a Spanish and Hawaiian-style instrument, Beauchamp produced something that was much greater than the simple combination of both: the first incarnation of what was to become a defining icon – and sound – of the 20th century, the electric guitar.

APPENDIX 1

HOW AN ELETROMAGNETIC PICKUP WORKS

Electromagnetism is often talked about as a single force, and while is this is true, it can be better understood as two sides of the same coin. Indeed, it was not until 1820 experiments of Hans Christian Ørsted (working in Copenhagen) that electricity and magnetism were generally understood to be related (although this relationship had been noted earlier in 1802 by Gian Domenico Romagnosi in Trento, Italy). The basic principle behind the electromagnetic pickup, electromagnetic induction, was discovered by Michael Faraday around 1831. Faraday discovered that if he moved a magnet within a coil of wire, or a coil of wire within a magnet, an electrical current was created within the wire. Faraday also discovered that the opposite was true, that putting electric current into a coil of wire created a magnetic field. This discovery led to many different inventions of the late-19th century, including the electric motor and the electric dynamo. In fact it is no exaggeration to say that much of electrical engineering of the late-19th and early-20th centuries consists of various combinations of coils of wire and magnets. Early loudspeakers, which utilised electromagnets, worked in almost an identically opposite manner to an electromagnetic pickup, analogous to the inverse relationship between electric motors electric generators. While many people in the late-19th and early-20th century understood the electromagnetic potential for sound reproduction, it was not till Beauchamp's design, with its use of a ferrous string as the pickup's armature, that the electric guitar became truly practicable.

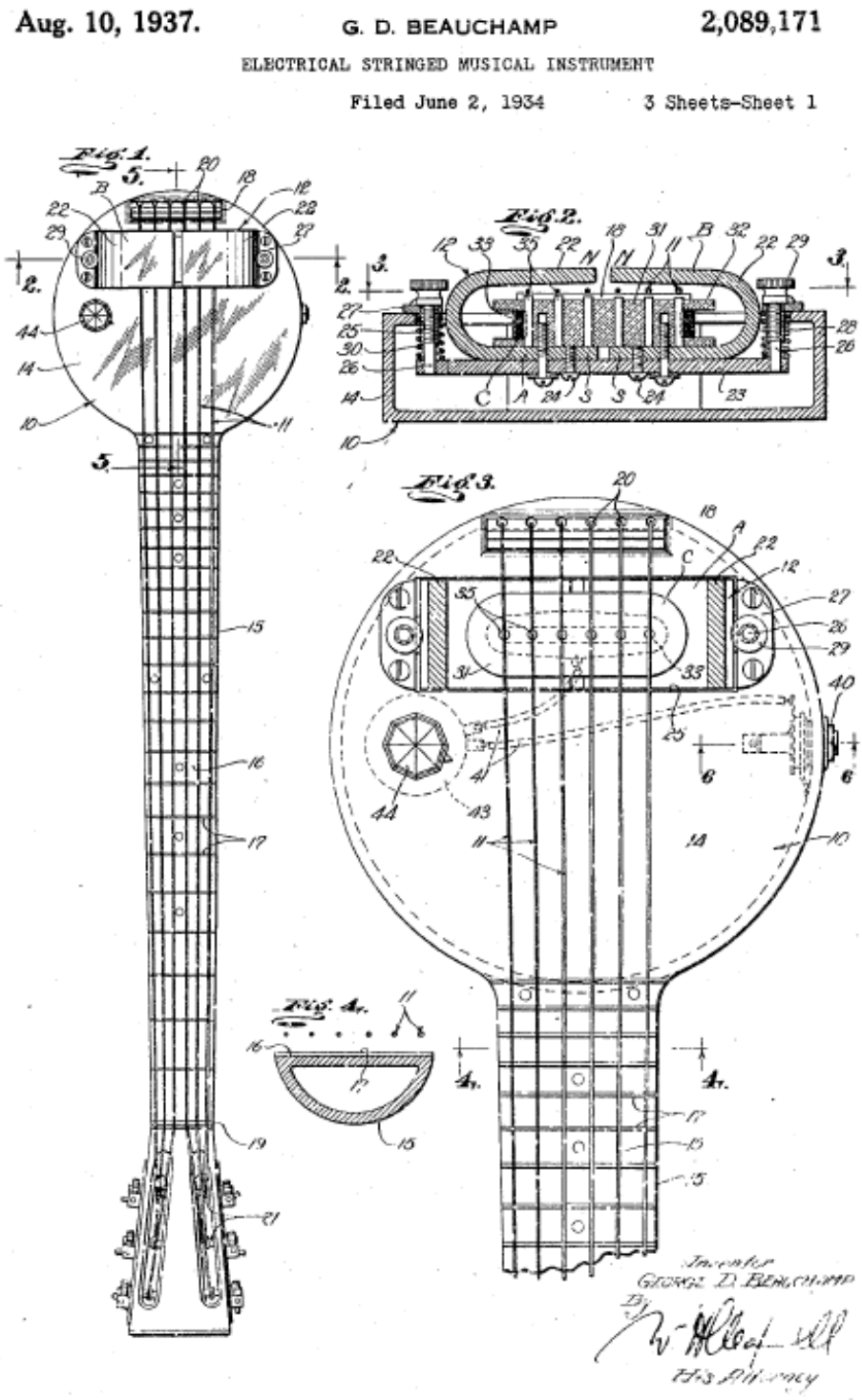
The modern electric guitar pickup is typically constructed as follows; a magnet (or magnets) is placed in close proximity to a coil of wire, often with the coil wire surrounding the magnet. The instrument's strings, which are made of a ferrous material, vibrate in close proximity to this coil of wire, which creates a small electromagnetic field, which in turn disturbs the magnetic field of the

magnet, which in turn creates electric field in the coil of wire. This in turn creates an electrical signal which is then transmitted to an amplifier. These electric and magnetic fields physically mimic each other in turn; they can be thought of as a "ghost" or "stencil" of the earlier fields generated, which is why the sound and pitch of the vibrating string is ultimately transmitted electronically to the amplifier. This process is known as an electrical transduction, the method by which a transducer takes energy in one form and gives back related energy in a different form. A good analogy in a static form would be the case of petrified wood: the original wood material is over time replaced with minerals which have an extremely similar appearance to the original wood, with an almost identical colour and grain. Although the new material is chemically completely different from the original wood, the form of the original wood is easily recognisable.

Although it would appear obvious that the voltages generated by electrical transduction would mimic the original acoustic waves in pitch and amplitude, the physics behind this process are still not fully understood.

APPENDIX 2

UNITED STATES PATENT NUMBER 2,089,171


Aug. 10, 1937. G. D. BEAUCHAMP 2,089,171

ELECTRICAL STRINGED MUSICAL INSTRUMENT

Filed June 2, 1934 3 Sheets-Sheet 1

Fig. 1.

Fig. 2.

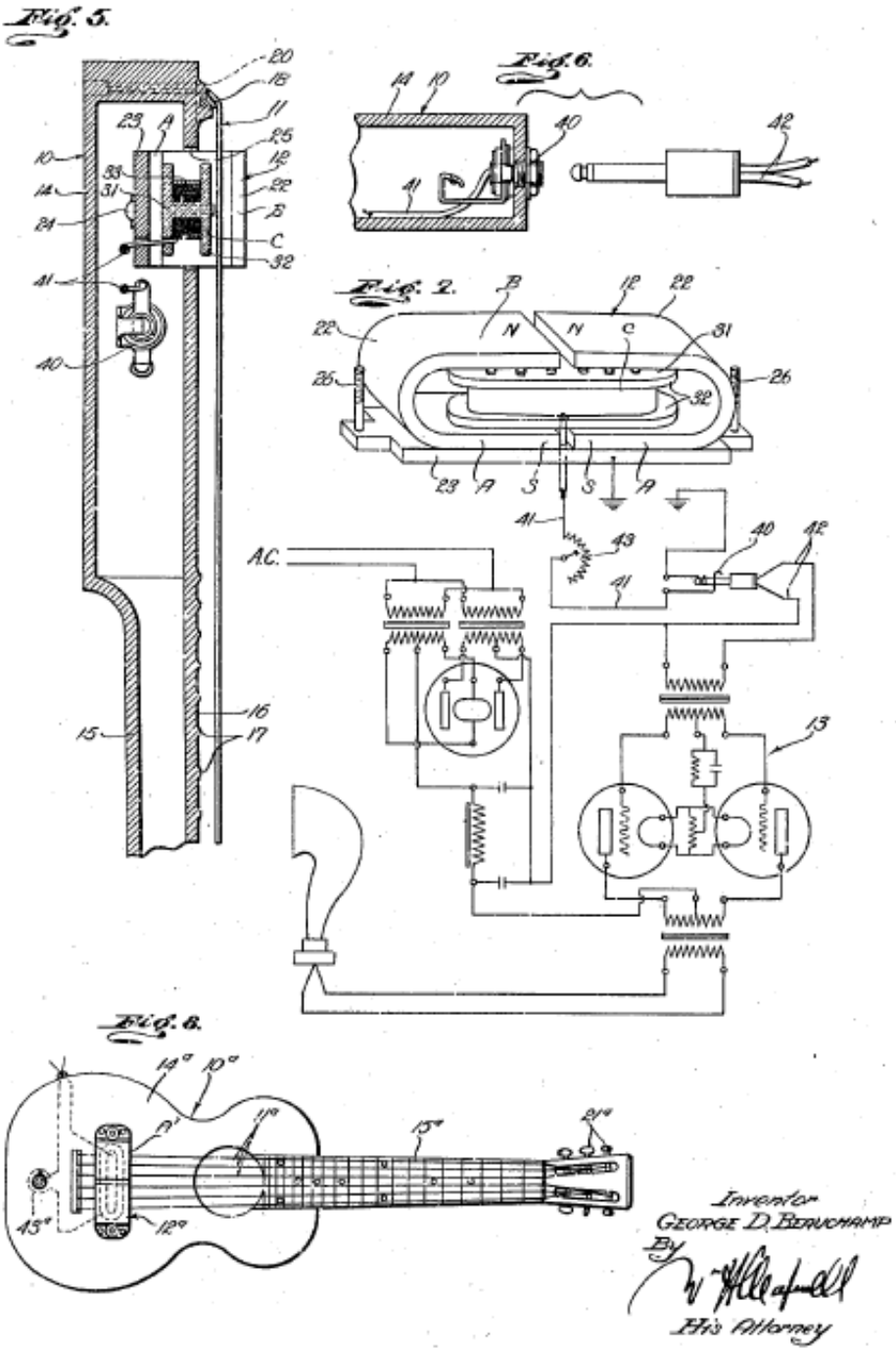
Fig. 3.

Fig. 4.

Aug. 10, 1937. G. D. BEAUCHAMP 2,089,171

ELECTRICAL STRINGED MUSICAL INSTRUMENT

Filed June 2, 1934 3 Sheets-Sheet 2



Aug. 10, 1937. G. D. BEAUCHAMP 2,089,171

ELECTRICAL STRINGED MUSICAL INSTRUMENT

Filed June 2, 1934 3 Sheets-Sheet 3

Fig. 9.

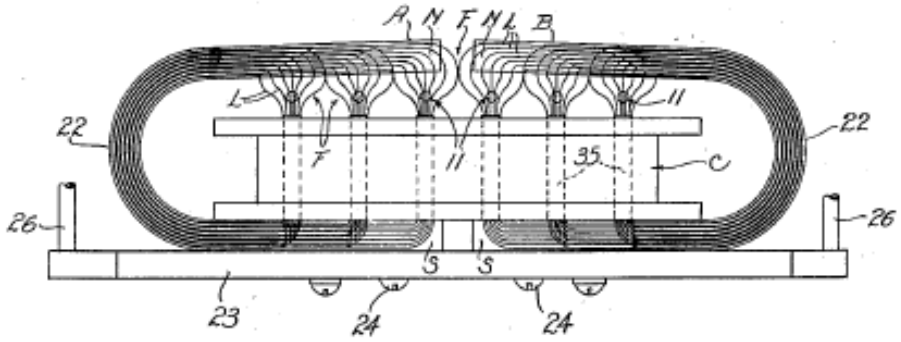
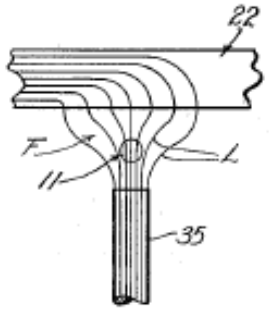


Fig. 10.



Inventor
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By
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Patented Aug. 10, 1937 2,089,171

UNITED STATES PATENT OFFICE

2,089,171

ELECTRICAL STRINGED MUSICAL INSTRUMENT

George D. Beauchamp, Los Angeles, Calif., assignor to Electro String Instrument Corporation, Los Angeles, Calif., a corporation of California

Application June 2, 1934, Serial No. 728,717

21 Claims. (Cl. 84—1)

This invention relates to musical instruments and it is a general object of the invention to provide a simple, practical and improved electrical stringed musical instrument.

This application for Letters Patent is a continuation in part of my application entitled Electrical stringed musical instrument, Serial No. 615,995, filed June 8, 1932.

An object of this invention is to provide a musical instrument in which the vibrations of the sound producing elements or strings directly vary the reluctance of a magnetic circuit to induce an electric current in a coil within the magnetic field, which current is suitably amplified and transformed into sounds as true reproductions of the sounds produced by the vibrations of the strings. In the present invention the true sound of the vibratory string with all its characteristics is accurately reproduced without the extraneous sounds and vibrations produced by instruments or devices in which a mechanical part is made to vibrate through its mechanical association with the vibratory string.

Another object of the invention is to provide an electrical musical instrument of the character mentioned including a novel, simplified and particularly effective electro-magnetic pick-up unit for converting the vibrations of the strings into an electric current having the characteristics of the string vibrations.

Another object of the invention is to provide an electrical musical instrument of the character mentioned including a single electro-magnetic pick-up unit for transforming the vibrations of the several strings of the instrument into an electric current. In the device of the present invention the vibrations of each of the several strings affect or vary the reluctance of the magnetic circuit of a single permanent magnet unit to induce an electric current in a coil superimposed on the magnet, and the single unit is not subject to the variations necessarily inherent in devices involving a plurality of electro-magnetic units.

Another object of the invention is to provide an electrical musical instrument that does not depend upon a sound board, resonance box, or the like in the production or propagation of the sound of the desired quality, whereby the body of the instrument may be of simple, inexpensive construction.

Another object of the invention is to provide a musical instrument of the character mentioned having tensioned vibratory strings of different diameters and including a single electro-magnetic pick-up unit constructed and designed to deliver an electric current to an amplifier which current is properly and truly characteristic of the vibrations of the several strings.

Another object of the invention is to provide an electrical stringed musical instrument that is adapted to be played manually in any typical or desired manner and electrically reproduce the sound or music at a remote point.

Another object of the invention is to provide an electrical musical instrument of the character mentioned that may be easily and conveniently adjusted by the musician or player to vary the volume of the music or sound produced.

Another object of the invention is to provide an improved electro-magnetic pickup unit capable of embodiment in stringed musical instruments of various characters with little or no modification.

A further object of the invention is to provide an electrical stringed musical instrument of the character mentioned that is small and compact and easy and convenient to play.

Other objects and features of the invention will be better and more fully understood from the following detailed description of typical forms and applications of the invention, throughout which description reference may be had to the accompanying drawings, in which:

Fig. 1 is a top or plan view of one typical embodiment of the present invention. Fig. 2 is an enlarged, transverse, detailed sectional view of the pickup unit and body taken as indicated by line 2—2 on Fig. 1. Fig. 3 is an enlarged plan elevation of the main portion of the body with the magnets in cross-section, being a view taken as indicated by line 3—3 on Fig. 2. Fig. 4 is a transverse detailed sectional view taken as indicated by line 4—4 on Fig. 3. Fig. 5 is an enlarged fragmentary detailed sectional view taken as indicated by line 5—5 on Fig. 1. Fig. 6 is a fragmentary detailed sectional view of the body showing the socket and illustrating the plug in position to enter the socket. Fig. 7 is a wiring diagram of the circuit involved in the present invention. Fig. 8 is an elevation view of the present invention embodied in a stringed musical instrument having a wooden body. Fig. 9 is a diagrammatic view illustrating the non-uniform magnetic fields of the pick up unit and Fig. 10 is an enlarged fragmentary diagrammatic view illustrating a portion of one pole portion of the magnet and a portion of one core member with a string passing through the field provided thereby.

The instrument provided by the present invention includes, generally, a body 10, a plurality of sound propagating elements or tensioned strings 11 on the body 10, an electric magnetic pickup unit 12 on the body 10 for transforming vibrations of the strings 11 into an induced electric current, and an amplifying unit or system 13 for amplifying the pulsations in said current and converting them into sounds which are the true sounds of the strings 11.

The body 10 may be varied considerably in size, shape and construction, and may be constructed of various materials without departing from the spirit of the invention. In the particular form of the invention in Figs. 1 to 7, inclusive, of the drawings, the body 10 is a simple integral casting of metal, such as aluminum or the like, and comprises a major or main portion 14 and a neck 15. The main portion 14 of the body is substantially disc shaped, having flat upper and lower sides and a curved or cylindrical periphery. The neck 15 projects radially with respect to the center of the portion 14 and is of gradually diminishing cross-section. The neck 15 has a flat upper side forming a fingerboard 16 provided with spaced frets 17. The underside of the neck 15 may be convex or rounded as illustrated in Fig. 4. The body 10 may be hollow as shown in the drawings to be light in weight, it being understood that in some instances it may be desirable to make the body 10 solid.

The strings 11 are the sound vibration producing elements of the instrument and are adapted to be manually plucked or otherwise manipulated to produce the desired vibrations. The strings 11 extend diametrically across the top of the body portion 14 and over the fingerboard 16 to the outer end of the neck. In the particular instrument illustrated there are six spaced strings 11 in a substantially parallel series. The plurality of strings 11 preferably lie in the same plane, that is, their central longitudinal axes are in or adjacent a common plane. The strings 11 pass over a bridge 18 on the main portion 14 of the body and over a similar bridge 19 on the outer portion of the neck 15. The inner ends of the strings are suitable secured in openings 20 adjacent the bridge 18 and the strings have their outer ends engaged by securing and tensioning keys 21. The portions of the strings 11 extending between the bridges 18 and 19 are under various degrees of tensile strain and are free to vibrate in the production of recognized musical tones. It is to be noted that the opposite ends of the strings 11 are rigidly and unyieldingly connected to the rigid metallic body 10 so that their major portions may have long periods of vibration with no dampening action due to the absorption of the vibrations by wooden body parts or the like at the ends of the strings. In accordance with the usual practice in instruments of the class illustrated the strings 11 are graduated in diameter. The strings 11 are formed wholly or in part of conducting material or magnetic material having a different degree of magnetic permeability than the surrounding air to properly influence or affect the reluctance of the magnetic field in the unit 12.

The pick-up unit 12 is a magnetic or electromagnetic device for converting the actual tone producing vibrations of the strings 11 into an induced electric current. The frequencies and the other characteristics of the vibrations of the strings 11 which may be termed the physical properties of the sound produced by the strings are represented in the electrical circuit in a proportional or definite manner with relation to the actual physical vibrations of the strings so that the amplifying unit 13 is actuated by or influenced by the physical properties of the sound to faithfully and accurately reproduce the sound. The pick-up unit 12 comprises a magnet which, in practice, may be a pair of like opposed permanent magnets 22. The magnets are U-shaped or of horse-shoe design and are attached to a supporting plate 23. The opposed lower or inner arms A of the magnets 22 have their lower sides resting on the plate 23 and the arms A are attached to the plate by suitable screws 24. In accordance with the invention the ends of the magnets 22 are in opposed relation with their poles north to north and south to south, as indicated in the drawings. This provides a continuous polarity at the opposite sides of the magnet or magnet unit. In the preferred construction the confronting or opposed ends of the magnets 22 are in spaced relation.

An opening 25 is provided in the top or upper side of the body portion 14 to receive the pickup unit 12. The plate 23 carrying the magnets 22 is inserted in the opening 25 and studs or bolts 26 project upwardly from the opposite ends of the plate to extend through openings in plates 27 on the body. The plates 27 may carry sleeves 28 for receiving the bolts 26. It is preferred to mount or support the unit 12 so that it may be adjusted and accurately set with relation to the strings 11. Nuts 29 are threaded on the outer ends of the bolts 26 and bear against the outer sides of the plates 27. The nuts 29 may be tightened down to adjust or shift the unit 12 outwardly. Springs 30 surround the bolts 26 and are arranged under compression between the plate 23 and the plates 27 to normally urge the unit inwardly and hold it against movement.

With the unit 12 mounted or supported as just described the pair of opposed magnets 22 are disposed transversely of the series of strings 11 and their upper or outer arms B are spaced above the top surface of the body. The strings 11 pass under the magnet arms B with considerable clearance. The strings 11 pass through the magnetic field of the magnets 22. The outer arms B of the magnets may be slightly inclined toward their opposing ends to compensate for the widened magnetic field at their poles or ends. The above described inclination of the magnetic arms B is such that the spaces between the arms and strings vary substantially in proportion to the intensity of the magnetism of said arms.

The pickup unit 12 includes a coil C arranged on or superimposed on the permanent magnet. The coil C is supported on the inner arms A of the pair of magnets 22 and is to receive an induced electric current when the reluctance of the field of the magnet or magnet unit is varied. The coil C includes a coil form or spool 31 having spaced upper and lower flanges 32. A winding 33 of suitable enameled wire is provided on the spool 31 between the flanges 32. The spool 31 is formed of a suitable insulating material. The number of turns in the winding 33 and the gauge of the wire of the coil depends upon the particular amplifying unit 13 with which the instrument is to be used. In accordance with the invention the coil C is positioned between the north and south poles of the magnet and is related to the strings 11 to be influenced or affected by their vibration in the magnetic field.

The outer side of the spool 31 is spaced below the series of strings 11.

The invention includes a plurality of core members 35 for concentrating the magnetic force of the magnet in non-uniform fields linked with the coil. The members 35 may be in the form of plates. However, it has been found practical to make the members 35 in the form of posts or pins as illustrated throughout the drawings. The lower ends of the pins rest on or engage the lower arms A of the magnets while the upper ends of the pins project from the spool 31. The upper ends of the core pins 35 are spaced directly below the strings 11 as clearly illustrated in Figs. 2 and 3 of the drawings. In order to properly compensate for differences in the extent or degree of variation of the magnetic reluctance in the spaces between the outer ends of the members 35 and the adjacent arms of the magnet due to the differences in the diameter of the strings 11, the spaces between the upper ends of the pins 35 and the strings 11 are graduated substantially in proportion to the graduation in the diameter of the strings.

To eliminate the necessity of a ground lead from the coil C one or both of the end pins 35 project from the surface of the spool 31 and are engaged by the inner windings 33 which have the enamel removed therefrom to electrically contact or connect with the pins. The pins 35 thus electrically connected with the inner winding or windings of the coil C are grounded to the body 10 through the magnet arms A, the plate 23, bolts 26 and plates 27. By thus grounding the coil winding to the body through the magnets the sounds or noises that are characteristics of the coil and magnets are eliminated or avoided. It is believed that it will be apparent how the nuts 29 may be employed to set or position the unit where the pins 35 are related to the strings 11 to provide for the desired operation of the pickup unit 12. The pins 35 in extending into the coil C operate to concentrate the magnetic force in spaced zones or fields in the spaces between their outer ends and the adjacent arms of the magnet and carry the magnetic force into the center of the field of the coil. The strings passing between the ends of the pins 35 and the magnet arms B vary the reluctance of the magnetic field when vibrated and thus induce an electric current in the coil C.

The coil C is electrically connected to a suitable amplifier and speaker unit 13 whereby the variations in the reluctance of the magnetic circuit imposed on the coil are converted into sound. The sound thus produced is a true reproduction of the sounds or tones produced by the strings 11. The particular amplifying unit 13 illustrated in the drawings is a one stage audiofrequency amplifying circuit and is merely typical of the various amplifying systems that may be employed. Means is provided for conveniently connecting the coil C with the amplifying unit 13. In the form of the invention being described a socket or jack 40 is provided in the body 10 and is electrically connected with the coil C by a conductor 41. The socket 40 is adapted to removably receive a plug on the end of a flexible two-conductor cord 42 extending from the amplifying unit 13. Means is interposed between the coil C and the amplifying unit 13 for varying the amplification of the sound. The volume control is preferably provided on the instrument proper to be conveniently accessible to the player. In the drawings I have shown a typical variable resistance element 43 connected between the socket 40 and the coil C and including a control or regulating knob 44 projecting from the upper surface of the body.

Fig. 8 of the drawings illustrates the invention embodied in an instrument in the form of a guitar having a wooden body 10^a. The body 10^a has the usual resonance box 14^a and the neck 15^a. The strings 11^a extend across the upper surface of the body and are maintained under the required tension by keys 21^a. The electromagnetic pickup unit 12^a is supported on the body 10^a so that the strings 11^a pass under its outer magnet arms A^1. The strings 11^a pass between the magnet arms A^1 and the coil of the unit. The unit 12^a operates in the same manner as the unit 12 and suitable conductors extend from the coil of the unit to connect with an amplifying unit or system. A volume control element 43^a is arranged in the circuit of the coil. In the instrument illustrated in Fig. 8 of the drawings where the body 10^a is of wood a ground conductor is connected with the coil of the unit 12^a.

It is believed that the operation of the instrument provided by the present invention will be readily understood from the foregoing detailed description. In playing the instrument the strings 11 are plucked or otherwise vibrated as desired and may be engaged along the fingerboard 16 by the fingers of the player or by a steel or playing bar held in the player's hand.

As best illustrated in Figs. 9 and 10 of the drawings the magnetic flux passes between the upper or outer arms of the magnets 22 and the members 35 in concentrated non-uniform fields F. That is, the lines of magnetic force as illustrated diagrammatically by the spaced lines L in Figs. 9 and 10 are relatively concentrated in the spaces or fields F between the outer arms of the magnets and the exposed ends of the pole members 35 and converge to or flare outwardly from the relatively limited surfaces presented by ends of the members 35. The lines L appearing in Figs. 9 and 10 are not intended to illustrate the total lines of magnetic force in the fields F and merely illustrate the general grouping and the general direction of the lines of force in the fields when the strings 11 are in their normal positions. The vibratory strings 11 of magnetic material pass through these concentrated non-uniform fields F and when they are stationary or unmoved there is a fixed or stable condition of magnetic flux and reluctance in the fields F. Movement or vibration of a string 11 in any direction alters this fixed condition of the field F through which it passes varying the reluctance in the space or field F. The variation in the reluctance of the field F induces a current in the coil C. The current induced in the coil C has characteristics proportional to the characteristics of the movement of the strings 11. As the fields F are non-uniform or composed of flaring or converging lines L of magnetic force, movement or vibration of the strings 11 in the direction of the longitudinal axes of the members 35 and movement of the strings 11 in a direction transverse of said axes both vary the reluctances of the fields F and thus induce a current in the coil. However, the tone or the character of the tone produced by the amplifier 13 resulting from the current induced in the coil C by variation in the reluctance of a given field F caused by movement or vibration of the string 11 therein in a direction substantially transverse of the longitudinal axis of the

adjacent member 35 is different from that resulting from vibration of the string in a direction substantially axially of said axis. Assuming that a string 11 is vibrated to move substantially transversely through its field F relative to the general direction of the lines of force L, the magnetic path through the string 11 is longer or greater when the string is in the end positions of its vibratory motion than when the string is in the intermediate position of such motion. The reluctance of the space or field F therefore is greater with the string 11 in the end positions of its vibratory motion than with the string in the intermediate position of its movement. Thus vibration of the string 11 horizontally or substantially transverse of the longitudinal axis of the member 35 induces a current in the coil C which is converted by the amplifier 13 into a tone in which the second harmonic of the note of the string predominates. Assuming that the above-mentioned string 11 is vibrated in a general vertical direction or in a direction substantially parallel with or axially of the longitudinal axis of the member 35, the effect of the string in reducing the reluctance of the field F is greater when at the end of its vibratory travel nearest the member 35 than when at the end of its travel nearest the arm of the magnet 22. This is due to this particular movement of the string 11 in the non-uniform or substantially fan shaped field F made up of the lines L of force converging to or flaring from the end of the member 35. Vibration of the string 11 in a substantially vertical direction or in a direction substantially axial of the member 11 induces a current in the coil C which actuates the amplifier to produce a tone which is strongly that of the fundamental note of the string. While it may not be practical to vibrate the strings 11 in truly vertical or truly horizontal directions the player or musician may at will readily vary and control the character of the tones produced electrically by the instrument by plucking or otherwise vibrating the strings 11 to vibrate in a generally vertical direction or a generally horizontal direction. The sound produced by the system or unit 13 therefore has all the tonal qualities of the sound which results from the physical vibration of the strings 11. The element 43 may be employed to control or vary the volume of the sound produced by the unit 13 and is conveniently accessible to the hand of the player or musician employed to pluck or vibrate the strings. The sound is reproduced without the mechanical vibration of any part at the pickup unit 12 other than the strings 11. The resultant music or sound accordingly does not have any extraneous vibrations or unwanted qualities.

Having described only typical preferred forms and applications of my invention I do not wish to be limited or restricted to the specific forms and applications herein set forth, but wish to reserve to myself any modifications or variations that may appear to those skilled in the art or fall within the scope of the following claims.

Having described my invention, I claim:

1. A pick up unit for use with the vibratory strings of a musical instrument, including a permanent magnet, a coil supported by the magnet between its poles, means mounting the magnet to have the strings pass between one of its poles and the coil, and core members within the coil each having an end facing a string.

2. In combination, a series of tensioned strings of magnetic material of different diameters, a single magnet having its pole portions at opposite sides of the series of strings, a coil between the pole portions of the magnet, and magnetic core members extending from one of the pole portions toward the other and terminating to form string spaces which vary in size with the strings.

3. In combination, a plurality of spaced vibratory strings of magnetic material, and a pick up unit including, a pair of permanent magnets arranged to surround the strings with their corresponding poles opposed, a coil within the field of the magnets, and means supporting the magnets and coil for adjustment relative to the strings.

4. A musical instrument comprising, a body to be held by the player, a plurality of spaced vibratory strings of magnetic material at the exterior of the body having portions accessible to be engaged by the player, a permanent magnet having a polar part extending over the strings to cover the same adjacent said portions and form a guard therefor and a rest for the operator, and a coil within the field of the magnet sensitive to disturbances therein.

5. A musical instrument comprising, a body to be held by the player, a plurality of spaced vibratory strings of magnet material at the exterior of the body having portions accessible to be engaged by the player, a permanent magnet having its polar parts spaced above and below the strings whereby the strings pass through a dense portion of the field of the magnet, the upper polar parts extending over the strings adjacent said portions to cover the same and form a guard for the strings and a hand rest for the player, and a coil in said field sensitive to disturbances therein.

6. A musical instrument comprising, a plurality of spaced vibratory strings of magnetic material, a magnet unit positioned so that the strings pass through its field, a coil associated with the magnet unit to have a current induced therein having the characteristics of the vibrations of the string, and means supporting the magnet unit at spaced points for individual adjustment at said points relative to the strings to effect tuning of the pick up means.

7. A pick up unit for use in combination with a plurality of spaced strings of a musical instrument, said pick up unit comprising, an elongate magnet unit disposed transversely of the strings to have a polar part above the strings, a coil carried by the magnet to receive an induced current from its field, and means for shifting the magnet from either end to move it relative to the strings to tune the pick up unit.

8. A pick up unit for use in combination with the vibratory string of an instrument including, a magnet having spaced polar parts, an induction coil positioned between the said polar parts, and means for supporting the magnet and coil so that the string passes through the space between the coil and one of said parts whereby vibration of the string varies the reluctance of the said space to induce a current in the coil.

9. A pick up means for use in combination with a musical instrument having a vibratory string of magnetic material, said pick up means including, a magnet having spaced polar parts, a coil positioned between the said parts, the magnet and coil being positioned so that the string passes through the space between the coil and one of said parts whereby vibration of the string varies the reluctance of a relatively dense portion of the magnetic field to induce a current in the coil,

and means carrying the magnet and coil for adjustment relative to the string.

10. In combination, a series of vibratory strings of magnetic material of different diameters, a magnet, a coil in the field of the magnet, the magnet being positioned so that the strings pass through its field, magnetic core members extending from one pole portion of the magnet and passing through the coil toward the other pole portion of the magnet and terminating at points spaced from the said other pole portion to leave spaces through which the strings pass, and means for shifting the magnet to vary the relation between the strings and said spaces.

11. A musical instrument comprising a body to be held by the player, a plurality of vibratory strings of magnetic material extending across an exterior face of the body in spaced relation thereto, a permanent magnet on the body having a polar part related to the strings to cover the strings and form a guard therefor and a hand rest for the player, and a coil in the field of the magnet sensitive to disturbances therein.

12. In a musical instrument, a series of spaced vibratory strings of magnetic material, an elongate magnet unit disposed transversely of the strings where the strings pass through its field, a coil carried by the magnet unit to receive an induced current from the magnetic field, and means for shifting the magnet from either end to adjust it relative to the strings.

13. In a musical instrument, a series of spaced vibratory strings of magnetic material, an elongate magnet unit disposed transversely of the strings where the strings pass through its field, a coil in the magnetic field of the unit to receive an induced current therefrom, and means for rocking the magnet unit in a plane substantially transverse of the strings to adjust it relative to the strings.

14. In a musical instrument, a series of spaced vibratory strings of magnetic material, an elongate magnet unit disposed transversely of the strings where the strings pass through its field, a coil in the magnetic field of the unit to receive an induced current therefrom, and means for tilting the magnet unit in a plane substantially transverse of the strings, said means including supports for the magnet unit at points at opposite sides of the series of strings.

15. In combination, a vibratory string of magnetic material, a magnet having pole portions at opposite sides of the string, a coil between the pole portions of the magnet, a magnetic core member extending from one of the pole portions toward the other pole portion and terminating at a point spaced therefrom to form a space through which the string passes, and means for shifting the magnet to vary the positions of the core member and the said other pole portion with relation to the string.

16. A musical instrument comprising a body, a plurality of exposed vibratory strings extending across a face of the body in spaced relation thereto, a pair of opposed magnets on the body having polar portions disposed transversely of the strings and related to the strings to form a guard therefor, said guard extending over the strings to cover the same, and a coil in the field of the pair of magnets sensitive to disturbances therein.

17. In a pick up unit, vibratory strings of magnetic material, a magnet having spaced pole portions and positioned so that the strings pass between said pole portions, a plurality of magnetic pole members on one of said pole portions, each member having a limited surface of magnetic attraction adjacent one string whereby the strings act in zones wherein the lines of magnetic force flare inwardly to said limited surfaces, and a coil surrounding the pole members.

18. In a pick up unit, vibratory strings of magnetic material, a single permanent magnet having a series of projecting pole parts of like polarity, each pole part presenting a limited surface adjacent a string whereby the lines of magnetic force flare outwardly from said surfaces about the strings, and an induction coil surrounding said series of parts.

19. In a pick up unit, a plurality of vibratory strings of magnetic material, a magnet having spaced pole portions positioned so that the strings pass between the pole portions in closer proximity to one than the other, magnetic posts extending from said other pole portion and each having a surface of limited extent adjacent a string and opposing the first mentioned pole portion whereby the strings vibrate in a zone where the lines of magnetic force converge to said surfaces, and a coil in the field of the magnet.

20. In a pick up unit, a plurality of vibratory strings of magnetic material having their axes in a common plane, a magnet having a pole portion adjacent the strings and inclined with respect to said plane so that the spaces between said portion and the strings vary substantially in proportion to the intensity of the magnetism of said pole portion, and a coil in the field of the magnet.

21. In a pick up unit, a plurality of vibratory strings of magnetic material having their axes in a common plane, a magnet having a pole portion adjacent the strings and inclined with respect to said plane so that the spaces between said portion and the strings vary substantially in proportion to the intensity of the magnetism of said pole portion, the magnet having a second pole portion, magnetic posts on said second pole portion having limited surfaces adjacent the strings and opposing the first mentioned pole portion whereby the vibratory strings act in fields where the lines of magnetic force converge to said limited surfaces, and a coil in the field of the magnet.

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