C.G. Conn Tuba Designs from 1880-1940:

An Investigation of Early Tuba Product Lines and Construction Techniques

by

David M. Earll

A Research Paper Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Musical Arts

Approved September 2014 by the
Graduate Supervisory Committee:

Deanna Swoboda, Chair
John Ericson
James DeMars
Douglas Yeo

ARIZONA STATE UNIVERSITY

December 2014

ABSTRACT

The C.G. Conn instrument manufacturing company is known as one of the most successful and innovative band instrument manufacturers in the history of the United States. Many of C.G. Conn's instrument product lines have undergone significant changes throughout the company's history, especially in the brass family. The C.G. Conn tuba product lines are no exception to this company's extraordinary success, and have been significantly redesigned since the company began manufacturing these instruments in circa 1880. This research project investigates the tuba product lines that C.G. Conn manufactured between 1880 and 1940. C.G. Conn designed six different tuba product lines during this timeframe, including an unnamed tuba product line with Stölzel valves, the Wonder Valve line, the New American line, the Wonder Model line, the 20-J, and the 22-J instrumental product lines. These tuba product lines have been investigated using extant publications and patent information because the majority of C.G. Conn's internal records prior to 1970 have been lost. In addition to investigating each of C.G. Conn's early tuba product lines, this project also explores the particularly anomalous design in the top-action valve apparatus of the Conn Wonder Model tuba product line. This anomalous design was implemented in the all of C.G. Conn's top-action tuba and tuba-like product lines from circa 1890-1940. This author's measurements of period instruments and analysis of data taken from these measurements indicates that this anomalous top-action valve apparatus design utilized interchangeable parts with other front-action C.G. Conn tuba product lines.

ACKNOWLEDGMENTS

The author would like to thank the following individuals and organizations for their contributions to this project.

Committee Members:

Dr. Deanna Swoboda – Assistant Professor of Tuba and Euphonium –
Arizona State University – Advisor and Committee Chair

Dr. James DeMars – Professor of Music Theory and Composition –
Arizona State University

Dr. John Ericson – Associate Professor of Horn and Brass Area Coordinator –
Arizona State University

Douglas Yeo – Professor of Practice: Trombone – Arizona State University

National Music Museum – University of South Dakota – Vermillion, South Dakota:

Dr. Margaret Downey Banks – Associate Director, Senior Curator of Musical Instruments, Professor of Music – University of South Dakota –
Advisor of On-Site Research

Supporting Organizations:

2013 Northern Trust/Piper Enrichment Award

U.Discover Summer Scholar Research Program

Additional Thanks:

Samuel Pilafian – Professor of Tuba and Euphonium – Frost School of Music, University of Miami – Former Advisor and Committee Chair of this Research Project

Dr. Kenneth P. Drobnak – Assistant Professor of Music, Director of Bands –
Northwestern Oklahoma State University

Dr. Steven Sudduth – Assistant Professor of Music, Director of Bands,

Professor of Low Brass – University of the Cumberlands

Special Thanks:

While it would be impossible to thank all of the outstanding individuals who have been a part of my academic and professional journey, I want to extend my appreciation to a number of people who have left an irreversible mark on my life for the better. In particular, I wish to thank my family for their support of my dreams. Mike and Mary Earll, I couldn't ask for more loving or supportive parents, and I will always look up to you both. Josh Earll, you are as supportive as a brother could be, and I always appreciate your opinions as my sounding board. To Barb and Lyle Earll and to Anne and Frank Breuker; I could not have asked for four more supportive grandparents and lifelong role models.

Additionally, I would like to extend a special thanks to my Arizona 'family,' who were there to support me through each step through graduate school. To Kathy Berry and Leonora Stephanoff, you made me feel like family from the first time we met, and I am grateful to have been found by two such outstanding 'Arizona grandmothers.' To my friends Susan, Michael, and Tyler McCall, I will always be grateful for having you in my life as well.

Lastly, I would like to thank all of my music teachers who are not listed above. Each of you were the inspiration for me to follow my dreams, to work harder than I knew was possible, and to open a door to a more exciting career than I could have ever hoped for. Mike Andersen, Rolyn Beaird, Galen Benton, Peter Carlson, Luci Ferrin, Lorenda Glade, Kelly Jacobsma, Cindy Kemp, Corkey Koerselman, Dr. Larry Mitchell, Dr. Rolf

Olson, Dr. Gary Reeves, and Dr. Stephen Yarbrough: each of you are my heroes and role models. Thank you for planting the love of music in my life and helping me walk on this journey to my calling.

TABLE OF CONTENTS

Page

Page

APPENDIX

INTRODUCTION

The C.G. Conn instrument manufacturing company is recognized as one of the most successful and innovative band instrument manufacturers in the history of the United States. The strides this company made in instrument design (particularly in valve technology, instrument wrap[1], and bore diameter expansion)[2] were especially important to the integration of new concepts in the development of the concert tuba[3], which had been first patented only thirty-nine years before C.G. Conn was founded in 1874.[4] Unfortunately, much of the historical documentation regarding the C.G. Conn instrument manufacturing company's construction techniques, equipment, and training have been lost due to factory fires in 1883 and 1910.[5] Beyond the loss of these early records, almost all of C.G. Conn's historical documents after the factory fire of 1910 were unfortunately disposed of during a transition in the company's corporate headquarters during the 1970s.[6] Despite the loss of these historical records, it is still possible to investigate this chapter in the development of the modern tuba through other research methods. The principal methods used to investigate this timeframe will include examination of extant period (circa 1880-1940) advertisements and periodicals, analysis of patent information,

[1] 'Wrap' is a term used in brass instrument manufacturing that is used to discuss the curvature of tubing in an instrument.
[2] Jeffrey Paul Hodapp, "The York Tuba : Design Idiosyncrasies that Contribute to its Unique Sound" (DMA diss., University of Madison-Wisconsin, 2002), 26-44.
[3] 'Concert tubas' are often simply referred to as tubas, and typically played in a seated position. This instrument design will be discussed at length throughout this document, and excludes other tuba-like instruments such as sousaphones, helicons, and bombardons.
[4] Margaret Downie Banks, "A Brief History of the Conn Company (1874-present)," National Music Museum, http://people.usd.edu/~mbanks/CONTENT.html (accessed February 14, 2012).
[5] Ibid.
[6] Margaret Downie Banks, "The Conn Company Archive," National Music Museum, http://orgs.usd.edu/nmm/connarch.html (accessed June 20, 2014).

and measurements taken from period tuba models from the instrument collections at the National Music Museum of Vermillion, South Dakota.

This document investigates the six earliest tuba product lines produced by the C.G. Conn instrument manufacturing company between approximately 1880 and 1940 and discusses the design of these instrument product lines in Chapter 1. The first two tuba product lines were only offered by C.G. Conn over the course of approximately ten years which is a rather brief period of time when compared to this company's third design. C.G. Conn's third tuba design was in production for nearly fifty years. The two tuba product lines of this third design, based on two patents granted to Charles Gerard Conn in 1889 and 1890, were first made available for purchase circa 1890 and became the basic designs for all of C.G. Conn's concert tuba, euphonium, baritone, tenor horn, and alto horn[7] product lines manufactured by the C.G. Conn instrument manufacturing company until 1940.[8] C.G. Conn's next two tuba product lines were released in roughly 1940, and implemented new designs which differentiated these instruments significantly from the earlier tuba product lines.[9]

The two tuba product lines of the third C.G. Conn design, called the "New American Model" and "New Wonder Model" tubas,[10] were highly endorsed by leading artists of the time[11] and were considered to demonstrate high quality in their

[7] This list of instruments (the euphonium, baritone, tenor horn, and alto horn) will often be referred to as 'tuba-like' instruments throughout this document due to be construction similarities that these instruments exhibit, especially in early C.G. Conn instrument design.
[8] C.G. Conn, *Selling Points and Testimonials "Bass."* (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, 1923-1924), 5-18.
[9] C.G. Conn, *Conn Band and Orchestra Instruments*, (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, September 1940), 36-37.
[10] C.G. Conn, *Wonder and American Model Valve Instruments*. (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, 1895).
[11] Conn, *Selling Points and Testimonials "Bass,"* 1 22-36.

construction.[12] While these tuba product lines showed immense success in the highly competitive instrument sales market of the United States during their time of manufacture,[13] the New Wonder Model tuba and tuba-like product lines were built with a highly anomalous valve apparatus design when compared to many contemporary and modern tuba models. This atypical design and the potential reasons for such a design in the New Wonder Model tubas and tuba-like product lines will be discussed at length in Chapter 2, including a new study of the apparent use of interchangeable parts between the New Wonder Model tuba product lines and the New American Model tuba product lines.

[12] John Joseph Swain, "A Catalog of the E-flat Tubas in the Arne B. Larson Collection at the University of South Dakota." (PhD diss., Michigan State University, 1985), 221.
[13] Hodapp, 7.

CHAPTER 1

THE EARLY C.G. CONN TUBA PRODUCT LINES

SECTION 1: THE SUCCESS AND ADVERTISEMENT OF EARLY C.G. CONN TUBAS

The C.G. Conn instrument manufacturing company is well known for its innovative and competitive role in the early environment of band instrument construction and sales in the United States. Although this company originally designed and sold cornets after their foundation in 1874, C.G. Conn quickly became one of the most competitive distributors of nearly every band instrument and was endorsed by musical artists from both the United States and abroad.[14] The C.G. Conn tuba product lines were no exception in this company's success, and were as heavily endorsed by artists as the cornets and trumpets with which C.G. Conn established its early national prestige.[15]

The first three tuba product lines that the C.G. Conn instrument manufacturing company designed and manufactured were available from approximately 1880 to 1940. Many of these tuba models were a common fixture in many of the preeminent concert bands and orchestras and the choice of many tuba artists throughout the United States.[16] Additionally, these tuba product lines were able to maintain a considerable amount of success during this timeframe when many instrument manufacturing companies were vying for a place in the competitive instrument market in the United States. Companies such as York & Sons, H.N. White, Holton, and the Grand Rapids Instrument Company were all simultaneously working to secure their individual successes[17] alongside C.G. Conn in this unpredictable period in instrument manufacturing history, and each of these popular manufacturers witnessed other young companies struggle and fail to survive in

[14] Swain, 271.
[15] Conn, *Selling Points and Testimonials "Bass,"* 22-36.
[16] Ibid. 1 22-36.
[17] Hodapp, 4-10.

such a competitive and quickly evolving market.[18] The source of the C.G. Conn instrument manufacturing company's success in sales during this timeframe is likely a culmination of a multifaceted and well-managed business plan that was adjusted carefully throughout this company's development[19] coupled with C.G. Conn's commitment to the quality of their instrumental products through innovative and adaptive construction techniques.[20]

The C.G. Conn instrument manufacturing company was not only innovative in construction techniques but was at the forefront of marketing and advertising during this these early years of instrument manufacturing and sales in the United States.[21] Like many companies of this era, C.G. Conn initially worked as a mail-order business, predominantly distributing full product catalogs that contained brief descriptions of their instruments and some reviews from notable artists of the era.[22] In addition to these full product catalogs, C.G. Conn began to release a publication titled *C.G. Conn's Truth*[23] in September of 1890 and kept these periodicals in publication into the 1940s.[24] Unlike a typical mail-order catalog, the *C.G. Conn's Truth* periodicals were filled with stories, endorsements, images, and anecdotes about C.G. Conn instruments. Many of these periodicals included success stories of ensembles comprised entirely, or at least in

---

[18] Swain 267-274.
[19] Swain, 270-272.
[20] Conn, *Selling Points and Testimonials "Bass,"* 2-4.
[21] Trevor Herbert, "Selling brass instruments: The commercial imaging of brass instruments (1830-1930) and its cultural messages," *Music In Art: International Journal for Music Iconography* 29, no. 1-2 (March 1, 2004): 213 http://web.b.ebscohost.com.ezproxy1.lib.asu.edu/ehost/pdfviewer/pdfviewer?vid=6&sid=2e2fecaa-0437-4d20-a9d7-a0ef7279b85d%40sessionmgr112&hid=122 (accessed August 18, 2014).
[22] Swain, 271.
[23] Sometimes referred to as the *C.G. Conn Musical Truth*, *Conn's Truth*, or *Conn's Musical Truth*.
[24] Deborah Check Reeves, "C.G. Conn's Double-Wall Wonder Clarinets." National Music Museum. http://orgs.usd.edu/nmm/Clarinets/Conn/DoubleWallClarinets/ConnDblWallClarinetsBanks.html (accessed July 12, 2014)

majority, of C.G. Conn instrument players, humorous stories from these musicians, and sections devoted to endorsements of specific instruments by players and conductors in both recognized and budding ensembles throughout the United States and even occasionally from abroad.[25] While the *C.G. Conn's Truth* publications were seemingly designed to be for the entertainment and enrichment of a musically savvy audience, the periodical also included pricing and ordering information for the instrumental products that were endorsed in each issue. This new form of marketing periodical demonstrated C.G. Conn's versatility and ingenuity in the competitive marketing environment that evolved around musical instrument sales and construction in the United States during the late 1800s. Several examples of the imagery, prose, and endorsements taken from a *C.G. Conn's Truth* may be seen in further detail in Appendix A.

Beginning in the 1920s, the C.G. Conn instrument manufacturing company also began to publish a series of instrument-specific catalogs and pamphlets for each of the C.G. Conn band instrument product lines, although they had been publishing cornet/trumpet-specific marketing materials as early as the 1890s. These instrument-specific catalogs were extensive collections of high-fidelity images, construction information, dimensions, accessories, advertisements, and endorsements of the instrument featured within each publication. The endorsement sections of these instrument-specific catalogs were similar in content to the endorsements found in many of the *C.G. Conn Truth* periodicals, but were typically much more extensive and allowed for greater focus on each instrument's most renowned artists as well as budding artists

[25] C.G. Conn, *C.G. Conn's Truth Vol. 5, No. 7* (Musical Instrument Manufacturers Archive Conn Musical Truth 1897-1918, National Music Museum, November 1903), 26-27.

throughout the United States.[26] The instrument-specific pamphlets utilized some of the images and advertisements used in the instrument-specific catalogs, but were considerably limited in length and as such focused on basic product lines and ordering information.[27] These instrument-specific marketing materials served as a targeted marketing tool for the C.G. Conn instrument manufacturing company and allowed for the general catalogs to be less cumbersome. The instrument-specific marketing materials provided separate but considerably detailed information to each of their specific instrumental clientele. An example of a tuba-specific catalog (1923-1924) and several selections from a euphonium-specific (1921) catalog from this period of advertisement can be seen in further detail in Appendix A, figures A-4 and A-5.

While C.G. Conn's marketing expertise and diversity in advertisements likely played a major role in this company's overall success in the competitive musical instrument trade of the early 1900s, C.G. Conn was also known for the remarkable quality of their instruments. C.G. Conn's early tuba product lines were one of many product lines that were standards in the musical instrument industry and were known to have a very high quality of construction which likely contributed to their success.[28] In particular, the two tuba product lines that were patented and manufactured by C.G. Conn in 1889 and 1890 became the basic designs for all of this company's concert tuba,

[26] Conn, *Selling Points and Testimonials "Bass,"* 22-36.
[27] C.G. Conn, *French Horn, Mellophone, Alto* (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, ca. 1927), 16.
[28] Hodapp, 6-8.

euphonium, baritone, and alto horn[29] product lines until approximately 1940.[30] Each of the separate instrumental product lines that utilized these two early designs was also quite successful in the competitive market of musical instrument sales in the United States,[31] at least in part due to the high level of quality in construction for which C.G. Conn became so well known.[32]

[29] Details of each of these instrumental product lines can be seen in further detail in Appendix A.
[30] Conn, *C.G. Conn's Truth Vol. 5, No. 7*, 18-27.
[31] Hodapp, 6-8.
[32] Swain, 221 271.

SECTION 2: THE FIRST KNOWN C.G. CONN TUBA PRODUCT LINE

The first known C.G. Conn tuba product was made available as early as 1879,[33] and the design included a modified Stölzel valve for which Charles Gerard Conn received a patent on November 1, 1881.[34] Stölzel valves are an early variety of piston valve developed originally by Henrich Stölzel as early as 1814. Dr. Sabine Klaus states the following in her writing about the elements of brass instrument construction:

> The main difference between the Stölzel valve and the [modern] Périnet[35] […] valves is that the main tubing enters the piston from below. Two different Stölzel valve models can be distinguished. In the "early model," the piston is guided and the spring is stopped by a horizontal screw, going through the outer casing. In the "later model," the spring is enclosed in a barrel; therefore, no screw is visible at the valve casing. Guidance is provided by a key fitting in a groove or keyway at the valve casing.[36]

The Stölzel valve featured in this tuba model's design would be classified as the later model mentioned above.[37] Further details of this modified Stölzel valve patent can be found in Appendix B, in figure B-1.

In addition to this tuba model's unique implementation of modified Stölzel valves, this model also featured a noteworthy design which causes the instrument's lead-pipe to travel behind the valve apparatus and form a hand grip for its player. The early Stölzel valve tuba model also featured engraved metal touch-pieces on the valves, rather than the inlaid mother-of-pearl touch-pieces which became C.G. Conn's standard

---

[33] Tuba pitched in E-flat by C.G. Conn, Serial Number 4037, *NMM 5,892*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1880-1881.
[34] Charles G. Conn, Piston-Valve Musical Instrument, US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.
[35] The Périnet valve will be discussed at length in Section 3.
[36] Sabine Klaus, "Elements of Brass Instrument Construction," National Music Museum, http://orgs.usd.edu/nmm/UtleyPages/Utleyfaq/brassfaq.html (accessed July 14, 2014).
[37] Charles G. Conn, Piston-Valve Musical Instrument, US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.

accoutrement for brass instrument product lines starting as early as 1888. [38] This tuba model was available in the key of E-flat with a top-action[39] valve assembly, but it is unlikely this design was also available in the key of B-flat.[40] The loss of so many early C.G. Conn records due to factory fires in 1883 and 1910 has left the name of this product line a mystery even though it was likely available for between roughly six and ten years.[41] It is possible that this tuba model was advertised during this timeframe, but any extant periodicals available from 1879-1888 do not reference this line of tuba model. It could be that this tuba product line was available only by request until C.G. Conn released the company's next tuba product lines in approximately 1888.

This first tuba model with Stölzel valves shares very few design characteristics with the product lines patented in 1889 and 1890 which were mentioned above, possibly due to the tightness of wrap that Stölzel valves can cause in tuba design when compared to Périnet pistons. While an image of this tuba model was not available in any C.G. Conn periodicals, an extraction of an image from Charles Gerard Conn's United States patent No. 249,012 can be seen below in figure 2.1. Unfortunately, this patent diagram is not entirely accurate to the final design of this instrument. The lead-pipe construction of this tuba model must have been modified at some time after this patent was submitted. This tuba model's final design lengthened the lead-pipe section of the instrument to enter into the third valve casing, rather than the first valve entry that is shown below. Aside from

[38] Tuba pitched in E-flat by C.G. Conn, Serial Number 4037, *NMM 5,892*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1880-1881.
[39] The term 'action' refers to the placement of valves on a tuba, which are most typically listed as 'top-action/right-facing' and 'front-action/left-facing.' This common tuba construction variable will be discussed at length later in this document.
[40] C.G. Conn, *C.G. Conn – Solo and Band Instruments Catalog*, (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, 1888).
[41] Banks, "The Conn Company Archive."

construction difference in the lead-pipe, the remainder of this basic design is quite similar to the single C.G. Conn Stölzel valve tuba model which is in the musical instrument collection of the National Music Museum in Vermillion, South Dakota.[42]

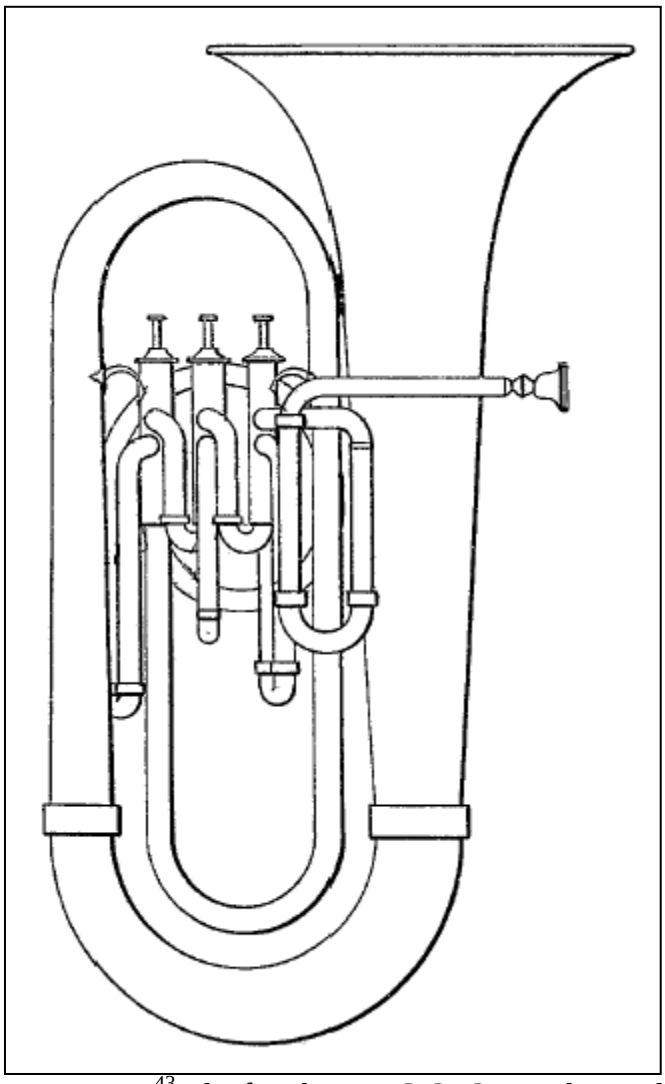


Figure 2.1: [43] The first known C.G. Conn tuba product with Stölzel valves. Model name unknown, pitched in E-flat, available circa 1880-1888.

[42] Tuba pitched in E-flat by C.G. Conn, Serial Number 4037, NMM 5,892, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1880-1881.
[43] Charles G. Conn, Piston-Valve Musical Instrument, US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.

It is tempting to consider that this first C.G. Conn tuba model with Stölzel valves may have been imported or designed using European patents due to a popular trend in early musical instrument manufacturing in the United States. Not only is the design of this tuba model so fundamentally dissimilar in design from all of C.G. Conn's subsequent low brass product lines, the presence of a traditionally German Stölzel valve on a tuba manufactured in the United States is also considerably anomalous. The practice of importing and then signing unmarked instruments from Europe was fairly popular with early American instrument manufacturers, especially when these manufacturers were in the first stages of selling new instrument product lines.[44] While this practice was fairly popular in this timeframe, and certainly would have been a viable option for the staff at the C.G. Conn instrument manufacturing company, there is enough extant documentation to provide a strong case that this tuba model was indeed designed and manufactured by C.G. Conn. The strongest argument that this tuba model was designed and manufactured by C.G. Conn is found in Charles Gerard Conn's patent from 1881 to modify Stölzel valves, specifically in the context of tuba and valve trombone product lines.[45] An engraving on the bell of this tuba model in the musical instrument collection of the National Music Museum which claimed that the instruments were "made by C.G. Conn [of] Elkhart [Indiana]" [46] serves as an additional, if somewhat less credible, sample of evidence that this instrument was designed and manufactured in the United States, because many of the other musical instrument manufacturers that were importing and

[44] Swain, 271.
[45] Charles G. Conn, Piston-Valve Musical Instrument, US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.
[46] Tuba pitched in E-flat by C.G. Conn, Serial Number 4037, *NMM 5,892,* Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1880-1881.

signing unmarked instruments would make similar claims.[47] Particularly with C.G. Conn's patent information as support of this tuba model's design, this tuba model was most likely designed and constructed by C.G. Conn in the United States rather than being imported despite this tuba product line's somewhat anomalous design and the popularity of the this importation trend.

[47] Swain, 271-272.

SECTION 3: THE C.G. CONN "WONDER VALVE" TUBA PRODUCT LINE

The next C.G. Conn tuba product lines which were regularly advertised and made available for sale from approximately 1888-1890 are also unlike all of the later C.G. Conn tuba, euphonium, baritone, and alto horn product lines. These two new tuba product lines were titled the "New Model Wonder Valve Double Bb Bass"[48] model and the "Bell Up Wonder Valve Eb Bass," model, and featured top-action valve assembly with bottom-sprung Périnet piston valves.[49] Périnet piston valves are one of the most common piston valves found on modern brass instruments, and are described by Dr. Sabine Klaus in her writings on brass instrument construction:

> The Périnet valve is named after François Périnet, the Parisian who invented this type of piston valve in 1838 and patented it the following year. The valve loops are arranged in such a way that the inlet tubing is positioned on a different level than the outlet tubing. The piston is held at rest by a spring, which is placed either on top (top-sprung) or below (bottom-sprung) the piston. The Périnet valve is now the standard for trumpets in most countries (except Germany and Austria), and is often simply called the 'piston valve.'[50]

Both of these tuba models were part of a series of instrument product lines that C.G. Conn marketed as the "Wonder Valve Band Instruments." Alto horns, tenor horns, baritones, euphoniums, tubas, and helicons were all advertised as Wonder Valve instruments in this 1888 C.G. Conn catalog,[51] and it is likely that each of these instrumental product lines included a design from the Périnet valve modification patent which was issued to Charles Gerard Conn on June 15, 1886. Initially this patent seems to indicate this valve modification is intended to be implemented in cornets, but Conn states

[48] Tubas in this timeframe were often referred to as basses, brass basses, or even blow basses.
[49] Conn, *C.G. Conn – Solo and Band Instruments Catalog.*
[50] Sabine Klaus, "Elements of Brass Instrument Construction."
[51] Conn, *C.G. Conn – Solo and Band Instruments Catalog.*

in the specifications of this new technology that the invention would be utilized in the "improvements in cornets and other piston-valve musical instruments."[52] C.G. Conn's modification of the Périnet piston valve for this technology's implementation in multiple product lines is reminiscent of the efforts made in the earlier Stölzel valve modifications in 1881.[53] This modified Périnet piston valve design may be seen in further detail in Appendix B in figure B-2.

The Bell Up Wonder Valve Eb Bass model was listed in an 1888 C.G. Conn catalog as being "patented in Europe and America,"[54] which is a further indicator that this tuba model was developed and modified from existing patents much like the Stölzel valve patent that C.G. Conn acquired earlier in 1881.[55] The Stölzel valve tuba model that C.G. Conn offered previously was most likely replaced by this new Wonder Valve E-flat tuba model, as there no other mention of the previous Stölzel valve model in this or other extant periodicals from circa 1888. The Wonder Valve Eb Bass was available for purchase with three valves, although it is possible that a fourth valve could have been added because this was available on other tuba and euphonium Wonder Valve products in the same 1888 C.G. Conn catalog.[56] An image of the Bell Up Wonder Valve Eb Bass tuba model taken from a C.G. Conn Catalog published in 1888 is shown below in figure 3.1.

[52] Charles G. Conn, Cornet, US Patent No. 343,888, filed August 28, 1885, and issued June 15, 1886.
[53] Charles G. Conn, Piston-Valve Musical Instrument, US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.
[54] Conn, *C.G. Conn – Solo and Band Instruments Catalog*.
[55] Charles G. Conn, Piston-Valve Musical Instrument, US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.
[56] Conn, *C.G. Conn – Solo and Band Instruments Catalog*.

The New Model Wonder Valve Double Bb Bass was listed as "patented April 15, 1886," in a C.G. Conn catalog from 1888,[57] but no records of any patent extended to Charles Gerard Conn on this date can currently be found. It is feasible that this printing of "April 15" was a mistake in the C.G. Conn catalog, and that the patent utilized in the construction of this new tuba model in the key of B-flat was in fact the modified Périnet valve patent that Conn was awarded on June 15, 1886.[58] This is the most probable patent used considering that the New Wonder Model Valve Double Bb Bass was part of the Wonder Valve product line, which featured this same valve technology on each of the other tuba-like instruments. This tuba model is also the only Wonder Valve product listed in this catalog without a claim of "patented in the United States and Europe," which might indicate that this particular model of B-flat tuba was an initial design or prototype for a new tuba product line. This concept that the New Model Wonder Valve Double Bb Bass may have been a prototype seems feasible because the Wonder Valve instruments were available for only four years or less before being replaced permanently with two new tuba designs which stayed in production for roughly 50 years. The New Model Wonder Valve Double Bb Bass is also likely the first B-flat tuba model that C.G. Conn offered, as the advertisement claims that this new model was designed:

> In response to a demand for a Bass [Tuba] with more volume of tone and capable of greater resources than the Eb Bass, I have constructed a BBb Bass of light weight, convenient and handy proportions which can be used by any bass player with ordinary lung capacity. The use of this instrument will prove invaluable to bands of more than 18 persons.[59]

[57] Ibid.
[58] Charles G. Conn, Cornet, US Patent No. 343,888, filed August 28, 1885, and issued June 15, 1886.
[59] Conn, *C.G. Conn – Solo and Band Instruments Catalog.*

Each of the instruments within the Wonder Valve series were also designed to incorporate the primary tuning slide before the valve apparatus,[60] which is atypical for the construction and design techniques of many other tubas and tuba-like instruments made in the United States during this timeframe. Most other tuba models from competing manufacturers featured a design which placed the primary tuning slide of the instrument after the valve apparatus, which tended to allow for a more rapid expansion of the tuba model's bore after the valve apparatus.[61] The New Model Wonder Valve Double Bb Bass was available with either three or four valves in this 1888 catalog, and was also available with "extra engraving."[62] An artistic interpretation of this extra engraving option on the bell of these instruments can be seen below in figures 3.1 and 3.2. Images of the both the Bell Up Wonder Valve Eb Bass and the New Model Wonder Valve Double Bb Bass taken from a C.G. Conn Catalog published in 1888 is pictured below in figures 3.1 and 3.2.

[60] Ibid.
[61] Swain, 221.
[62] Conn, *C.G. Conn – Solo and Band Instruments Catalog*.

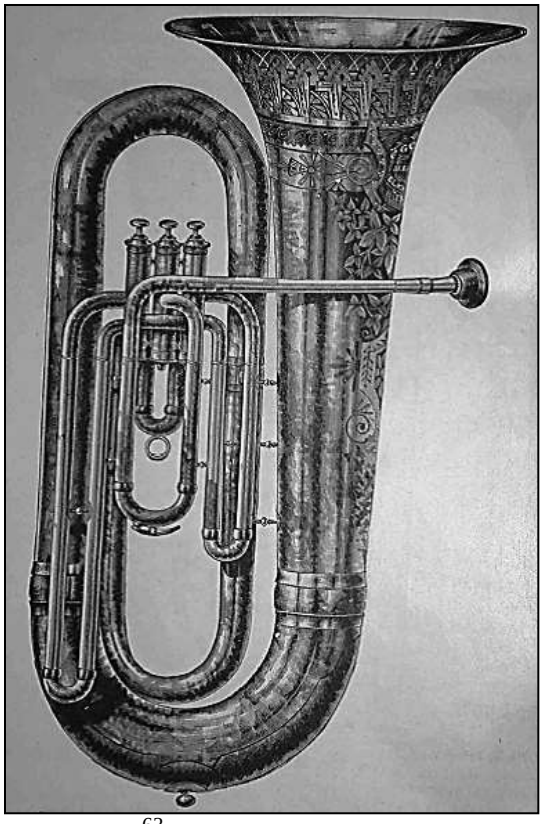


Figure 3.1:[63] The Bell Up Wonder Valve Eb Bass with Périnet valves. Available circa 1888-1890.

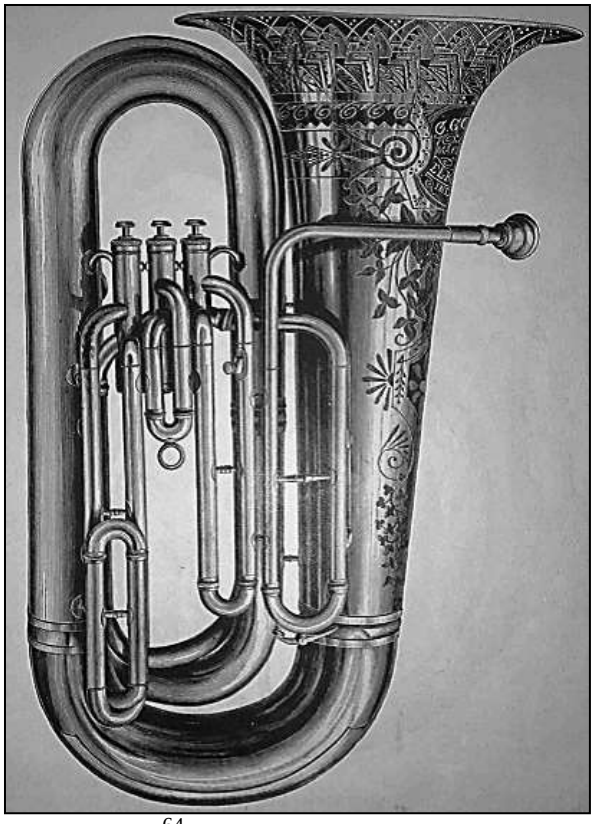


Figure 3.2:[64] The New Wonder Valve Double Bb Bass with Périnet valves. Available circa 1888-1890.

The valve apparatuses of both the Bell Up Wonder Valve Eb Bass and the New Wonder Valve Double Bb Bass are worth consideration. This valve apparatus design is similar to most contemporary and modern top-action tuba valve configurations with bottom-sprung Périnet valves, but is completely anomalous from the next 50 years of top-action tuba, euphonium, tenor horn, and alto horn designs produced by C.G. Conn. It is also noteworthy that the Wonder Valve series tenor horn, baritone, and euphonium seem to be built from the same basic design as the Wonder Valve tubas. Examples of these other tuba-like instruments utilizing the Wonder Valve design can be seen in Appendix A in figure A-1. This design was replaced in each of these Wonder Valve product lines with

[63] Ibid.
[64] Ibid.

C.G. Conn's new patents and product lines released in approximately 1890.[65] This significant disparity in construction between this traditional design and C.G. Conn's next top-action design will be discussed at length in several later sections of this document.

As mentioned above, the design of the Wonder Valve tuba product lines differ from the early Stölzel valve model and C.G. Conn's next series of tuba product lines. Most notably, the valve apparatus design of each of these product lines implemented different technologies designed from three different patents.[66] Additionally, each of these three tuba product lines were constructed with different dimensions in their bells and outer bough[67] structures.[68] These disparities in design indicate that it is unlikely that any significant construction components were reutilized or shared between the first three top-action C.G. Conn tuba product lines.

[65] C.G. Conn, *Wonder and American Model Valve Instruments*, (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, 1895).
[66] See Appendix B for additional information regarding these valve technology patents.
[67] "Boughs" refer to the loops of tubing that are found between the valve apparatus and bell section of tubas. These boughs often form the outer shape of the instrument. Boughs are also referred to as bows or loops in some writings.
[68] Height (also referred to as 'length' in some publications) was the greatest variable, as can be seen in Appendix A.

SECTION 4: THE C.G. CONN "NEW AMERICAN" AND "WONDER MODEL" TUBA PRODUCT LINES

The next two tuba product lines offered by C.G. Conn were first made available for purchase in approximately 1890, and the designs for these products immediately replaced all of the preexisting tuba and tuba-like instrument models that were manufactured by C.G. Conn. These two product lines were called the "New American Model" and the "Wonder Model" tubas, and marked the first time that C.G. Conn offered both front-action (the New American Model) and top-action (the Wonder Model) tubas and tuba-like instruments. The New American Model tubas were the first known front-action instruments made available by C.G. Conn, and were likely very popular due to the general preference that tubists have for front-action instruments.[69] Each of these designs featured bottom-sprung Périnet valves and was initially offered with the primary tuning slides located after the valve apparatus.[70] These two new C.G. Conn tuba models were also available for purchase from an 1895 C.G. Conn Catalog in a variety of finishes and with various accessories, but it is worth noting that each of the two separate models could be purchased for the same price. This same catalog also lists the basic dimensions of each of these separate models as interchangeable, saying that the each of the tuba models:

> Weigh[…] 11 ¼ pounds, [have a] length from edge of [the] bell to [the] bass of the largest bend [of] 30 inches; width [of the instrument] across at [the] valves [of] 14 inches, diameter of [the] bell, 19 ½ inches.[71]

Once C.G. Conn secured these patents for the New American Model in 1889[72] and the Wonder Model in 1890,[73] they continued to manufacture tuba product lines that

[69] Swain, 177
[70] C.G. Conn, *Wonder and American Model Valve Instruments*.
[71] Ibid.

were simple variations on these basic models for approximately the next fifty years. In fact, these two initial product lines implemented a design which became the basis of all the other tuba,[74] euphonium,[75] and alto/tenor horn[76] product lines manufactured by the C.G. Conn instrument manufacturing company until 1940.[77] The basic design and the similarities of these other tuba-like products can be seen in further detail in Appendix A, figures A-4, A-5, and A-6, and the patents for these two new C.G. Conn instrumental product lines can be seen in Appendix B, figures B-3 and B-4. The New American Model and Wonder Model tubas can be seen below in figure 4.1 and 4.2.

[72] Charles G. Conn, Musical Wind Instrument, US Patent No. 405,395, filed November 30, 1888, and issued June 18, 1889.
[73] Charles G. Conn, Musical Wind Instrument, US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.
[74] Conn, *Selling Points and Testimonials "Bass,"* 3-18.
[75] C.G. Conn, *Baritones and Euphoniums,* (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, C-778, National Music Museum, January 1921).
[76] Conn, *French Horn, Mellophone, Alto*.
[77] Conn, *Conn Band and Orchestra Instruments*, 36-37.

Figure 4.1:[78] The New American Model. Tuba. Front-action Périnet valves, originally pitched in E-flat, but later offered in B-flat. Circa 1890

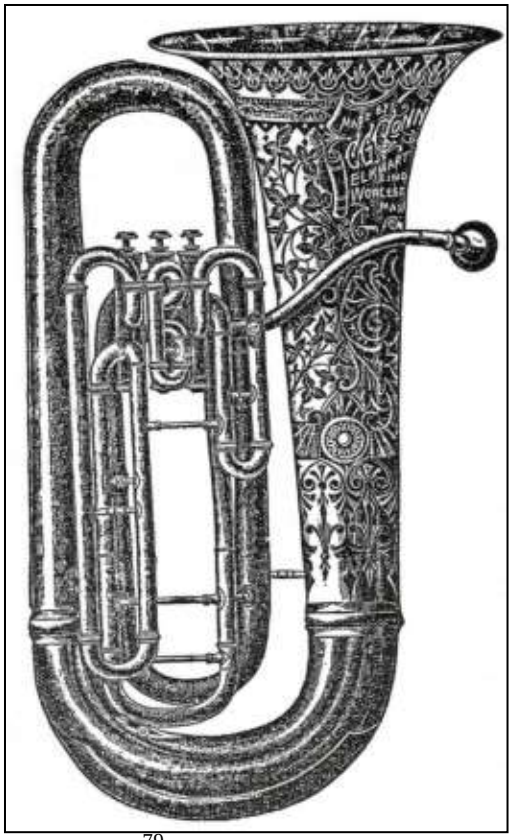


Figure 4.2:[79] The Wonder Model Tuba. Top-action Périnet valves, originally pitched in E-flat, but later offered in B-flat. Circa 1890.

The New American Model tubas, which will hereafter be referred to as American Model tubas, were built with a fairly standard front-action valve apparatus design[80] when compared to other contemporary tubas manufactured in the United States.[81] While the first advertisement of these American Model tubas offered them only in the key of E-flat, they were available in both the keys of B-flat and E-flat within three to five years.[82] According to the American Model instrument patent, the American Model tubas were designed to allow for a fourth valve to be easily integrated to these instruments during the

[78] Conn, *Wonder and American Model Valve Instruments*.
[79] Ibid.
[80] Swain, 150 170 177.
[81] Clifford Bevan, *The Tuba Family 2nd Edition*, (Winchester, England: Piccolo Press, 2000), 355.
[82] Conn, *C.G. Conn's Truth Vol. 5, No. 7*, 26.

construction process.[83] While this fourth valve option was not initially advertised in their 1895 advertisement, C.G. Conn made a common practice of listing this in later catalogs.[84] The early advertisements of the American Model tuba also made a definite appeal to their target audience's sense of nationalism, with endorsements such as "invented and patented by an American, manufactured by American workmen, and immensely popular with American bandsmen and musicians."[85] While these front-action tubas employed a standard valve apparatus, the outer bough structure of these instruments was considerably more open in wrap[86] than many of the other competitive contemporary front-action tuba models.[87] While the basic design of the C.G. Conn American Model tubas remained unchanged for approximately the next 50 years, the subsequent models built using this design underwent many minor changes in model name, size, and bore expansion.[88] Many of these additional front-action concert tuba and tuba-like instrument models released during this construction period can be seen in further detail in Appendix A.

While the design of the front-action valve apparatus of the C.G. Conn American Model tubas was standard when compared to contemporary competitive tuba models, the top-action valve apparatus of the C.G. Conn Wonder Model tubas was an absolute anomaly and perhaps the most notably unique design that C.G. Conn has implemented in the history of this company's tuba product lines.[89] This top-action valve apparatus featured tubing which ascended upwards out of the valves and then doubled back down,

---

[83] Charles G. Conn, Musical Wind Instrument, US Patent No. 405,395, filed November 30, 1888, and issued June 18, 1889.
[84] Conn, *Selling Points and Testimonials "Bass,"* 13-18.
[85] Conn, *Wonder and American Model Valve Instruments*.
[86] 'Open in wrap' means that these tubas were designed to incorporate gradual curves of the instrument's main tube and valve tubing. This type of construction is most often referred to as open wrap.
[87] Swain, 120 150.
[88] Conn, *Selling Points and Testimonials "Bass,"* 5-18.
[89] Swain, 126.

forming an oval- or square-shaped section of tubing for each of the valve tuning slides and valve tubing. This square-like shape in the valve tubing was most prominent in the first and third valve tubing of C.G. Conn's top-action E-flat tubas, but was pronounced in all three sections of valve tubing on their B-flat tubas. The 1895 C.G. Conn catalog known for featuring the Wonder Model tuba,[90] and the 1890 patent for Conn Wonder Model instruments, claims that this valve apparatus arrangement will "prevent the accumulation of water in valve slides"[91] and be implemented in "alto [horns], tenor [horns], baritones, euphoniums, and basses [tubas] of all kinds."[92]

Dr. John Swain wrote about this "rather special valve slide tubing arrangement" as well, mentioning that such a design implemented in the valve apparatus would allow the tubing of the third valve to be "especially protected by the main coil [bough]," which could have been an additional consideration in the design of the C.G. Conn Wonder Model tubas.[93] Another possibility that will be explored at length in several later sections of this document is that this top-action valve tubing apparatus was designed in particular to be interchanged with the valve tubing of C.G. Conn's front-action valve apparatus product lines as a means of streamlining the construction process of these two separate instrument designs. An expanded image of one valve and valve tubing from the C.G. Conn Wonder Model tuba valve apparatus is shown below in figure 4.3 and may be compared with another expanded image of a more standard top-action valve that was

[90] Conn, *Wonder and American Model Valve Instruments*.
[91] Charles G. Conn, Musical Wind Instrument, US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.
[92] Conn, *Wonder and American Model Valve Instruments*.
[93] Swain, 126.

manufactured and designed by C.G. Conn in their earlier New Wonder Valve Double Bb Bass in figure 4.4.

While the C.G. Conn Wonder Model top-action instrument product lines were designed with an atypical valve apparatus, the remainder of the structures of these tubas and tuba-like product lines were quite similar to contemporary and competitive top-action instrument designs.[94] The top-action C.G. Conn Wonder Model tubas first known advertisement was on the same page as the New American Model tubas in an 1895 mail-order catalog and shared many of the options discussed above that were originally offered with this front-action counterpart model. The C.G. Conn Wonder Model tubas were also first available in the key of E-flat, featured a primary tuning slide located after the valve apparatus, and came with several accessory options with their purchase. Like their front-action counterpart models, the Wonder Model tubas were available with a variety of finishing and plating options. C.G. Conn's first finish package included a burnished silver-plated finish with gold plated ferrules, valve touch-pieces, valve-tops/bottoms, and water keys and mother-of-pearl inlaid valve touch-pieces. The second finish package featured a burnished, fully silver-plated instrument with mother-of-pearl inlaid valve touch pieces. C.G. Conn's third finish package was available with a "highly polished brass finish" with silver plated mountings and mother-of-pearl inlaid valve touch pieces.[95] Similarly to the New American Model front-action tubas, the Wonder Model instruments featured a considerably more open wrap in their outer boughs than many of the contemporary competing tuba models.[96]

[94] Swain, 177.
[95] Conn, *Wonder and American Model Valve Instruments*.
[96] Swain, 177.

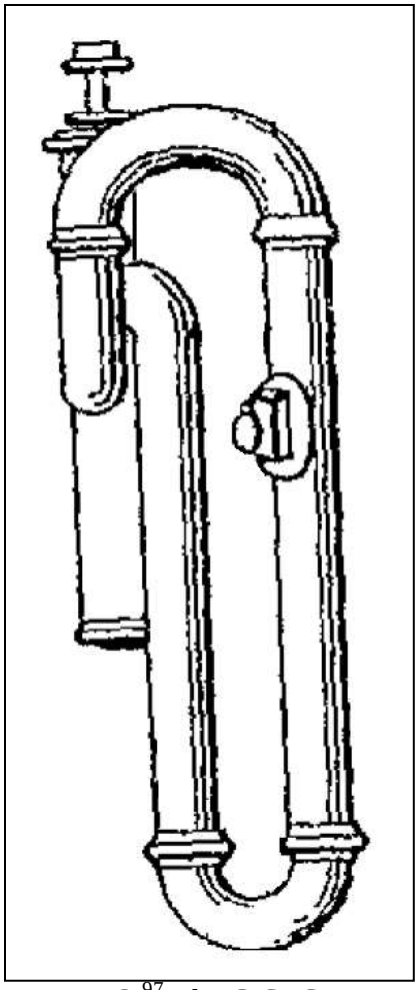


Figure 4.3:[97] The C.G. Conn Wonder Model 1st valve tubing. Note how the tubing exits the valve casing in an upward direction before returning downwards and then re-entering the valve casing above the exit port.

Figure 4.4:[98] Traditional top-action 2nd valve tubing. Note how the tubing exits the valve casing in a downward direction immediately and returning to the valve casing below the exit port.

Although the C.G. Conn Wonder Model tubas and tuba-like product lines underwent several small modifications, such as an increase in bore diameter, relocation of the primary tuning slide, and some other minor cosmetic adjustments like engraving

[97] Charles G. Conn, Brass Wind Musical Instrument, US Patent No. 931,273, filed February 13, 1908, and issued August 17, 1909.
[98] Conn, *C.G. Conn – Solo and Band Instruments Catalog*.

location,[99] all of the subsequent top-action tuba and tuba-like product lines[100] utilized the same basic design as the Wonder Model tubas until the release of the Conn 20-J tuba product line in approximately 1940.[101]

As was mentioned above, many minor modifications to these two tuba product lines patented in 1889 and 1890 were applied over the next fifty years, and many new model names were applied to these product lines during this timeframe. Because these adjustments to each the overall designs were so slight during this fifty year span, these newer individual product lines are sometimes difficult to identify accurately without referring to each instrument's serial number and attempting to match each instrument with a publication or catalog from that same year of manufacture. Unfortunately, creating a comprehensive list of each of the models released in this timeframe would be impossible without access to extant catalogs from each year from circa 1890 until 1940. However, a C.G. Conn tuba-specific catalog from 1923-1924 provides a great deal of information regarding the variety of tuba product models that were available during these fifty years of manufacture.[102] A euphonium/baritone-specific catalog from January of 1921 also shows many of the tuba-like products that utilized these same basic designs during this timeframe.[103]

The most significant differences between the C.G. Conn tuba models available in the 1920s and the original design of the New American Model and Wonder Model tubas

[99] Conn, *Selling Points and Testimonials "Bass,"* 5-18.
[100] These subsequent product lines can be seen in Appendix A.
[101] Conn, *Conn Band and Orchestra Instruments*, 36-37.
[102] Conn, *Selling Points and Testimonials "Bass,"* 5-18.
[103] Conn, *Baritones and Euphoniums.*

were the location of the primary tuning slide[104] and an increase of the bore diameter and bore expansion of the outer boughs of these instruments.[105] These minor adjustments in the overall design began to make these tubas somewhat larger than the original product lines released in circa 1890. This tuba-specific C.G. Conn catalog also featured several helicon and sousaphone models, but the outer structures of these instruments are so disparate from the designs of concert tubas that it is unlikely that they shared many construction characteristics with the concert tuba product lines. However, like the earlier Wonder Valve instrument series which were most likely related due to valve technology,[106] the helicons and sousaphones offered in this tuba-specific catalog are all advertised as "Wonder Model" instruments.[107] While this product series name is not a conclusive piece of evidence in the case of these marching instruments, it might be possible that these instruments shared some basic valve apparatus designs with the front-action C.G. Conn tuba product lines.

The entirety of the tuba product lines available in this C.G. Conn tuba-specific catalog are part of the "New Wonder Model" product line, which should be noted is a different series of instruments than the 1890 "New Wonder Model E-flat Bass." The term "Wonder" model had become rather popular with the C.G. Conn instrument manufacturing company and was used as an addition to many of this company's product

[104] The primary tuning slide was located before the valve apparatus in these more recent tuba models, with the exception of one product available in this catalog.
[105] Conn, *Selling Points and Testimonials "Bass,"* 5-18.
[106] Conn, *C.G. Conn – Solo and Band Instruments Catalog.*
[107] Conn, *Selling Points and Testimonials "Bass,"* 12-17.

lines during their early years, but it did often link groups of instrumental product lines together as a result of design.[108]

The 1923-1924 tuba-specific C.G. Conn catalog offered nine different models of concert tuba based off of C.G. Conn's original patents in 1889 and 1890, including: the Standard Eb Basses (top-action model 2-J and front-action model 4-J), the "Professional" Eb Basses (top-action model 10-J and front-action model 12-J), the "Giant" Eb Basses (top-action model 18-J and front-action model 20-J), the "Monster" BBb Basses (top-action model 26-J and front-action model 28-J), and the Orchestra Grand Bass in BBb or CC (both front-action, B-flat model 34-J and C model 36-J).[109] This same catalog also details the different helicon and sousaphone models available during the 1920s, including: the Helicon Monster BBb (model 32-K), the Wonder Model Helicon in Eb (model 10-K), the Sousaphone Bass in BBb (raincatcher[110] model 34-K), the Sousaphone Bass in Eb (raincatcher model 18-K), the Sousaphone Grand Bass in BBb (front-facing model 38-K), and the Sousaphone Grand Bass in Eb (front-facing model 26-K).[111]

These different tuba, sousaphone, and helicon models were common fixtures in many preeminent ensembles of this era, and were endorsed by many well established tuba artists. Some of the more prominent artists to endorse the C.G. Conn tuba products included August Helleberg, William J. Bell, and John Kuhn (also known as "Red Cloud").[112] The Helleburg model mouthpiece made originally for the artist August Helleburg, later models of which have become recognized as a standard mouthpiece in

[108] Reeves, "C.G. Conn's Double-Wall Wonder Clarinets."
[109] Conn, *Selling Points and Testimonials "Bass,"* 5-11 18.
[110] "Raincatcher" sousaphones are an early variety of this instrument, with a bell that points directly upward instead of facing forward.
[111] Conn, *Selling Points and Testimonials "Bass,"* 12-17.
[112] Ibid., 17-19.

modern tuba playing,[113] was even available in this early C.G. Conn tuba-specific catalog.[114] These different C.G. Conn tuba models and artist endorsements can be seen in further detail in Appendix A, figure A-5.

A C.G. Conn euphonium/baritone-specific catalog from 1921 also offers nine varieties of tuba-like models which are built from the basic designs utilized in this company's tuba product lines. Unfortunately, this instrument-specific catalog does not indicate the model number of each of these euphoniums and baritones, but each of these nine models are part of the Wonder instrument series like the tubas, sousaphones, and helicons mentioned above. This catalog also contains endorsements from many leading euphonium artists of this era, perhaps most notably Salvatore Florio and Simone Mantia.[115] Each of these euphonium and baritone models which share the notable construction characteristics of the C.G. Conn tuba-like instrument product lines and the endorsements of these outstanding early euphonium artists from the United States can be seen in further detail in Appendix A, figure A-4.

The C.G. Conn General Catalog "B" from November of 1924 also includes an example of the alto horn designs which are also built from the 1889 and 1890 American and Wonder model instrument patents. It should be noted that many of these instrument models were offered in both low pitch and high pitch due to the gradual transition in tuning frequency which occurred in the United States and abroad during this timeframe, which could have also prompted some of the minor design changes that were

[113] Hodapp, 9.
[114] Conn, *Selling Points and Testimonials "Bass,"* 19 22-24.
[115] Conn, *Baritones and Euphoniums.*

implemented during this manufacturing period.[116] This could have been the impetus for the C.G. Conn Instrument Company's design shift that repositioned the tuning slide in the tuba-like instrumental product lines.

Placing a primary tuning slide before the valve apparatus in tuba-like instruments generally requires that the tuning slide is cylindrical, meaning that each side of the tuning slide is of the same diameter. This is contrasted by the primary tuning slides placed after a tuba-like instrument's valve apparatus which are able to expand in their bore diameter, often making the exit side of the tuning slide much larger in bore than that of the entrance.[117] If instrumentalists were playing in multiple ensembles with different pitch centers during this time of transition, it would be much easier build standard equipment for adjusting the intonation/length of the larger low brasses with standard cylindrical tubing than needing specialized equipment for each different model based on each model's bore expansion and tuning slide dimensions. This way, additional slides or loops of tubing could be added to instruments with much more ease, because manufacturers could simply produce cylindrical slide extenders for existing primary tuning slides rather than creating a replacement slide.

While each of these two designs underwent several small modifications during the 50 years in which they were manufactured, these designs were eventually replaced by a new model that was released in approximately 1940.

[116] C.G. Conn, *Conn General Catalog "B,"* (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, November 1924), 17.
[117] Swain, 221.

SECTION 5: THE C.G. CONN 20-J AND 22-J PRODUCT LINES

Around 1940, C.G. Conn released a new tuba product line – the 20-J/22-J Short Action Recording Bass – that marked the end of a 50 year manufacturing period of C.G. Conn's New American and New Wonder model tubas. The 20-J top-action tuba model incorporated C.G. Conn's newly patented technology for short-action valves,[118] a primary tuning slide located after the valve apparatus, greatly expanded and re-wrapped boughs, a directional/recording bell,[119] and a newly designed top-action valve apparatus. This new top-action valve apparatus was likely designed to accommodate the newly patented short-action valves, which have oval shaped entrance and exit tubing, but maintains the basic appearance of the earlier atypical C.G. Conn top-action valve apparatus. The most significant differences in the design of this valve apparatus can be seen in the wrap of the third valve and the traditional arrangement of the second valve. The 22-J front-action tuba also incorporated this same new valve technology and similar alterations, but with a redesigned front-action valve apparatus.[120] The most notable difference in this valve apparatus can be seen in the first valve tubing, which has been stretched towards the bell in order to accommodate the new oval-shaped vents of the short-action valves. The C.G. Conn 20-J top-action model can be seen below in Figure 5.1. Additional information about the Conn 20-J and short-action valves can be found in Appendix A, figure A-7.

[118] Conn, *Conn Band and Orchestra Instruments*, 36-37.
[119] Charles G. Conn, Brass Wind Musical Instrument, US Patent No. 931,273, filed February 13, 1908, and issued August 17, 1909.
[120] Conn, *Conn Band and Orchestra Instruments*, 36-37.

Figure 5.1:[121] The C.G. Conn 20-J, Top-Action, Key of B-flat. Note the expanded outer boughs and re-wrapping of the valve tubing in the second and third valve.

The creation of the C.G. Conn 20-J and 22-J tuba models marks the end of this investigation of the early tuba product lines available through the C.G. Conn instrument manufacturing company. While these newly released tuba product lines were likely successful, the next sections of this document will investigate the unique and anomalous design that was incorporated into the top-action tuba models that were patented by Charles Gerard Conn in 1890 and then left in production for the next approximately 50 years.

[121] Ibid., 36.

CHAPTER 2:

INVESTIGATION OF THE C.G. CONN TUBA DESIGNS AND CONSTRUCTION TECHNIQUES

SECTION 6: REVIEW OF THE ANOMALOUS C.G. CONN TUBA DESIGN

The purpose of this section is to briefly elaborate on the previous discussion of the anomalous construction techniques used in C.G. Conn's top-action tuba product lines. The 'Conn Wonder Model' product line implemented a particularly anomalous design in the configuration of these tuba model's valve apparatus.[122] Most notably, the valve tubing of the 'Conn Wonder Model' exits their valve casings in an upward direction, which is a counter-intuitive construction technique and atypical with the arrangement of other tuba valve apparatuses built in this era.[123] This unique top-action valve apparatus in the 'Conn Wonder Model' product line was patented in 1890, and the design was implemented in various product lines – including top-action tubas, euphoniums, and alto horns – until approximately 1940.[124] Why would the C.G. Conn instrument manufacturing company utilize such a counter-intuitive design as that implemented in the 'Conn Wonder Model' instruments for approximately fifty years? Although there are no longer any records of the techniques used to construct this product line, an investigation utilizing comparative measurements indicates that C.G. Conn may have implemented a construction technique which utilized interchangeable parts between the Conn Wonder Model (top-action) and the Conn American Model (front-action) tuba product lines.

By taking and analyzing measurements of period tubas from the musical instrument collection at the National Music Museum of Vermillion, South Dakota, it is clear that the C.G. Conn instrument manufacturing company designed their top-action and front-action tuba product lines to be built with a significant number of

[122] Swain, 158.
[123] Charles G. Conn, Musical Wind Instrument, US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.
[124] Conn, *Conn Band and Orchestra Instruments*, 36-37.

interchangeable parts. These interchangeable parts between the C.G. Conn tuba models are especially prominent in the bell, outer bows, and sections of the valve apparatus. Utilizing interchangeable parts in their distinct tuba product lines would have proven to be economical for the C.G. Conn instrument manufacturing company at the possible cost of ergonomics or ease of playing of these top-action instruments.

Because of such a significant loss of historical documentation regarding the construction of these instruments, the principle theories about their construction have been either hearsay or conjecture. This document investigates the implementation of these interchangeable parts by analyzing new areas of evidence, including: analysis of patents regarding these instrument product lines, forty-seven comparative measurements of fourteen C.G. Conn instruments (from 1890 to 1940),[125] and advertisements/interviews from C.G. Conn periodicals. This document also discusses the anatomy of tubas, describes and analyzes my research on instruments from the National Music Museum, and analyzes historical documentation of the unusual 'Conn Wonder Model' top-action tuba design. Using this evidence, especially the concrete evidence provided by my comparative measurements, this document offers another explanation for the reasoning behind the C.G. Conn instrument manufacturing company's peculiar design in their top-action tuba product lines.

[125] These measurements were taken on-site at the National Music Museum by this author.

SECTION 7: THE ANATOMY OF CONCERT TUBAS

In order to discuss the construction techniques of these C.G. Conn tubas, it is important to first have a general understanding of the anatomy of the concert tuba. The basic components that are included in a concert tuba are the leadpipe, valve apparatus, primary tuning slide, boughs, and bell.[126] These components can be seen in greater detail in Appendices C and D along with diagrams that will serve to familiarize the reader with the anatomy of concert tubas.

The concert tuba designs that will be discussed throughout this chapter of the document will be broken down into two varieties: front-action (like the Conn American Model) and top-action (like the Conn Wonder Model).[127] The 'action' refers to placement of the valve apparatus and each model of concert tuba stems from two traditional configurations.

As discussed earlier, front-action tubas are directly influenced by early German designs which originally implemented traditional rotary valves and the antiquated Berlin valves. The Berlin valve is a predecessor to the modern Perinét piston valve, but the entrance and exit ports of the valve casing are "arranged on the same plane as the main tubing," which often made the Berlin valves too large for comfortable hand positioning when implemented on tubas. [128] This arrangement of valve casing ports on Berlin valves also made the organization and placement of the valve tubing difficult. Modern front-action instruments typically employ the use of rotary valves, bottom-sprung Perinét

[126] Arthur H. Benade, *The Fundamentals of Musical Acoutics* (New York: Oxford Press, 1976), 392.
[127] Though C.G. Conn produced a large number of low brass product lines (including: sousaphones, helicons, euphoniums, baritones, and others), this portion of the document is devoted strictly to their concert tubas.
[128] Klaus, "Elements of Brass Instrument Construction."

piston valves, or both of these valve types working in conjunction.[129] Traditionally, early front-action tubas have a significant distance between their upper bough and rim of the instrument's bell.[130] This arrangement of the bough tubing results in a tighter wrap[131] over the majority of the tuba's length.

As was mentioned earlier, the C.G. Conn American Model tubas utilized a standard front-action valve section that shares similarities with contemporary tuba designs and even modern tuba designs. One of the many contemporary musical instrument manufacturers that competed with C.G. Conn in this timeframe was Holton, a company which also manufactured rather popular tuba product lines. The design of a Holton front-action tuba is displayed next to the design of a C.G. Conn front-action tuba to show these similarities below. Figure 7.1 displays a Holton front-action tuba and figure 7.2 displays an image taken from C.G. Conn's patent for American Model front-action instruments. Take notice of the similarities in valve apparatus between these two distinct tuba models from two separate instrument manufacturing companies. There are considerable differences in these two tuba models worth noting as well, particularly that the Holton tuba implements a bell-forward[132] and that the C.G. Conn sketch incorporates a bell-up[133] design. This consideration has no noticeable impact on the valve apparatus in tuba design.[134]

---

[129] Bevan, 355.
[130] This design is still commonly implemented in modern instruments manufactured by the German instrument manufacturing company Mirafone.
[131] "Tighter wrap" indicates that these tubas would have been designed with more sudden/rapid curvatures to the main tubing of these instruments. This construction technique is most often referred to as closed wrap.
[132] "Bell-forward" is also sometimes referred to as recording bell.
[133] "Bell-up" is also sometimes referred to as concert bell.
[134] Charles G. Conn, Brass Wind Musical Instrument. US Patent No. 931,273, filed February 13, 1908, and issued August 17, 1909.

Figure 7.1:[135] Holton front-action design. Pitched in the key of B-flat, bell-forward model.

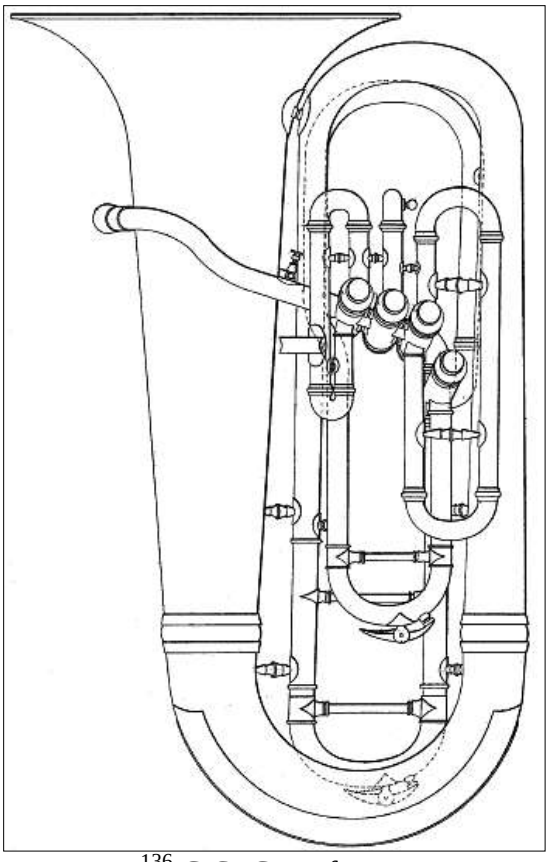


Figure 7.2:[136] C.G. Conn front-action design. Pitched in the key of E-flat, bell-up model.

Contrastingly, top-action tubas are in many ways a descendent of the saxhorn and a group of similar early brass instruments that were popular in France and England, which implemented a rotary valve apparatus or Périnet pistons placed in line with the upper-most bough of the instrument.[137] These top-action instruments incorporate a distinct design in their upper boughs that allow for a player's right hand to access the

---

[135] Ken Drobnak, "National Music Museum: A Catalog of Upright Tubas by Frank Holton & Company at the National Music Museum (USA)," *International Tuba/Euphonium Association Journal* 38:1 (Fall 2010), 94.
[136] Charles G. Conn, Musical Wind Instrument, US Patent No. 405,395, filed November 30, 1888, and issued June 18, 1889.
[137] Bevan, 256 283.

instrument's valves.[138] The Périnet piston valve (which is now the most widely used piston technology in brass instrument manufacturing) was first incorporated into French top-action instruments and then later into front-action instruments by manufacturers in the United States of America, but this new technology did not initially change the basic wrapping of the two different action-types of concert tubas.[139]

Figure 7.3:[140] Holton top-action design. Pitched in E-flat, bell-up model.

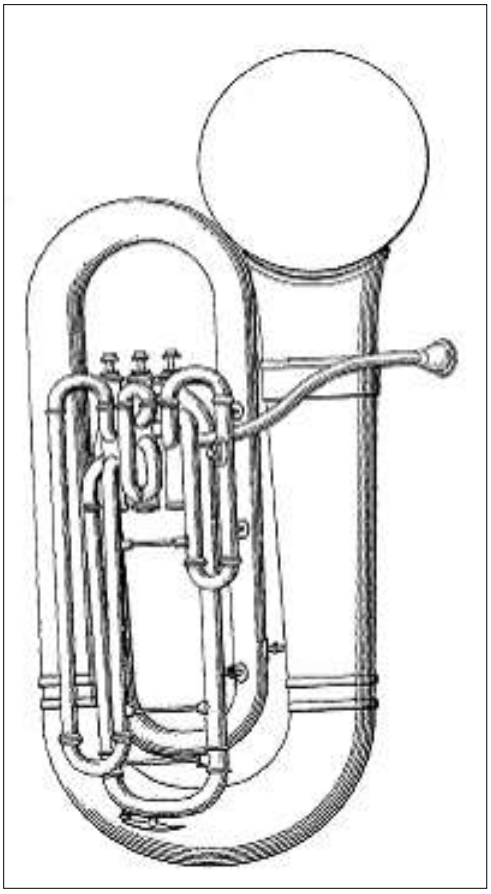


Figure 7.4:[141] C.G. Conn top-action design. Pitched in E-flat, bell-forward model.

[138] This design is still employed in current instruments manufactured by the British instrument manufacturing company Besson.
[139] Bevan, 283.
[140] Drobnak, 92.
[141] Charles G. Conn, Brass Wind Musical Instrument, US Patent No. 931,273, filed February 13, 1908, and issued August 17, 1909.

The two images above compare the designs of a traditional Holton top-action tuba model with the atypical design of the C.G. Conn top-action tuba model. Figure 7.3 displays a Holton top-action tuba pitched in E-flat, and the reader should carefully note the immediate downward turn that each valve's tubing makes after leaving the valve casing. Figure 7.4 displays a sketch of the C.G. Conn Wonder Model top-action tuba pitched in E-flat, and one should note the sudden upwards turn that each valve's tubing makes after leaving the valve casing. A closer image of the C.G. Conn top-action valve tubing can be seen above in figure 4.3 as a review.

Both top-action and front-action tubas are still in production by modern instrument manufacturers. Professional tuba players, especially in the United States of America, tend to favor front-action tubas because this design allows a player to use his or her left hand to adjust the tuning slides of the valve apparatus while playing, whereas top-action tubas make this course of action uncomfortable.[142] Front-action tubas also allow for a more natural and ergonomic hand position for the player's right hand.[143] The most significant physical dissimilarity caused by the placement of the valve apparatus is manifested in the direction of the tuba's bell. From the player's perspective, front-action tubas have a left-facing bell and top-action tubas have a right-facing bell.[144] This concept of altered bell direction as a result of valve location is demonstrated in figures 7.5 and 7.6 below. Take note of the identical outer bough and bell structures of these two instruments. The only significant disparity between these two tubas is the valve

[142] Bevan, 281-283.
[143] Swain, 177.
[144] To review, the direction of bell from the player's perspective is another common name for these two concert tuba designs. In these cases the tubas are referred to as: left-facing (front-action) or right-facing (top-action).

apparatus. These two C.G. Conn tuba models even show similarities in their valve tubing placement, in particular the first and third valve tubing of each instrument, when these tuba models are compared. These similarities between the valve tubing can also be in further detail in figures 8.1 and 8.2.

Figure 7.5: [145] Front-action C.G. Conn Tuba. Note that this design incorporates an identical outer bough structure to the Top-Action instrument in Figure 7.6.

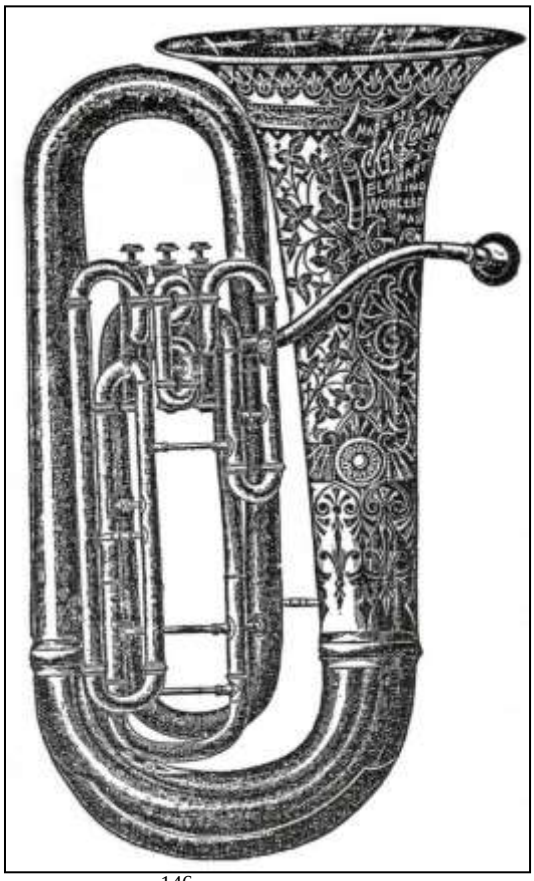


Figure 7.6: [146] Top-Action C.G. Conn Tuba. Note the similarities between the valve tubing seen in the Front-Action instrument in Figure 7.5.

The C.G. Conn instrument manufacturing company eventually offered both a German (front-action) and a French (top-action) model of tuba to the American 'melting pot' that was this company's clientele. However, manufacturing both models would not

[145] Conn, *Wonder and American Model Valve Instruments*.
[146] Ibid.

have been cost-effective, especially when the amount of time and labor involved in the production of the largest member of the brass family is taken into consideration. It is possible that C.G. Conn took the initiative to merge two previously separate designs in their front-action and top-action tubas. The bell and outer boughs of these tubas were influenced by a traditionally French tuba design, while the valve apparatus of each model was based on a German design. This construction method would have allowed for C.G. Conn to accommodate the specific demands of their diverse clientele without an unnecessary delay in production time or use of specific tools for the different models.

SECTION 8: THE ATYPICAL DESIGN OF THE C.G. CONN TOP-ACTION TUBAS

The inspiration for this investigation came while this author was re-cataloguing the tubas manufactured in the United States of America from the musical instrument collection at the National Music Museum in Vermillion, South Dakota. While working with several dozen tubas, this author was perplexed each time a top-action C.G. Conn instrument that had been manufactured between 1890 and 1940 was encountered. The design of the valve apparatus appeared to be counter-productive because of the unnecessarily complicated upward loops of tubing that constituted the design each of the valve's tuning slides. This top-action valve apparatus in the C.G. Conn Wonder Model instruments appeared to have been more labor-intensive to assemble, more difficult to maintain and repair, and seems particularly counter-intuitive because each section of valve-tubing incorporates at least 2 additional right-angle adjustments when compared to more conventional designs. Typically right-angle adjustments are avoided in tuba construction,[147] and that was one of the most notable features of the C.G. Conn Wonder Model top-action tubas.

On the other hand, the front-action C.G. Conn tubas seemed conventional in the design of their valve-apparatus, which was similar to many of the other tubas from this period from other competitive instrument manufacturers as has been discussed above. It was not until perusing an 1895 C.G. Conn Catalogue and Price List from the National Music Museum's Musical Instrument Manufacturer's Archive[148] that this author

[147] Bevan, 280.
[148] Referred to as 'MIMA,' most commonly at the National Music Museum.

suddenly realized that the two product lines – which were pictured side-by-side –[149] were almost certainly constructed to utilize interchangeable parts.

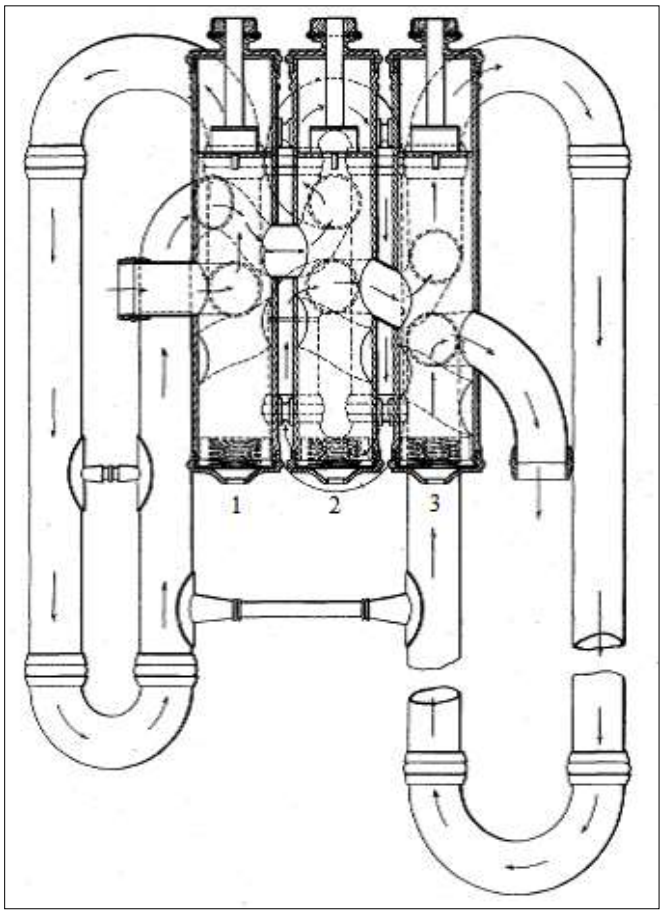


Figure 8.1:[150] C.G. Conn Top-Action Valve Apparatus. Arrows indicate the direction of airflow through the valve section. Note the upward direction of valve tubing from each valve's exit ports.

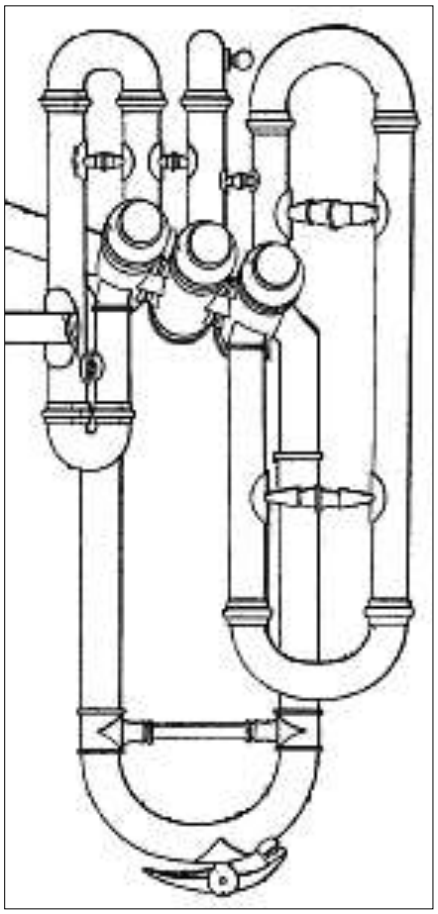


Figure 8.2[151]: C.G. Conn Front-Action Valve Apparatus. Note the similarities in tubing which mirrors the slides of the Top-Action design in the first and third valves.

A detailed comparison of the valve apparatus from both the top-action and front-action C.G. Conn tuba models is displayed above in figures 8.1 and 8.2. The top-action valve apparatus in figure 8.1 is shown from behind the valve apparatus, as if from the

[149] Conn, *Wonder and American Model Valve Instruments.*
[150] Charles G. Conn, Musical Wind Instrument, US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.
[151] Charles G. Conn, Musical Wind Instrument, US Patent No. 405,395, filed November 30, 1888, and issued June 18, 1889.

player's perspective, and displays the valve pathways with arrow indicators as they travel through the valve casings. This image in figure 8.1 is visible in a larger format in Appendix G due to this image's complexity. The front-action valve apparatus in figure 8.2 is displayed from in front of valve apparatus, as if from the opposite of the player's perspective. Review the similar placement of the valve tubing, especially in the first and third valve slides of each instrument. The valve tubing appears more natural in the front-action valve apparatus because of the valve casing's horizontal orientation. This orientation allows for the valve entrance and exit ports to be in line with the valve tubing, juxtaposed by the parallel position of the top-action valve casing in relationship to its valve tubing.

Other low brass researchers have noticed the strange top-action design in the C.G. Conn tubas produced during this timeframe. Most notably, Dr. John Swain mentions this odd valve tubing in his dissertation, *A Catalog of the E-flat Tubas in the Arne B. Larson Collection at the University of South Dakota.* Swain comments on this design five times in his dissertation,[152] and in his first dealing with C.G. Conn top-action tubas he states:

> This is one of a number of Conn instruments in the collection with a rather special valve slide tubing arrangement. The tubing for the first and third valves begins by ascending toward the top of the valves, and then it doubles back down. This is a space-saving arrangement which allows the third valve especially to be protected by the main coil.[153]

This conclusion – although this statement is certainly a plausible consideration that could have been part of C.G. Conn's tuba manufacturing – is not supported by any evidence

[152] Swain, 158-159 171 174 231.
[153] Ibid. 158.

throughout Swain's writings.[154] Regrettably, I am forced to consider this hypothesis to be based on supposition due to lack of evidence in his writings, however likely this design consideration might have been in C.G. Conn's top-action tuba design.

However, Swain makes an important comparison between the C.G. Conn top-action and front-action tubas based on the measurements acquired during his cataloguing procedures. While describing a front-action tuba from the National Music Museum's collection, Dr. Swain writes "the valve assembly of this tuba is different than that of the [C.G.] Conn top-action instruments, but the remainder of the construction is similar to that of the top-action tubas."[155] This noteworthy statement supports the possibility that these two different models of tubas were, in fact, designed to utilize interchangeable parts.

In addition to Dr. Swain's writings, this Top-Action tuba design is described in detail in a United States patent submission made in 1890 by Charles Gerard Conn. This patent claims that this unique wrapping of the valve tubing is designed to prevent water from collecting in the instrument's valve tubing and direct that water to the primary tuning slide. This is accomplished by "construct[ing] the valve-slides [so] that when the valves are depressed the air is made to enter said slides in an upward direction, so that it is impossible for any water which may be in the valves to run into the slides."[156] This claim is also presented in several period advertisements for the 'Wonder Model' tubas.[157] This explanation for the top-action tuba design is the only extant official record by C.G.

---

[154] Ibid.
[155] Swain, 177.
[156] Charles G. Conn, Musical Wind Instrument. US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.
[157] Conn, *Wonder and American Model Valve Instruments*.

Conn that makes any mention of this unique valve apparatus that was incorporated in so many tuba and tuba-like product lines.

Unfortunately, this proposed solution to the problem of water collecting in the valve tubing possesses several significant complications that immediately bring to question the validity of C.G. Conn's claim. Firstly, this design ignores the fact that the principal source of water forming in the valves of a brass instrument is condensation.[158] Secondly, this complicated construction technique which "excluded all water from the valve slides"[159] was significantly more expensive and time consuming than the option of adding water-keys to each of valve tuning slides. Adding this simple and effective technology – which was already incorporated on the primary tuning slide of all of their brass instruments – instead of a complicated new valve apparatus would have alleviated the concern of water forming in the valve slides at a fraction of the cost. Also, the production of this design was replaced by a more conventional top-action valve apparatus shortly after 1940.[160] Surely if the 1890 design for top-action instruments truly barred water from collecting in the tuning slides it would have been worth maintaining, and would have been vastly popular. Finally, it is imperative to recognize that advertisements from 1890 to 1940 often incorporated a dramatic sense of bravura regarding merchandise.[161] Many C.G. Conn advertisements incorporated outlandish (and often unfounded) claims to entice customers to order C.G. Conn products. Some of these exaggerated advertisements included statements such as "all successful players play Conn

[158] It is conceivable, though unlikely, that this understanding regarding condensation involving brass instruments may not have been common knowledge in when this proposition was made in 1890.
[159] Charles G. Conn, Musical Wind Instrument. US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.
[160] Conn, *Conn Band and Orchestra Instruments*, 36-37.
[161] Herbert, 213.

instruments," "scientifically proven to have superior tone," "perfect in intonation," and "enhances the musical value of any band by fifty per cent,"[162] among many others.[163] Although it is plausible that this design was intended to prevent water from collecting in a tuba's valve slides, this author suggests that there may have been other economical motivations for this unusual construction technique as well.

This lack of concrete evidence regarding the reason for this strange top-action design and the unexpected similarities between their top-action and front-action tuba models provoked several questions. Why would C.G. Conn produce such an atypical design for only fifty years if this design truly prevented water from collecting in the slides? What is the connection between the top-action and front-action designs and is there a way to quantify any relationship between these product lines? The answers to these questions could not be found either in extant historical documents or in modern scholarship.

[162] C.G. Conn, *This is why Sousa and His Band use and Endorse Conn Instruments*. (Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, ca. 1920).
[163] Conn, *Selling Points and Testimonials "Bass,"* 1 22-36.

SECTION 9: THE INFLUENCE TO PURSUE COMPARATIVE MEASUREMENTS

Without historical documentation to answer the questions raised above in Section 8, a new area of data collection needed to be explored. This author decided to follow in the footsteps of a fellow tubist's research on historical instruments. Dr. Jeffrey Hodapp worked in the National Music Museum several years before this author's time spent researching in Vermillion, South Dakota, and his research involving comparative measurements of York and C.G. Conn tubas provided a series of techniques that could yield physical data to investigate C.G. Conn's use of interchangeable parts.

Dr. Jeffrey Hodapp's dissertation, *The York Tuba : Design Idiosyncrasies that Contribute to its Unique Sound*,[164] provided an excellent example of investigation of historic tuba design through comprehensive and comparative measurements. Hodapp's research was directed on collecting measurements of the bore expansion of York tubas and comparing these results to the expansion in C.G. Conn tubas from the same timeframe.[165] The detail with which these measurements were taken inspired this author's own methods for comparison between Top-Action and Front-Action tubas.

Dr. Hodapp also published an article in the International Tuba/Euphonium Association Journal regarding his research on historic York tubas, which have become renowned and desirable[166] due to outstanding tone quality and the role that these instruments played in solidifying the use of open-wrap tubas in professional settings.[167] Although the York factory was closed in 1971, many modern tuba designs are either

---

[164] Jeffrey Paul Hodapp, "The York Tuba : Design Idiosyncrasies that Contribute to its Unique Sound" (DMA diss., University of Madison-Wisconsin, 2002).
[165] Hodapp, 11-16.
[166] Joseph Agnew, "The Tubas of the J.W. York Band Instrument Company." *International Tuba/Euphonium Association Journal* 31:4 (Summer 2004): 40-46.
[167] Brian Frederiksen, *Arnold Jacobs: Song and Wind*, (Gurnee, IL: WindSong Press, 1996), 182-183.

direct copies from older York designs or incorporate design elements that are strongly influenced by York wrap and bore expansion.[168] This article's goal was to quantify what elements of construction caused these instruments to have such a desirable tone quality.

Hodapp devised two main forms of measurement in order to calculate the cause of fine tone quality. His first method was a physical measurement of each instrument and the second was an analysis of the harmonic content of each tuba's sound while played with a standard mouthpiece.[169] Hodapp took these measurements with the use of calipers, tape measures, and plastic sheets.[170] His physical measurements determined that the central pipe of the tubas manufactured by York & Sons had a very gradually and precisely widening taper within each of the boughs and bell, while the C.G. Conn tubas had sections of nearly cylindrical tubing followed by sections of rapidly growing taper in order to compensate the lack of taper in the previous sections. These measurements were taken at 29 points between the valve apparatus and the termination of the bell on each of the tubas that were analyzed in this study.[171] Hodapp's analysis of each instrument's sound[172] suggests that evenly tapered bore causes an instrument's tone to have a greater capacity for harmonic content, and thusly a richer sound.[173]

---

[168] Jeffrey Paul Hodapp, . " The York Tuba : Design Idiosyncrasies that Contribute to its Unique Sound." International Tuba/Euphonium Association Journal 32:2, 2005. http://www.iteaonline.org/2008/members/iteajournal/32N2/32N2hodapp.php (accessed February 14, 2012).
[169] The mouthpiece used in this study was the industry standard mentioned earlier, the Conn Helleburg model.
[170] These thin plastic sheets were used to measure sections of the instrument that had been damaged. The concept behind the use of this product was to simulate the original diameter of sections of the instrument that had been bent in such a way that measurements would be otherwise skewed.
[171] Hodapp, 2002, 10-14.
[172] The analysis of each instrument's sound was made possible by the program VoceVista®, which produced a visual representation of each tone's harmonic content spectrum.
[173] Hodapp, 2002, 25.

Hodapp's procedure of comparative measurements provided the initial framework for the investigation of the design of C.G. Conn tubas. After analyzing his measurement techniques, this author designed a system of measurements that would provide data to either defend or refute the likelihood that C.G. Conn designed these two tuba models with interchangeable parts in mind.

SECTION 10: SELECTION OF POINTS OF MEASUREMENT

The first step in devising a system of measurements for comparison between Top-Action and Front-Action tubas involved determining which points along the approximately fourteen foot length of each instrument would provide the most relevant data. After careful consideration, this author chose fourty-seven points of measurement and designed a systematic method to measure each of the suitable C.G. Conn tubas in the National Music Museum's collection. These fourty-seven points were chosen as a result of several criterion, including: potential for interchangeability, structural importance, and involvement with the central pipe of each instrument. This author initially hoped to include both E-flat and B-flat tubas in this study, but was forced to exclude the lower pitched instruments due to a lack of compatible instrument models to compare. The National Music Museum's collection had fourteen E-flat tubas that were constructed during this timeframe, including eight front-action and six top-action instruments.

The forty-seven points of measurement selected for this project were taken in the order of their role in a tuba's energy chain. The energy chain refers to the pathway of energy from an instrument's initiation point to said instrument's termination point. [174]

Forty-seven points of measurement were chosen after carefully reviewing the potential for interchangeability, structural importance, and order that each of these potential points occurred along the energy chain of the tuba. This author also compared many of these points of measurement to those from Jeffrey Hodapp's dissertation.

[174] Thomas D. Rossing, F. Richard Moore, and Paul A. Wheeler, *The Science of Sound 3rd Edition*, (San Francisco: Addison-Wesley Pub. Co, 2002), 225-235.

Calipers,[175] measuring tape, and thin sheets of paper[176] were used to measure each chosen point to an accuracy within 0.06 inches.[177] These fourty-seven points of measurement are listed in detail in Appendices C and D.

After collecting over 600 individual measurements,[178] this author then entered the new data into a Microsoft Excel© document and began to compare relevant quantities. There are now two documents, one that analyzed the measurements to an accuracy of 0.001 inches and a second that examined these same measurements to an accuracy of 0.01 inches. This author selected this course of action in order to present both an accurate representation of the miniscule measurements in the valve tubing while also preserving precision with the larger measurements like those found in the outer boughs and bell section. Cells containing relevant matching measurements were then highlighted and tallied in order to provide new insight on the likelihood that C.G. Conn was implementing interchangeable parts in their tuba construction methods.

[175] These calipers allowed for an accuracy of up to 0.001 inches for any measurement smaller than six inches.
[176] These thin sheets of paper were used to measure sections of the instrument that had been damaged in a similar fashion to the thin plastic sheets used by Dr. Jeffrey Hodapp.
[177] It is generally assumed that inches would have been the favored method of measurement because these instruments were made by an American manufacturer. If a measurement was greater than six inches, then its accuracy was reduced to within 0.06 inches due to limitations of the calipers used in this project.
[178] Several instruments were in a state of disrepair, which caused some areas of measurement to be inaccessible. This caused the final number of measurements to be slightly lower than the originally anticipated 658 points of measurement. Some of the more common issues of disrepair are documented in Appendix C.

SECTION 11: OUTCOMES OF THE COMPARATIVE MEASUREMENTS

The results of these comparative measurements show a very high percentage of significant matching measurements, which can be seen in greater detail in Appendix F. These outcomes demonstrate that the C.G. Conn top-action and front-action tubas were most likely designed to incorporate interchangeable parts. Overall, when these measurements are compared at a level of 0.001 inches there are 19.55% of significant identical figures.[179] The percentage of identical figures increases to 46.99% when this same data is compared at a level of 0.01 inches.[180] These levels of comparison were chosen because it is uncertain as to what level of standard the C.G. Conn Manufacturing Company's tools were calibrated during this time period. While it is quite likely that many tools were calibrated to a standard of 0.01 inches, there is not enough extant documentation to assume that they were able to control the quality of their tools at a higher level of accuracy during the time period of this study.

Several areas demonstrate a significant number of matches. These include: the mouthpiece receiver, the piston diameters, the piston port diameters, the diameter of the valve tubing at their ferrules, the valve tubing bore diameters, most areas of the primary tuning slide, and the primary bough's circumference. Because of the relative number of matches in these areas (from 64% to 92%),[181] these measurements and matches help to support that the C.G. Conn instrument manufacturing company was using procedures to make these parts interchangeable to make assembly of these instruments more cost-effective.

[179] A chart designed to examine this level of comparison can be found in Appendix F.
[180] Consult Appendix F-4 for details on this data.
[181] These measurements can be found in both Appendix F-3 and F-4.

Some aspects of this data collection were skewed because of damage to the instruments. The outer boughs and bell of each instrument that were examined were damaged, some quite severely.[182] Because of this damage, it was nearly impossible to acquire an accurate measurement of the bell diameter, bell section length, circumference of the boughs, and length of the boughs. However, it is possible that these sections of the instrument were also designed to be interchangeable before sustaining damage that altered my measurements because of the significant number of identical measurements found in the undamaged sections of these same instruments.

These comparative measurements collected from each instrument in this study provide strong evidence that C.G. Conn implemented interchangeable parts in their top-action and front-action tubas that were manufactured between 1890 and 1940. The analysis of these measurements has also provided a new means of investigating the construction techniques that were hitherto a mystery because of the loss of historical documentation.

[182] Several common problems involving instrument damage are pictured in Appendix E, in Figures E-7 through E-9.

CONCLUSION

This document has examined the six earliest tuba product lines and construction techniques of the C.G. Conn instrument manufacturing company, one of the most successful band instrument manufacturers in the history of the United States. Regrettably, the majority of C.G. Conn's historical documentation prior to 1970 has been lost, leaving much of this company's history, operation, and construction techniques to educated supposition. However, much of the lost history of C.G. Conn's early tuba product lines has been recovered as a result this investigation of extant publications, patents, and period instruments.

The first six C.G. Conn tuba product lines manufactured each showed this company's considerable ingenuity in the competitive environment of instrument manufacture and sales in the United States between 1880 and 1940. Despite the notably anomalous design the Conn Wonder Model tuba product line, C.G. Conn maintained a leading role as a seller of tubas and other band instruments renowned for the quality of this company's instruments. In fact, this atypical top-action valve apparatus design was ubiquitous in C.G. Conn's tuba and tuba-like instrument construction for nearly half a century.

This document also investigates C.G. Conn's apparent use of interchangeable parts between the Conn Wonder Model and Conn American Model tuba product lines through this author's analysis of data taken from period instruments. This investigation provides strong evidence that these two tuba product lines were implementing interchangeable parts, which would have likely provided C.G. Conn with an economical benefit while still catering to a diverse clientele.

BIBLIOGRAPHY

Agnew, Joseph. "The Tubas of the J.W. York Band Instrument Company." *International Tuba/Euphonium Association Journal* 31:4 (Summer 2004) 40-46.

Banks, Margaret Downie. "A Brief History of the Conn Company (1874-present)." National Music Museum. http://people.usd.edu/~mbanks/CONTENT.html (accessed February 14, 2012).

____. "The Conn Company Archive." National Music Museum. http://orgs.usd.edu/nmm/connarch.html (accessed June 20, 2014)

Benade, Arthur H. *The Fundamentals of Musical Acoustics*. New York: Oxford Press, 1976.

Bevan, Clifford. *The Tuba Family 2nd Edition.* Winchester, England: Piccolo Press, 2000.

Conn, C.G. Flyer. *French Horn, Mellophone, Alto*. Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1927.

Conn, C.G. Instrument Manufacturing Company Advertisement. *Baritones and Euphoniums.* Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, C-778, National Music Museum, The University of South Dakota, Vermillion, SD, January 1921.

____. Instrument Manufacturing Company Advertisement. *C.G. Conn – Solo and Band Instruments Catalog*. Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, 1888.

____. Instrument Manufacturing Company Advertisement. *Conn Band and Orchestra Instruments*, September 1940. Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, 1940, 36-37.

____. Instrument Manufacturing Company Advertisement. *Selling Points and Testimonials "Bass."* Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, 1923-1924.

____. Instrument Manufacturing Company Advertisement. *This is why Sousa and His Band use and Endorse Conn Instruments*. Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1920.

Conn, C.G. Instrument Manufacturing Company Catalog and Price List. *Conn General Catalog "B."* Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, November 1924.

____. Instrument Manufacturing Company Catalog and Price List. *Wonder and American Model Valve Instruments*. Musical Instrument Manufacturers Archive Conn Catalogs 1888-1949, National Music Museum, The University of South Dakota, Vermillion, SD, 1895.

Conn, C.G. Conn Musical Truth. *C.G. Conn's Truth Vol. 5, No. 7, November 1903*. Musical Instrument Manufacturers Archive Conn Musical Truth 1897-1918, National Music Museum, The University of South Dakota, Vermillion, SD, November, 1903.

Conn, Charles G. Piston-Valve Musical Instrument. US Patent No. 249,012, filed April 2, 1881, and issued November 1,1881.

____. Cornet. US Patent No. 343,888, filed August 28, 1885, and issued June 15, 1886.

____. Musical Wind Instrument. US Patent No. 405,395, filed November 30, 1888, and issued June 18, 1889.

____. Musical Wind Instrument. US Patent No. 436,696, filed February 6, 1890, and issued September 16, 1890.

____. Brass Wind Musical Instrument. US Patent No. 931,273, filed February 13, 1908, and issued August 17, 1909.

Drobnak, Ken. "National Music Museum: A Catalog of Upright Tubas by Frank Holton & Company at the National Music Museum (USA)." *International Tuba/Euphonium Association Journal* 38:1, Fall 2010, 92-96.

Fredericksen, Brian. *Arnold Jacobs: Song and Wind.* Gurnee, IL: WindSong Press, 1996.

Herbert, Trevor. "Selling brass instruments: The commercial imaging of brass instruments (1830-1930) and its cultural messages." *Music In Art: International Journal for Music Iconography* 29, no. 1-2 (March 1, 2004): 213. http://web.b.ebscohost.com.ezproxy1.lib.asu.edu/ehost/pdfviewer/pdfviewer?vid=6&sid=2e2fecaa-0437-4d20-a9d7-a0ef7279b85d%40sessionmgr112&hid=122 (accessed August 18, 2014).

Hodapp, Jeffrey Paul. "The York Tuba : Design Idiosyncrasies that Contribute to its Unique Sound." DMA diss., University of Wisconsin-Madison, 2002.

____. "The York Tuba : Design Idiosyncrasies that Contribute to its Unique Sound." *International Tuba/Euphonium Association Journal* 32:2, 2005. http://www.iteaonline.org/2008/members/iteajournal/32N2/32N2hodapp.php (accessed February 14, 2012).

Klaus, Sabine. "Elements of Brass Instrument Construction." National Music Museum. http://orgs.usd.edu/nmm/UtleyPages/Utleyfaq/brassfaq.html (accessed July 14, 2014).

Reeves, Deborah Check. "C.G. Conn's Double-Wall Wonder Clarinets." National Music Museum. http://orgs.usd.edu/nmm/Clarinets/Conn/DoubleWallClarinets/ConnDblWallClarinetsBanks.html (accessed July 12, 2014).

Rossing, Thomas D. F. Richard Moore, and Paul A. Wheeler, *The Science of Sound 3rd Edition*, San Francisco: Addison-Wesley Pub. Co, 2002.

Swain, John Joseph. "A Catalog of the E-flat Tubas in the Arne B. Larson Collection at the University of South Dakota." PhD diss., Michigan State University, 1985.

Instruments from the National Music Museum Researched in this Study

Tuba pitched in E-flat by C.G. Conn, Serial Number 4037, *NMM 5,892*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1880-1881.

Tuba pitched in E-flat by C.G. Conn, Serial Number 16250, *NMM 356*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1886.

Tuba pitched in E-flat by C.G. Conn, Serial Number 16260, *NMM 276*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1902.

Tuba pitched in E-flat by C.G. Conn, Serial Number 17793, *NMM 2,656*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1890.

Tuba pitched in E-flat by C.G. Conn, Serial Number 18616, *NMM 254*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, 1890.

Tuba pitched in E-flat by C.G. Conn, Serial Number 28941, *NMM 4,147*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1894.

Tuba pitched in E-flat by C.G. Conn, Serial Number 31856, *NMM 106*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1895.

Tuba pitched in E-flat by C.G. Conn, Serial Number 62905, *NMM 270*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, 1901.

Tuba pitched in E-flat by C.G. Conn, Serial Number 70393, *NMM 129*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1901.

Tuba pitched in E-flat by C.G. Conn, Serial Number 71782, *NMM 120*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1902.

Tuba pitched in E-flat by C.G. Conn, Serial Number 87103, *NMM 303*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1904.

Tuba pitched in E-flat by C.G. Conn, Serial Number 161839, *NMM 353*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, 1918.

Tuba pitched in E-flat by C.G. Conn, Serial Number 163855, *NMM 126*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1918.

Tuba pitched in E-flat by C.G. Conn, Serial Number 173734, *NMM 348*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1920.

Tuba pitched in E-flat by C.G. Conn, Serial Number 178831, *NMM 5,965*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1921.

Tuba pitched in E-flat by C.G. Conn, Serial Number 183987, *NMM 2,637*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, ca. 1921.

Tuba pitched in E-flat by C.G. Conn, Serial Number 188071, *NMM 1,344*, Musical Instrument Collection, National Music Museum, The University of South Dakota, Vermillion, SD, 1922.

APPENDIX A

C.G. CONN TUBA-RELATED PERIODICALS

PERIODICALS IN CHRONOLOGICAL ORDER

FIGURE A-1
FIRST KNOWN ADVERTISEMENT FOR WONDER VALVE BAND INSTRUMENTS
C.G. Conn – Solo and Band Instruments Catalog - 1888

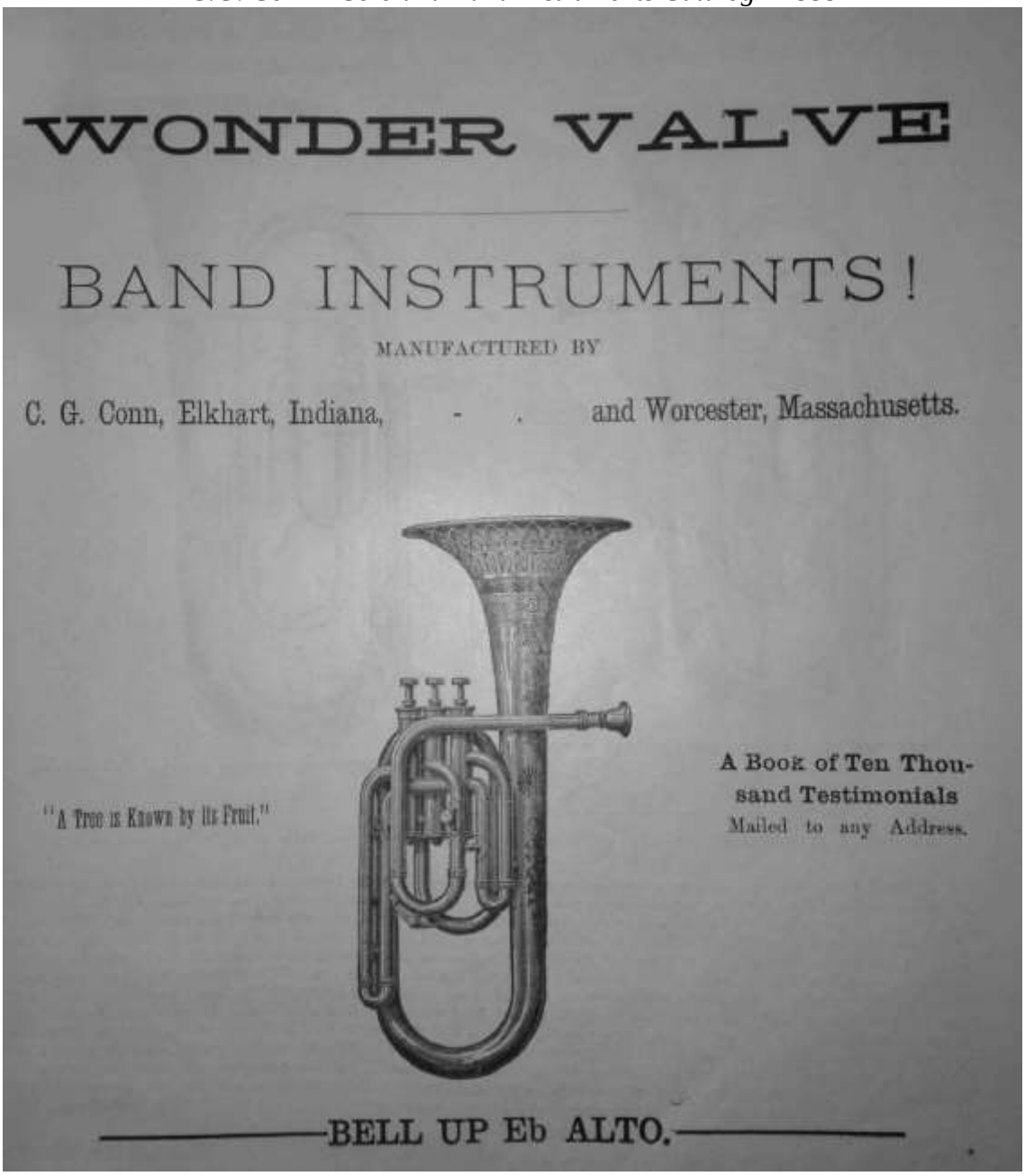


FIGURE A-1 – CONTINUED

FIGURE A-1 – CONTINUED

Write to C. G. Conn's Manufactories for prices on all kinds of Musical Merchandise.

The Wonder Valve
SOLO EUPHONIUM IN Bb,

Bell up Pattern.

Universally admired, and for artist's use, is the champion of all Euphoniums. Fourth Valve extra.

Solo Euphonium, with Fourth Valve, extra Engraving.

From A. W. WOOD, Principal Musician 7th U. Infantry.

Fort Yates, D. T.

C. G. Conn:—The instruments came duly to hand and I can't find words to express how well I am pleased with it. It is the easiest blowing instrument I have used for fifteen years. High E is very easily made and every tone is pure and clear. I believe there is not another in the world that would have treated me as generously as you have. Wishing you success.

Address all orders to

C. G. Conn, Elkhart, Ind., - - - Worcester, Mass.

THE WONDER VALVE Bb BASS

Bell up Pattern.

Undoubtedly the best valve Bass instrument ever invented. It has a full, rich organ like tone and even register, and is in perfect tune throughout its entire compass.

The Wonder Bb Bass with Fourth Valve, extra Engraving.

Patented in the United States and Europe.

rom GEO. H. FAFICUR, Solo Bass Player, Haverley's Theatre.

Chicago, Illinois.

C. G. Conn:—Please send me an Eb upright bass. The tuba I bought of you five years ago has given the greatest satisfaction in every respect. I regard it as the only tuba, and would have no other. It is my opinion, and of others of the Chicago musical society, that it is the richest toned instrument ever produced.

Address all orders to

C. G. Conn, Elkhart, Ind., - - - Worcester, Mass.

FIGURE A-1 – CONTINUED

Write to C. G. Conn's Manufactories for prices on all kinds of Musical Merchandise.

BELL UP WONDER VALVE Eb BASS

Length, 33 inches. Weight. 10 pounds.

PATENTED IN EUROPE AND AMERICA.

The instruments made by C. G. Conn have been fully endorsed by all of the leading bandmasters and musicians in the United States Army and Navy, and bands will make no mistake in supplying themselves with them.

A liberal discount from the list prices is given when several instruments are purchased at one time. All instruments are sent subject to approval, and a rigid and impartial comparison and test with other instruments is invited, and any instrument made upon the equa-valve system which does not prove, after sufficient trial, to be fully all that is represented, either the price paid for it will be returned or the instrument made good. Mr. Conn is responsible and will do all he represents.

I will guarantee this Bass to be the best in the world for full, organ-like volume of tone, ease of blowing and perfect construction and durability. It is symmetrical in proportion, lies convenient and easy to the side when in use, and every part liable to injury is fully protected by guards and bands.

Address all orders to

C. G. Conn, Elkhart, Ind., - - and Worcester, Mass.

FIGURE A-1 – CONTINUED

FIGURE A-2
FIRST KNOWN ADVERTISEMENT FOR NEW AMERICAN AND WONDER MODELS
Wonder and American Model Valve Instruments, Catalog and Price List – 1895

C. G. CONN'S CATALOGUE OF NET CASH PRICES.

NEW AMERICAN

MODEL Eb BASS

PATENTED BY C. G. CONN.

Invented and Patented by an American, Manufactured by American Workmen, and Immensely Popular with American Bandsmen and Musicians.

Weight with mouthpiece in position ready for use, 11¼ pounds; length from edge of bell to base of largest bend, 20 inches; width across instrument at valves, 14 inches; diameter of bell, 16 inches.

FINISH I.—Elegantly engraved, triple silver-plated, burnished finish, all points, ferrules, finger tips, valve tops and bottom caps and water key gold-plated, pearl inlaid finger tips. Complete with two mouthpieces, music holder, piston wiper and shoulder strap..... $85.00

FINISH II.—Engraved, triple silver-plated, burnished finish, pearl inlaid finger tips. Complete with the attachments as described in finish I..... $77.50

FINISH III.—Highly polished brass finish, silver-plated mountings, pearl inlaid finger tips. Complete with the attachments as described in the finish I and II..... $65.00

Every Instrument is Accompanied with a Five Year Guarantee of Excellence and Durability

C. G. Conn's Latest Patent.

THIS ILLUSTRATION SHOWS THE

Wonder Model Bell-up Eb Bass

With valve slides so arranged that water cannot accumulate in them. When the valves are depressed the air column is conducted through the upper bend in the valve slides, thence down into the lower bend and back into the valves. The same principle is carried into effect in the American Model Band Instruments, and by the use of this system no water can accumulate in the valve slides. The advantage of this patent to large instruments will be obvious to all musicians who have been obliged to play with water in the valve slides, and in the future all instruments of the Bell-up Wonder Model, including Altos, Tenors, Baritones, Euphoniums and Basses of all kinds, will be made with C. G. CONN'S Late Patent to prevent the accumulation of water in the valve slides

A Substantial Heavy Leather Case, sewed and lined with baize, to fit above instrument can be furnished at an extra cost of..... $14.00

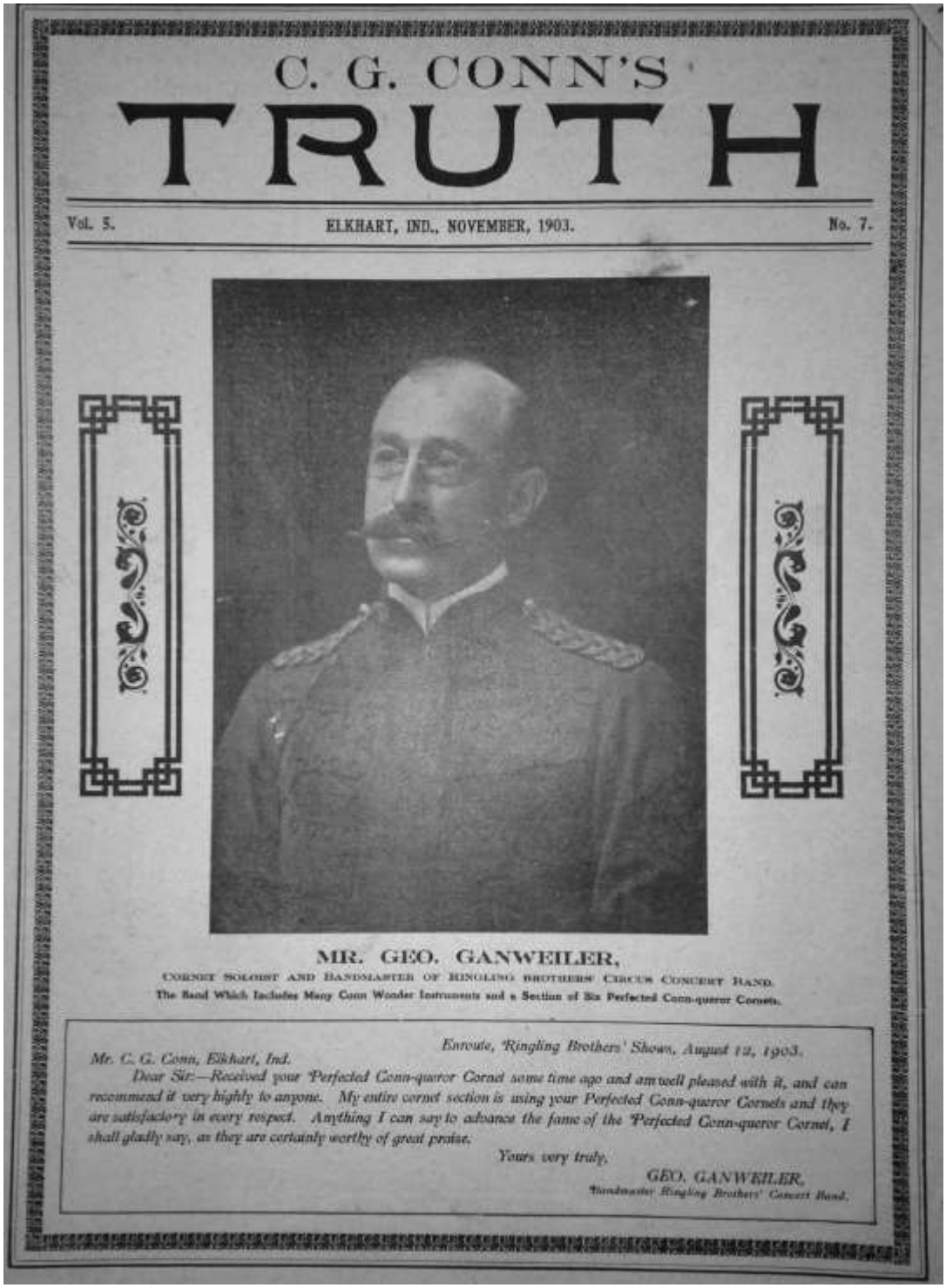
Every Instrument is accompanied with a Five Year Guarantee of Excellence and Durability.

Address all Orders to

C. G. CONN, - 23 East 14th Street, New York City.

FIGURE A-3

C.G. Conn's Truth Vol. 5, No. 7, November 1903 – November 1903



C. G. CONN'S

TRUTH

Vol. 5. ELKHART, IND., NOVEMBER, 1903. No. 7.

MR. GEO. GANWEILER,

CORNET SOLOIST AND BANDMASTER OF RINGLING BROTHERS' CIRCUS CONCERT BAND.

The Band Which Includes Many Conn Wonder Instruments and a Section of Six Perfected Conn-queror Cornets.

Enroute, Ringling Brothers' Shows, August 12, 1903.

Mr. C. G. Conn, Elkhart, Ind.

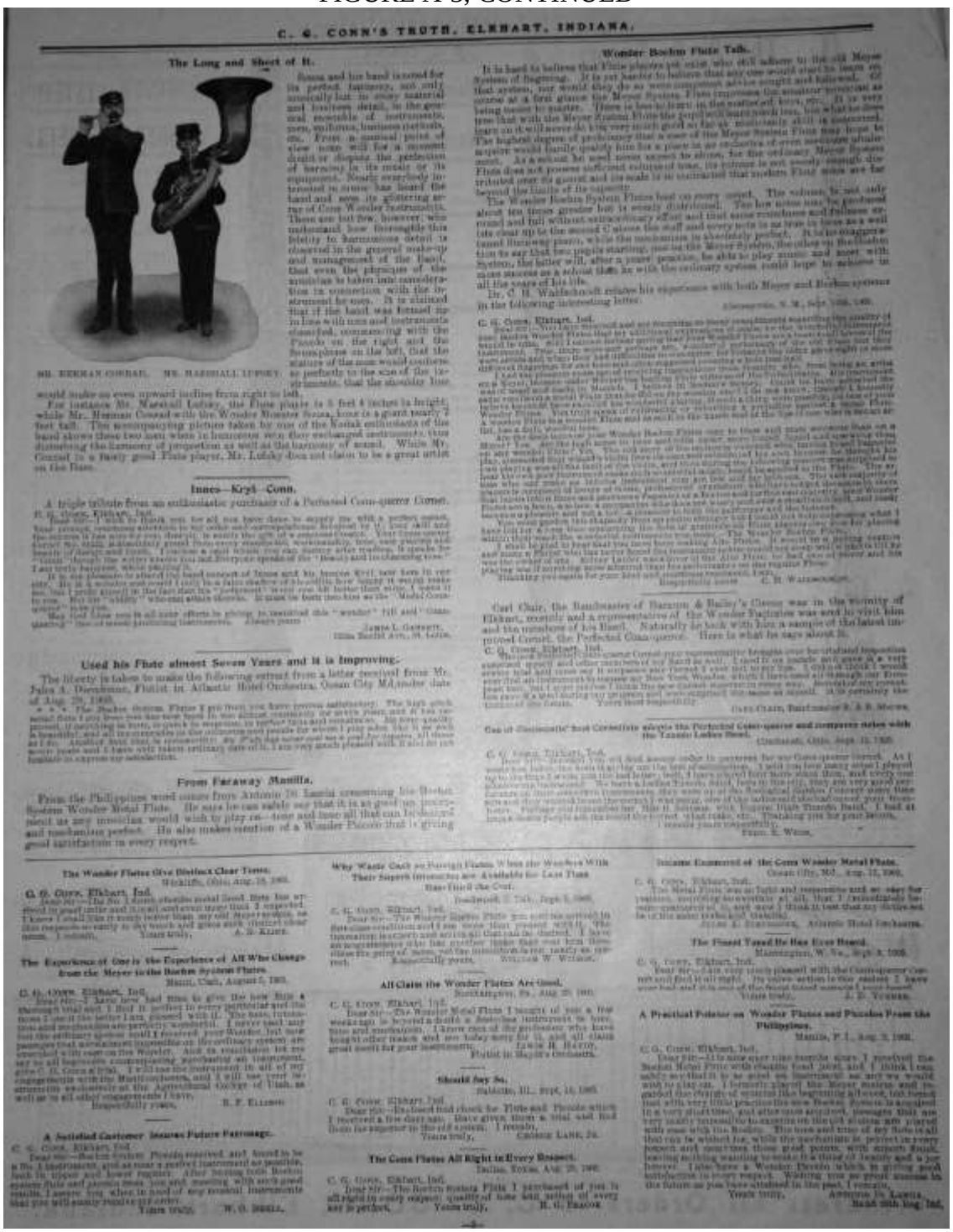
Dear Sir:—Received your Perfected Conn-queror Cornet some time ago and am well pleased with it, and can recommend it very highly to anyone. My entire cornet section is using your Perfected Conn-queror Cornets and they are satisfactory in every respect. Anything I can say to advance the fame of the Perfected Conn-queror Cornet, I shall gladly say, as they are certainly worthy of great praise.

Yours very truly,

GEO. GANWEILER,

Bandmaster Ringling Brothers' Concert Band.

FIGURE A-3, CONTINUED



C. G. CONN'S TRUTH, ELKHART, INDIANA.

The Long and Short of It.

MR. HERMAN CONRAD. MR. MARSHALL LUDDY.

Innes—Kryl—Conn.

Used his Flute almost Seven Years and it is Improving.

From Faraway Manilla.

Wonder Boehm Flute Talk.

Carl Clair, the Bandmaster of Barnum & Bailey's Circus was in the vicinity of Elkhart, recently and a representative of the Wonder Exclusive was sent to visit him and the members of his Band. Naturally he took with him a sample of the latest improved Cornet, the Perfected Cornet-queror. Here is what he says about it.

The Wonder Flutes Give Distinct Clear Tones.

The Experience of One is the Experience of All Who Change from the Meyer to the Boehm System Flutes.

A Satisfied Customer Assures Future Patronage.

Why Waste Cash on Foreign Flutes When the Wonders With Their Superb Intonation are Available for Less Than Half the Cost.

All Claim the Wonder Flutes Are Good.

Should Say So.

The Conn Flutes All Right in Every Respect.

Income Enamored of the Conn Wonder Metal Flute.

The Finest Toned Flute Ever Heard.

A Practical Pointer on Wonder Flutes and Piccolos From the Philippines.

FIGURE A-3, CONTINUED

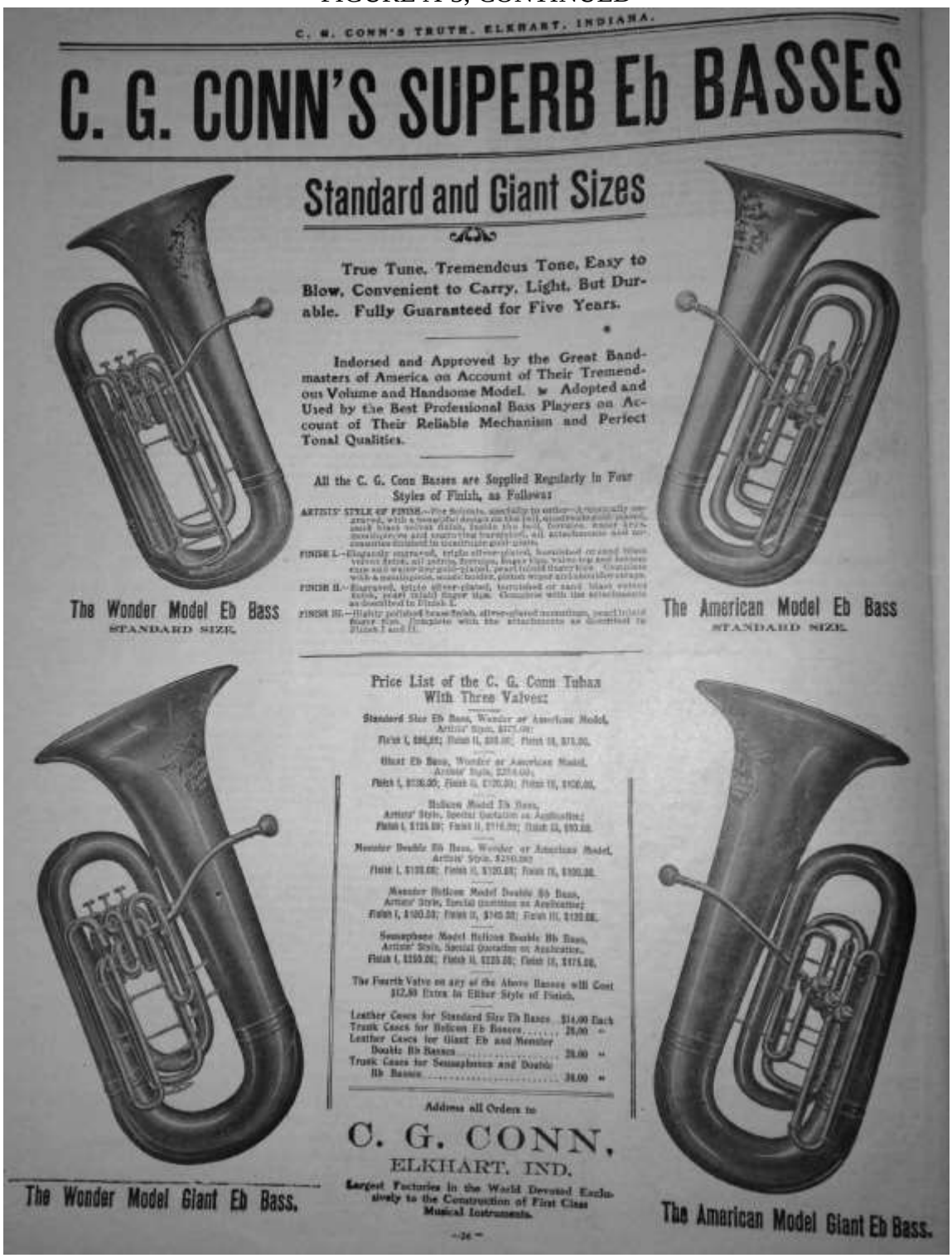


FIGURE A-3, CONTINUED

FIGURE A-4
Baritones and Euphoniums – Instrument-specific catalog – January 1921

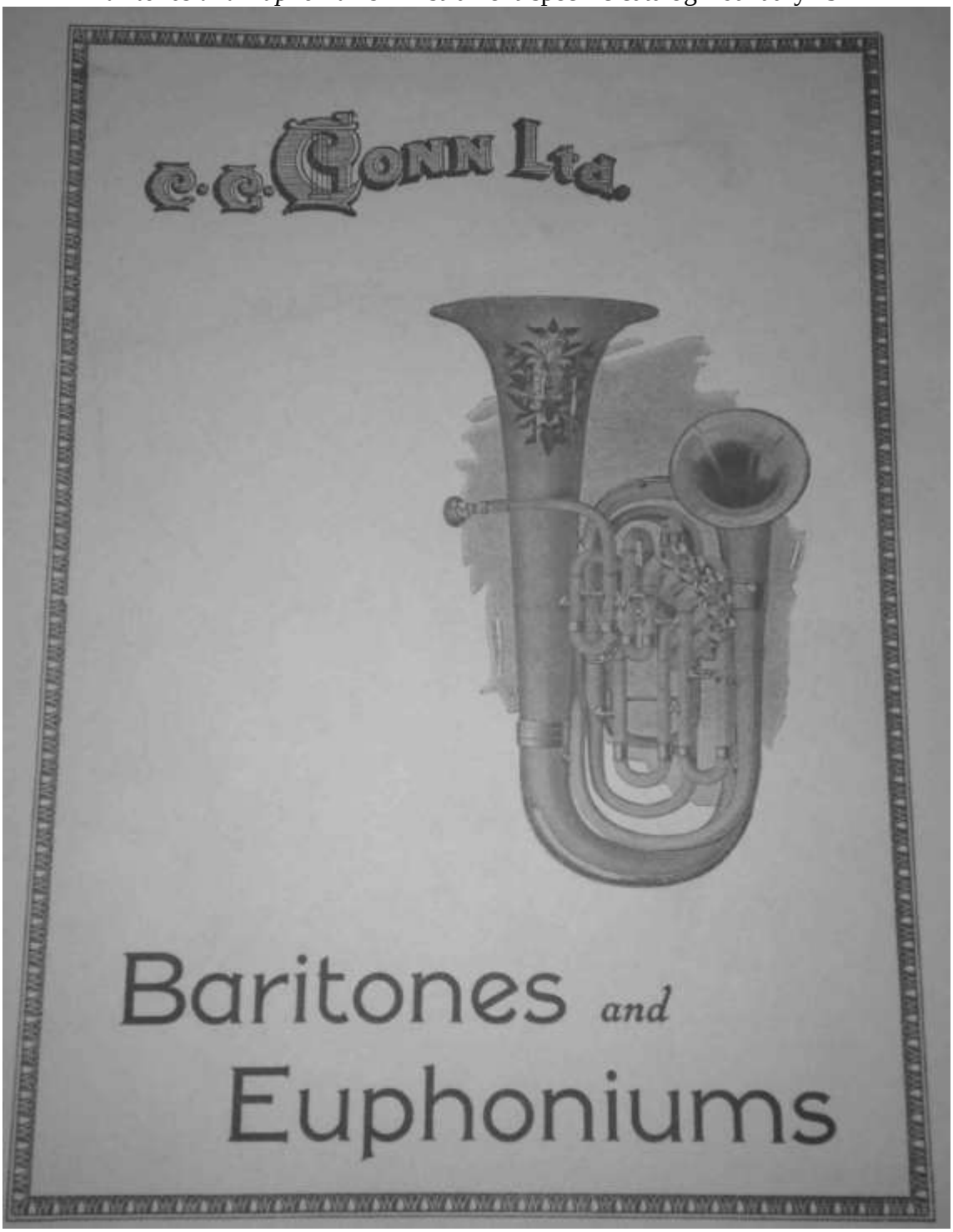


FIGURE A-4, CONTINUED

The Latest Model Conn Ltd., Euphonium Has Surpassed all Former Models in its Intonation, Tonal Quality and Power of Tone

Top Action Front Action

Built in Bb—3 or 4 Valves.

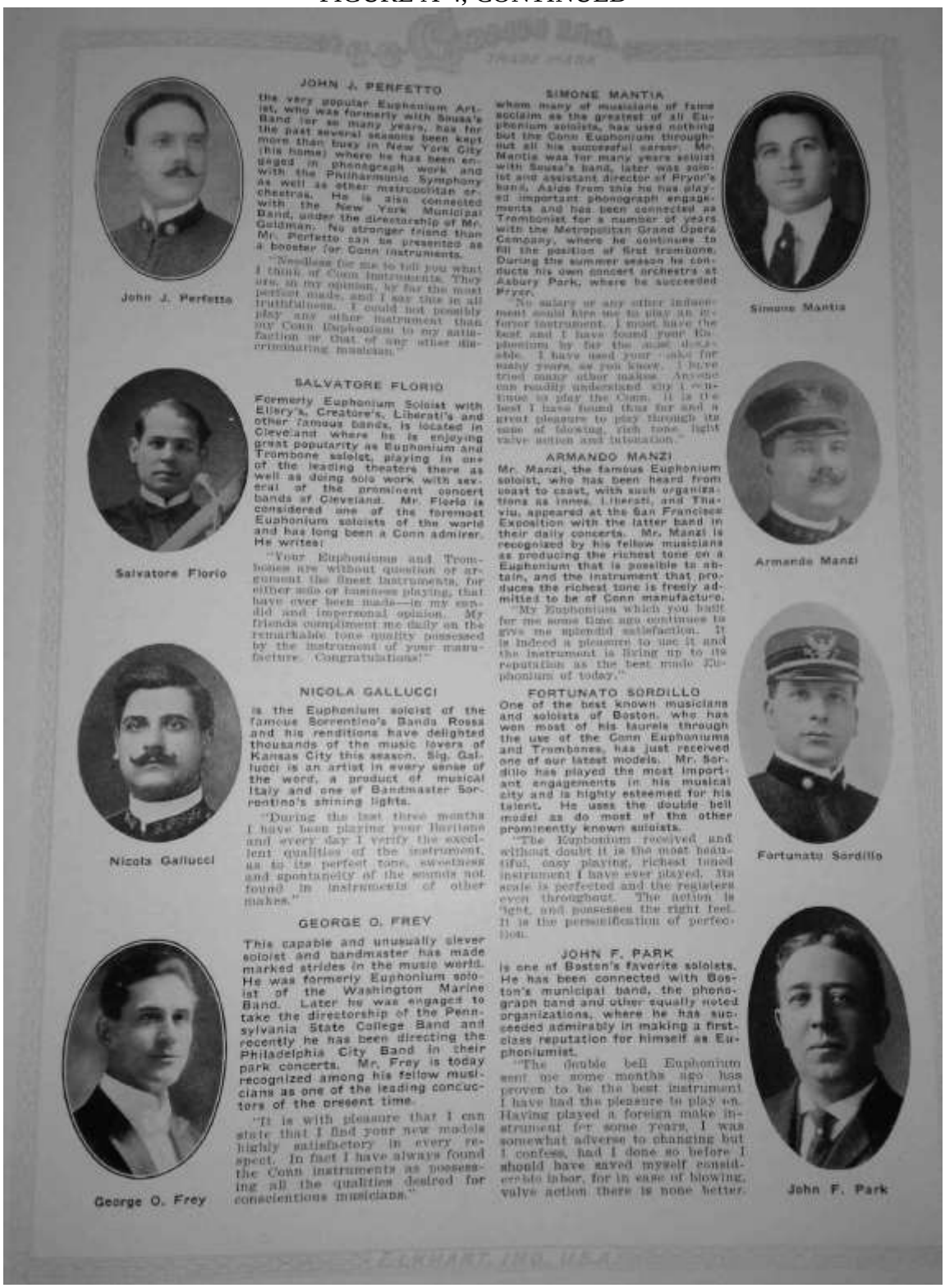
The C. G. Conn Ltd. New Wonder Model Single Bell Euphonium

SPECIFICATIONS

Length, 28¼ in. Width, 11 in. Weight, 6¼ lbs.

Bell Diameter, 11 in.

FIGURE A-4, CONTINUED



JOHN J. PERFETTO

the very popular Euphonium Artist, who was formerly with Sousa's Band for so many years, has for the past several seasons been kept more than busy in New York City (his home) where he has been engaged in phonograph work and with the Philharmonic Symphony as well as other metropolitan orchestras. He is also connected with the New York Municipal Band, under the directorship of Mr. Goldman. No stronger friend than Mr. Perfetto can be presented as a booster for Conn instruments.

"Needless for me to tell you what I think of Conn Instruments. They are, in my opinion, by far the most perfect made, and I say this in all truthfulness. I could not possibly play any other instrument than my Conn Euphonium to my satisfaction or that of any other discriminating musician."

John J. Perfetto

SALVATORE FLORIO

Formerly Euphonium Soloist with Ellery's, Creatore's, Liberati's and other famous bands, is located in Cleveland where he is enjoying great popularity as Euphonium and Trombone soloist, playing in one of the leading theaters there as well as doing solo work with several of the prominent concert bands of Cleveland. Mr. Florio is considered one of the foremost Euphonium soloists of the world and has long been a Conn admirer. He writes:

"Your Euphoniums and Trombones are without question or argument the finest instruments, for either solo or business playing, that have ever been made—in my candid and impersonal opinion. My friends compliment me daily on the remarkable tone quality possessed by the instrument of your manufacture. Congratulations!"

Salvatore Florio

NICOLA GALLUCCI

is the Euphonium soloist of the famous Sorrentino's Banda Rossa and his renditions have delighted thousands of the music lovers of Kansas City this season. Sig. Gallucci is an artist in every sense of the word, a product of musical Italy and one of Bandmaster Sorrentino's shining lights.

"During the last three months I have been playing your Baritone and every day I verify the excellent qualities of the instrument, as to its perfect tone, sweetness and spontaneity of the sounds not found in instruments of other makes."

Nicola Gallucci

GEORGE O. FREY

This capable and unusually clever soloist and bandmaster has made marked strides in the music world. He was formerly Euphonium soloist of the Washington Marine Band. Later he was engaged to take the directorship of the Pennsylvania State College Band and recently he has been directing the Philadelphia City Band in their park concerts. Mr. Frey is today recognized among his fellow musicians as one of the leading conductors of the present time.

"It is with pleasure that I can state that I find your new models highly satisfactory in every respect. In fact I have always found the Conn instruments as possessing all the qualities desired for conscientious musicians."

George O. Frey

SIMONE MANTIA

whom many of musicians of fame acclaim as the greatest of all Euphonium soloists, has used nothing but the Conn Euphonium throughout all his successful career. Mr. Mantia was for many years soloist with Sousa's band, later was soloist and assistant director of Pryor's band. Aside from this he has played important phonograph engagements and has been connected as Trombonist for a number of years with the Metropolitan Grand Opera Company, where he continues to fill the position of first trombone. During the summer season he conducts his own concert orchestra at Asbury Park, where he succeeded Pryor.

"No salary or any other inducement could lure me to play an inferior instrument. I must have the best and I have found your Euphonium by far the most desirable. I have used your valve for many years, as you know. I have tried many other makes. Anyone can readily understand why I continue to play the Conn. It is the best I have found thus far and a great pleasure to play through its ease of blowing, rich tone, light valve action and intonation."

Simone Mantia

ARMANDO MANZI

Mr. Manzi, the famous Euphonium soloist, who has been heard from coast to coast, with such organizations as Innes, Liberati, and Thayiu, appeared at the San Francisco Exposition with the latter band in their daily concerts. Mr. Manzi is recognized by his fellow musicians as producing the richest tone on a Euphonium that is possible to obtain, and the instrument that produces the richest tone is freely admitted to be of Conn manufacture.

"My Euphonium which you built for me some time ago continues to give me splendid satisfaction. It is indeed a pleasure to use it and the instrument is living up to its reputation as the best made Euphonium of today."

Armando Manzi

FORTUNATO SORDILLO

One of the best known musicians and soloists of Boston, who has won most of his laurels through the use of the Conn Euphoniums and Trombones, has just received one of our latest models. Mr. Sordillo has played the most important engagements in his musical city and is highly esteemed for his talent. He uses the double bell model as do most of the other prominently known soloists.

"The Euphonium received and without doubt it is the most beautiful, easy playing, richest toned instrument I have ever played. Its scale is perfected and the registers even throughout. The action is 'spot,' and possesses the right feel. It is the personification of perfection.

Fortunato Sordillo

JOHN F. PARK

is one of Boston's favorite soloists. He has been connected with Boston's municipal band, the phonograph band and other equally noted organizations, where he has succeeded admirably in making a first-class reputation for himself as Euphoniumist.

"The double bell Euphonium sent me some months ago has proven to be the best instrument I have had the pleasure to play on. Having played a foreign make instrument for some years, I was somewhat adverse to changing but I confess, had I done so before I should have saved myself considerable labor, for in ease of blowing, valve action there is none better.

John F. Park

FIGURE A-5

Selling Points and Testimonials "Bass" – Tuba-specific catalog, 1923-1924

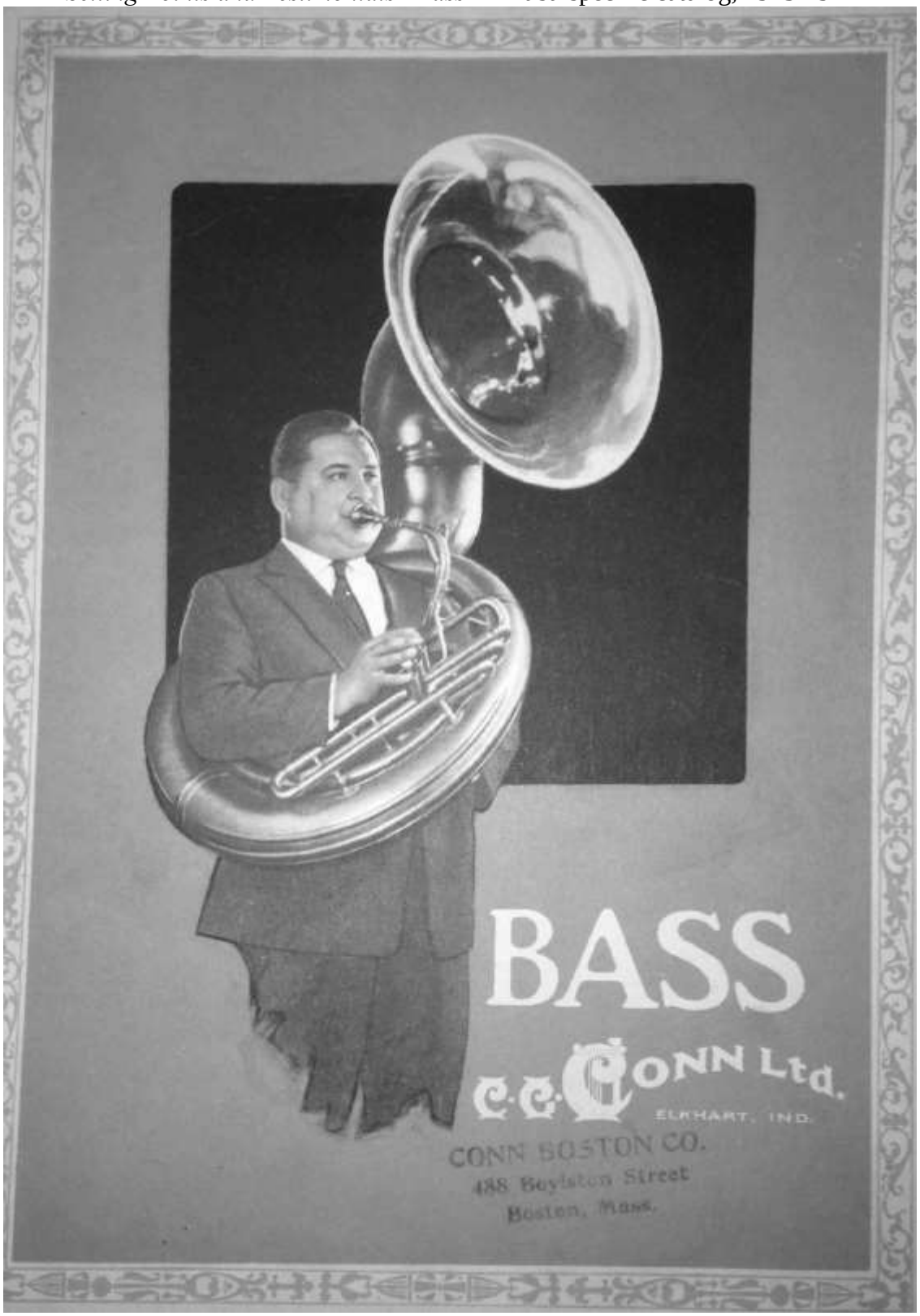


FIGURE A-5, CONTINUED

INTRODUCTORY

THE BASSES of all Military Bands and Concert or Symphony Orchestras give the fundamental tone color to these organizations and therefore must, of necessity, be rich in tone quality, perfect in intonation, sonorous in volume, responsive to the lightest attack, and must play easily. The lightest as well as the most powerful tone must be obtainable in order to give the proper fundamental to the ensemble of the Band or Orchestra and must never fail to function.

The String Basses have in the past served to suffice in most large Orchestras but with the more modern music now performed the Brass Bass has been added and has proven most effective and necessary. The imperfection of the Brass Basses of the earlier periods made it impossible to admit of their use in conjunction with the Strings; but the marked development in perfecting the Brass Bass in the Conn Ltd. has given the Music World instruments of such a high character that they do so with the utmost satisfaction.

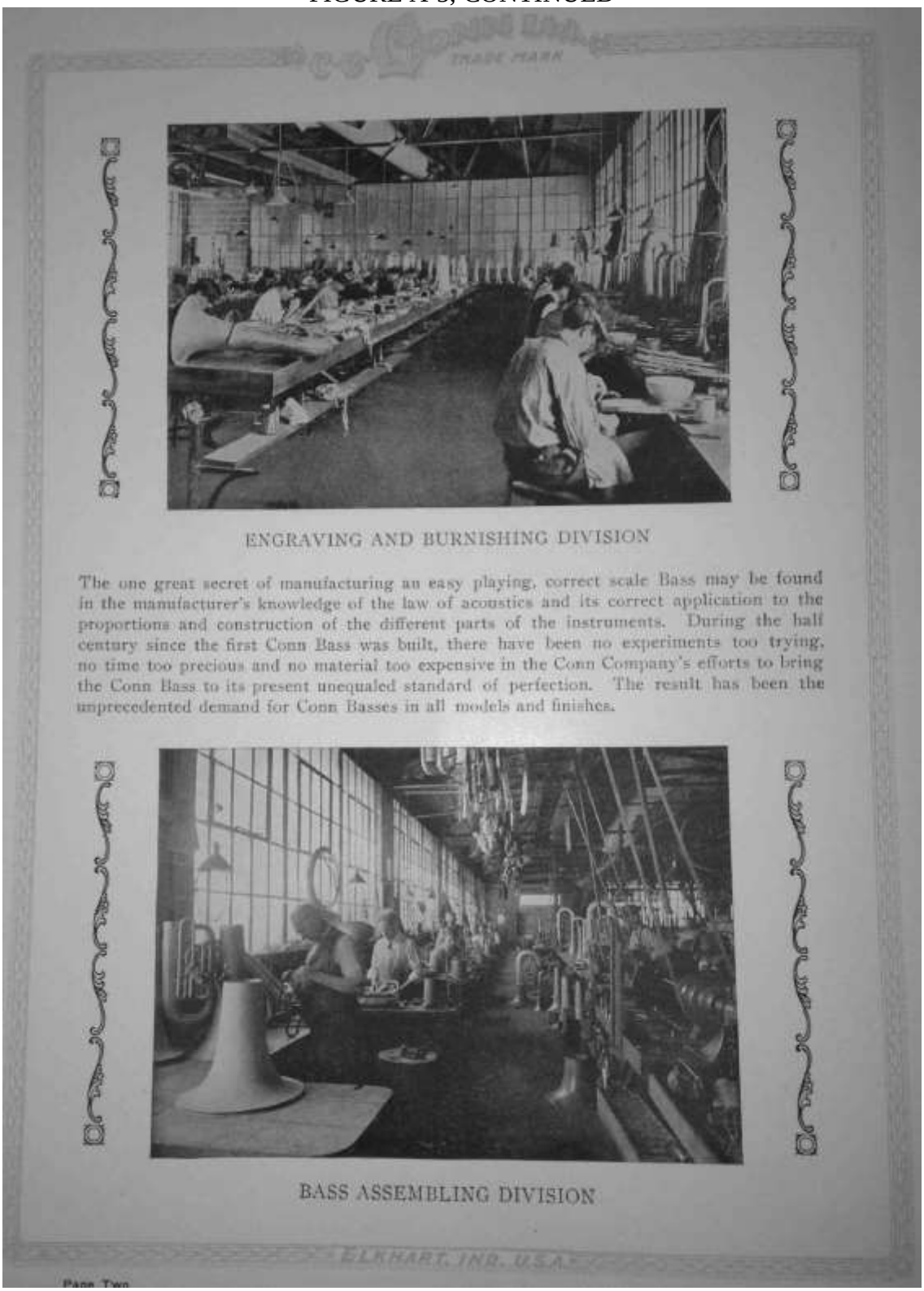
The Conn Ltd. Basses have been in use in all of the most prominent Concert Bands since the days of Gilmore and in Orchestras since the popularity of the Celebrated Thomas Chicago Symphony Orchestra. Every organization of prominence from those days down to the present have seen the Conn Basses in use. This record for the Conn product is one for which we may rightfully feel elated. There has never been a time when the Conn factories have not made persistent efforts toward the perfecting of all its Basses and it is through this fact that the most capable Bass Artists of the world have discovered that the Conn Basses were worthy of their careful test. In all instances where such a test has been made the Artists were eager to express their admiration and preference for the Conn product.

In presenting this Catalog to our readers we invite them to read the opinions as expressed by those who own Conns, and we desire, also, to express our regret in not being able to publish the thousands of letters contained in our files which teem with the highest praise for our Basses. Many Artists have never sent us their photos but have complimented us repeatedly on the virtues of their Conn Basses.

Most respectfully,

C. G. CONN Ltd.,
Elkhart, Indiana.

FIGURE A-5, CONTINUED



ENGRAVING AND BURNISHING DIVISION

The one great secret of manufacturing an easy playing, correct scale Bass may be found in the manufacturer's knowledge of the law of acoustics and its correct application to the proportions and construction of the different parts of the instruments. During the half century since the first Conn Bass was built, there have been no experiments too trying, no time too precious and no material too expensive in the Conn Company's efforts to bring the Conn Bass to its present unequaled standard of perfection. The result has been the unprecedented demand for Conn Basses in all models and finishes.

BASS ASSEMBLING DIVISION

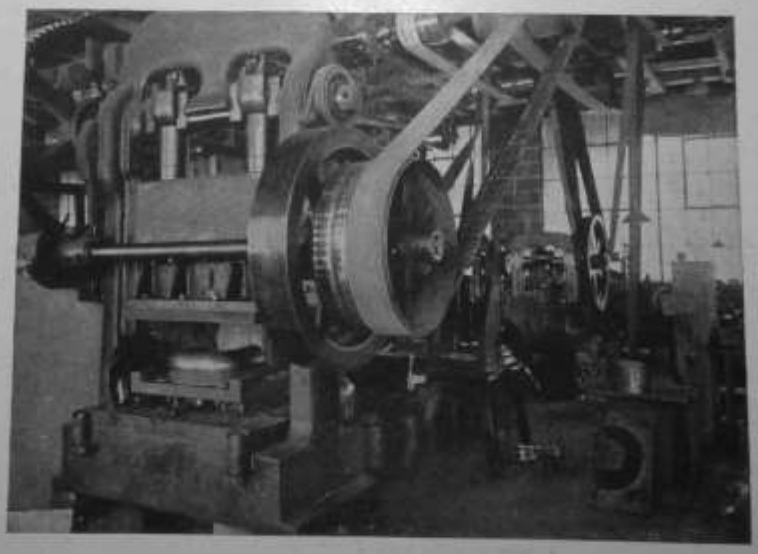
ELKHART, IND. U.S.A.

Page Two

FIGURE A-5, CONTINUED

BELL SPINNING DIVISION

The Bass Department of the Conn Ltd. factories is the largest and most modernly equipped of its kind in the world employing a force of workmen who are completely skilled in the arts of Bass construction. Each employee has started his career in this department as an apprentice and has learned the trade from the bottom. He is exceedingly well prepared to handle any part of the construction work with the assurance that proportions will be exactly correct and that the instrument will be of the highest class when completed.



FORMING OPERATION FOR BASS BOWS

FIGURE A-5, CONTINUED

A SUPERIOR FEATURE NOT FOUND IN ANY BASS OTHER THAN A CONN

The Conn Ltd. has spared no expense in improving its methods of manufacture. Thousands of dollars have been expended in new machinery, tools and other equipment in order to build each and every part of the various instruments in the most perfect possible manner. This equipment also added materially in increasing the efficiency of the production.

THE HYDRAULIC EXPANSION PROCESS

This process is fully patented by the Conn Ltd. and is fully described in our pamphlet entitled "How Wind Musical Instruments Have Been Improved." The Old process and the new imperfect Hand-Made bent taper branches cause defective intonation. The CONN process assures perfect intonation and also hardens the branches and makes them less liable to injury. Each taper branch is placed in a perfectly tool-made die, locked therein completely surrounded by this die, the nozzle of the Hydraulic apparatus is locked tightly into the end of one of the branch tubes, while the other end of the tube is perfectly plugged by another part of the apparatus. The entire die containing the tube is locked securely in the Hydraulic press and the water is then released and forced into the branch of the instrument of a certain tonnage of pressure which expands the branch to the walls of the perfect die. This pressure is so powerful that if the branch possesses any weak point in its body that weak point will split and the branch is then junked. Through this Hydraulic system each branch becomes identical with another of the same character and the interior of the branch is made as smooth as glass. The exterior of the branch assumes a perfectly smooth surface, the same as the die in which it is expanded.

THEREFOR, with the branches of Conn Instruments made perfectly alike and exceptionally smooth on their interior, one can readily realize why they should produce more perfect and clear tones, play much more easily, possess more perfect intonation and stand the wear and tear better through the hardening of the metal, than any other instrument manufactured by the old process. The Old process requires the filling of the branches by lead, pitch or other composition so that the maker can hammer the outside of the branch until it becomes smooth on the exterior but by this method the interior of the branch cannot fail to be irregular and uneven, therefor instruments thus made could not possess the superior qualifications as outlined above as being possessed by the NEW PROCESS constructed C. G. Conn Ltd. Instruments. Comparison proves this.

Before

This illustration shows a helicon taper branch after it leaves the hands of the workman who does the bending. While in this condition the branch is placed in the molds and expanded by hydraulic pressure until all of the marks, defects and depressions have been removed.

After

This illustration shows the same helicon taper branch seen in illustration No. 1, after it has been expanded by the Conn hydraulic process. It is now a perfect specimen of accurate acoustic proportions, smoothly finished and ready to be placed in the instrument.

ELKHART, IND., U.S.A.

Page Four

FIGURE A-5, CONTINUED

FIGURE A-5, CONTINUED

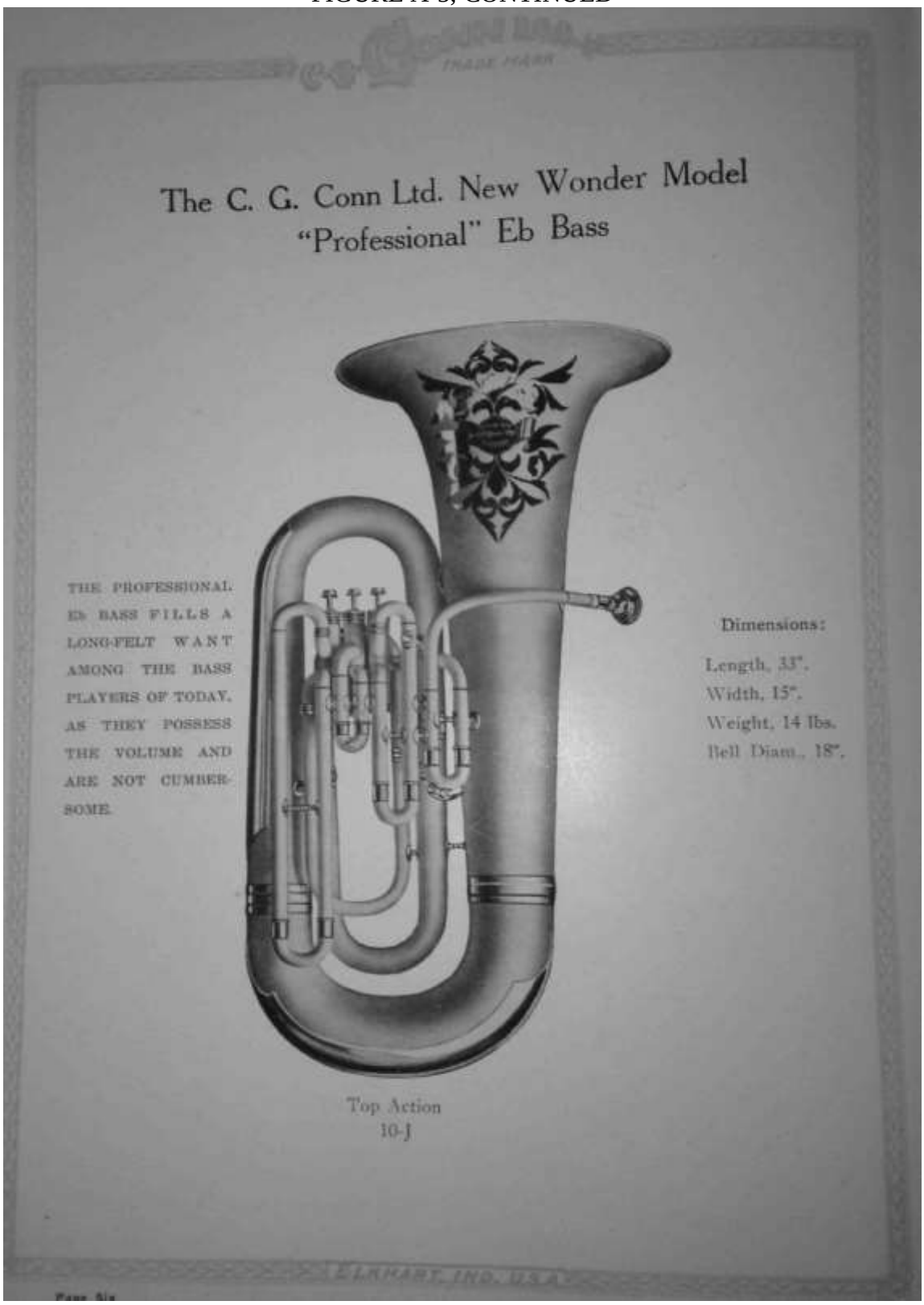


FIGURE A-5, CONTINUED

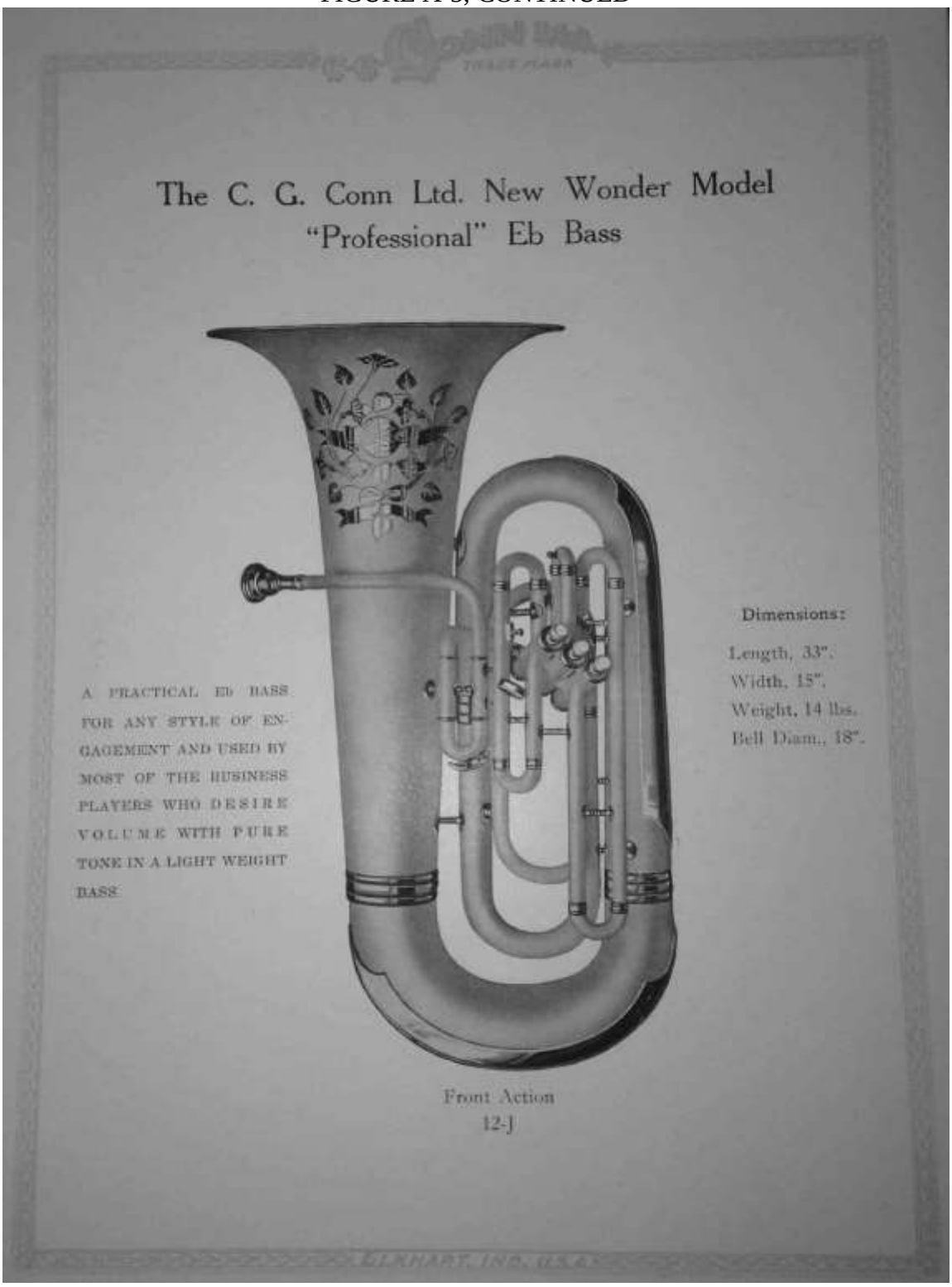


FIGURE A-5, CONTINUED

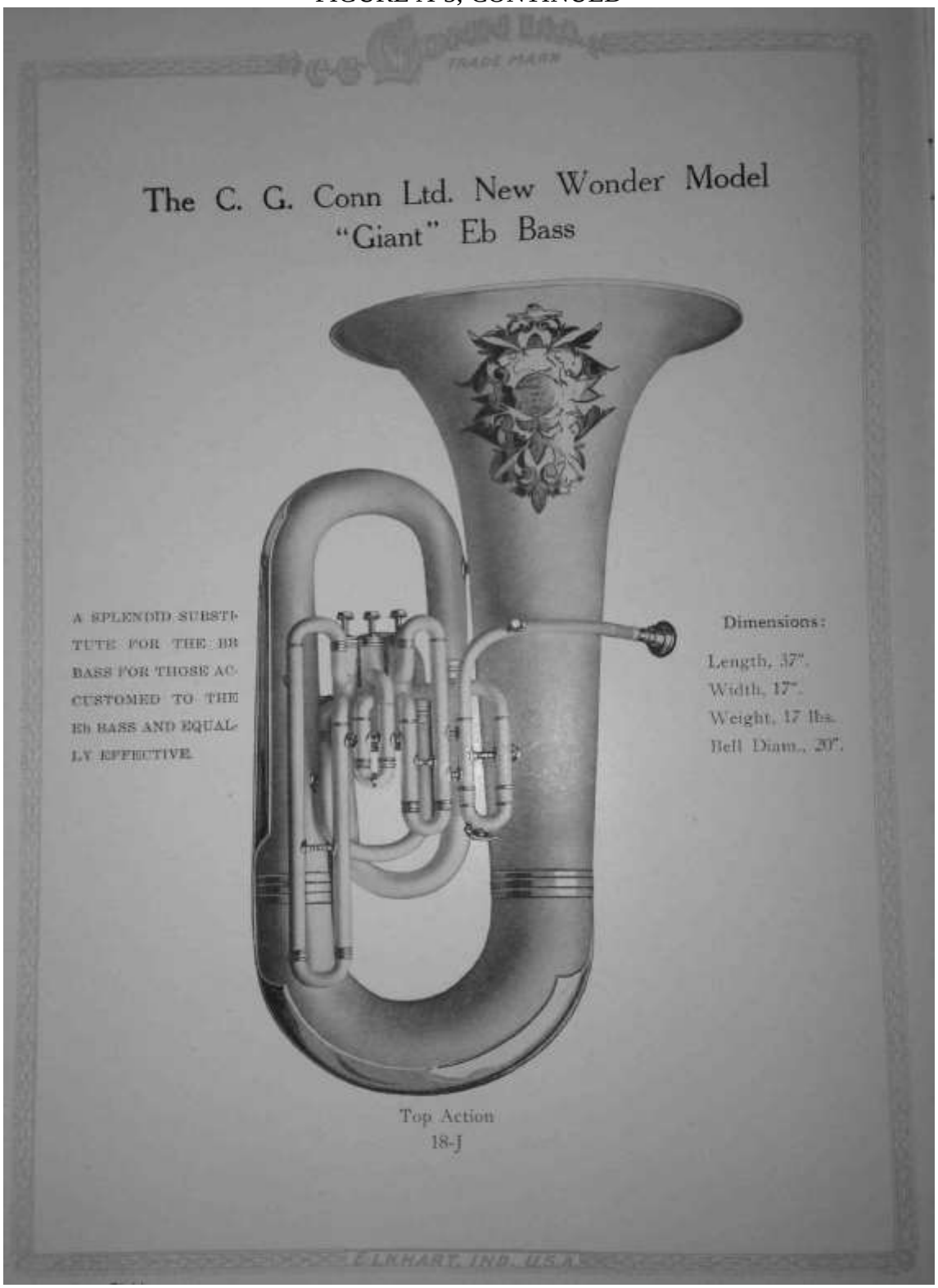


FIGURE A-5, CONTINUED

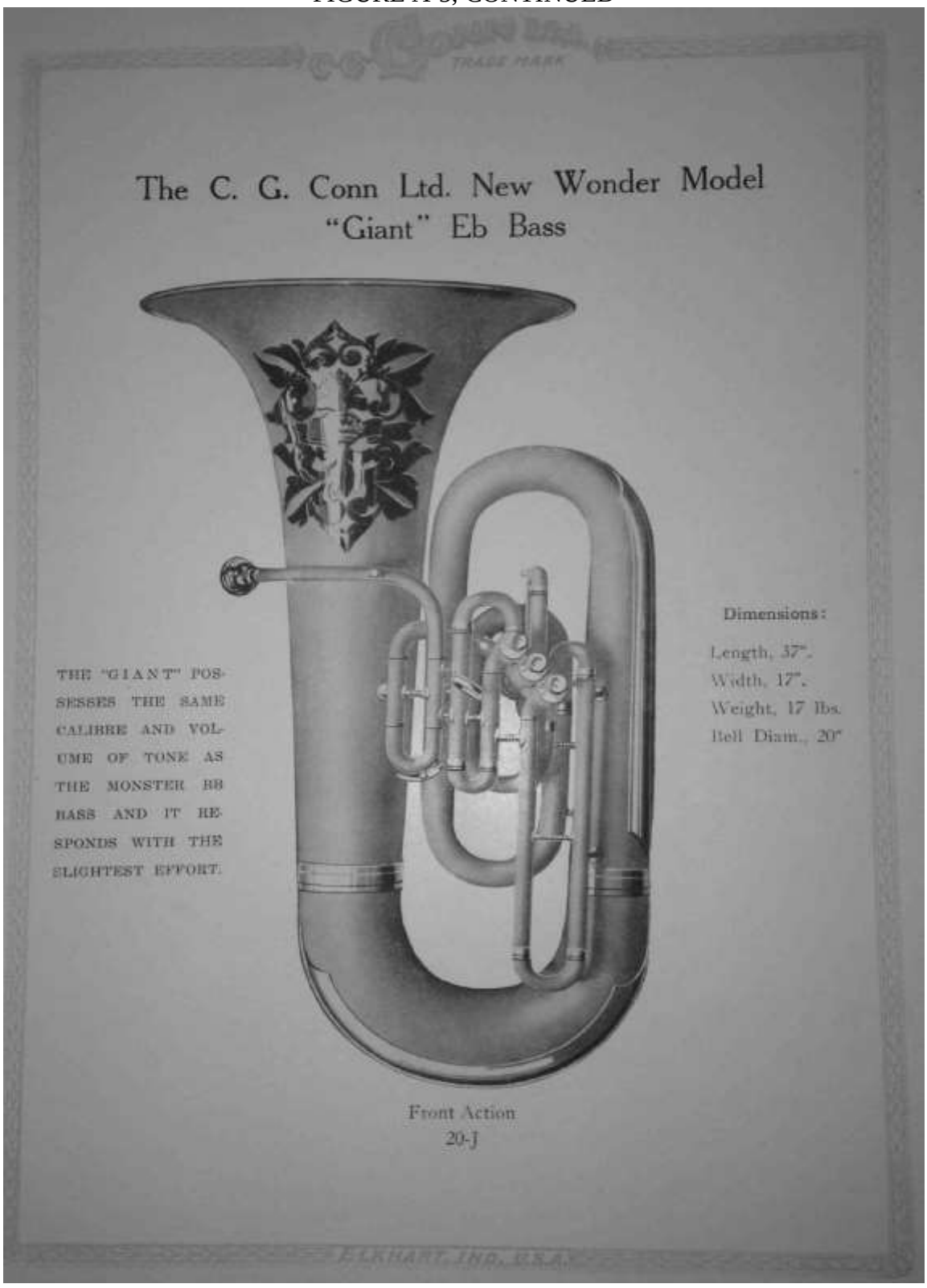


FIGURE A-5, CONTINUED

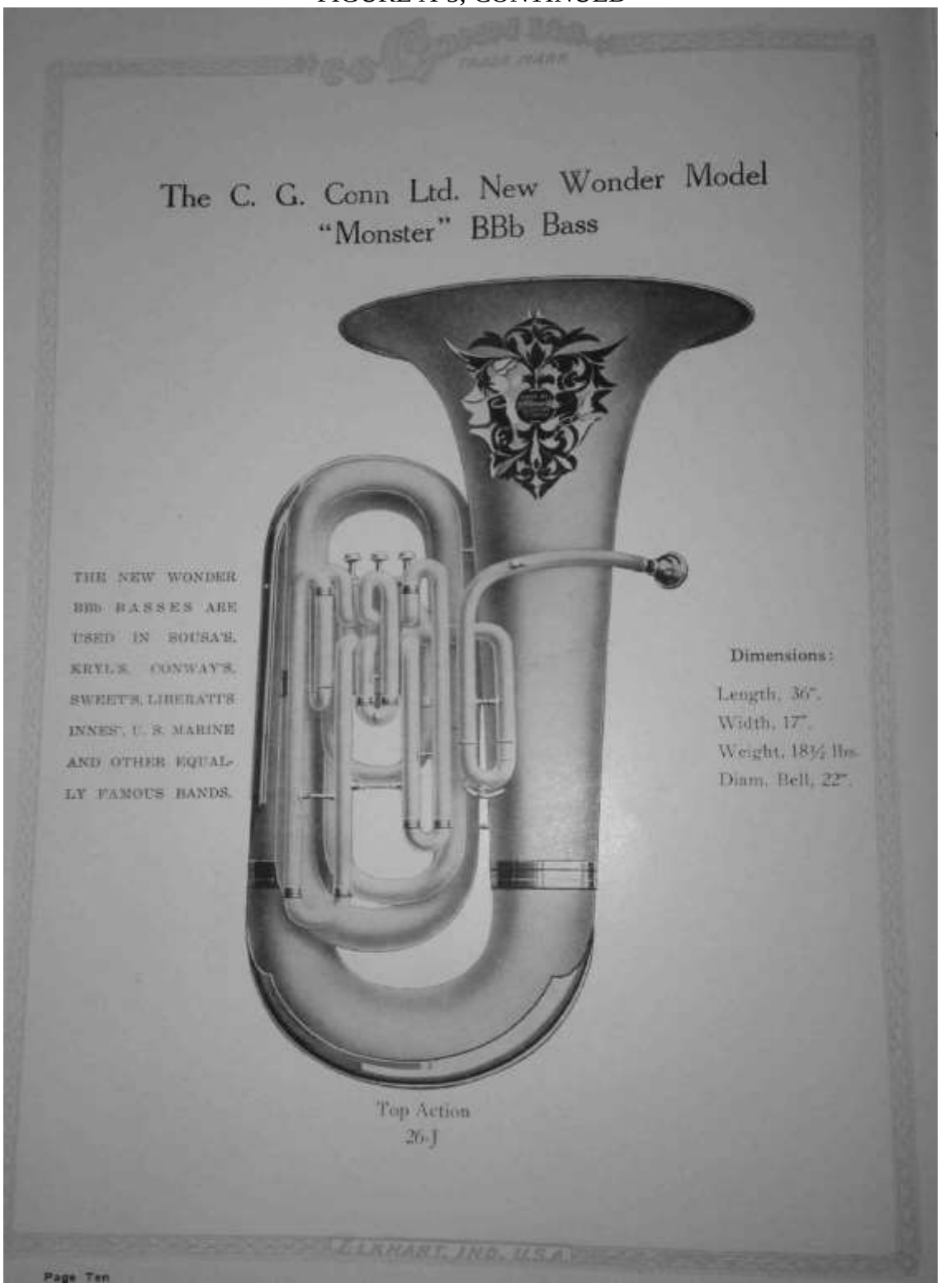


FIGURE A-5, CONTINUED

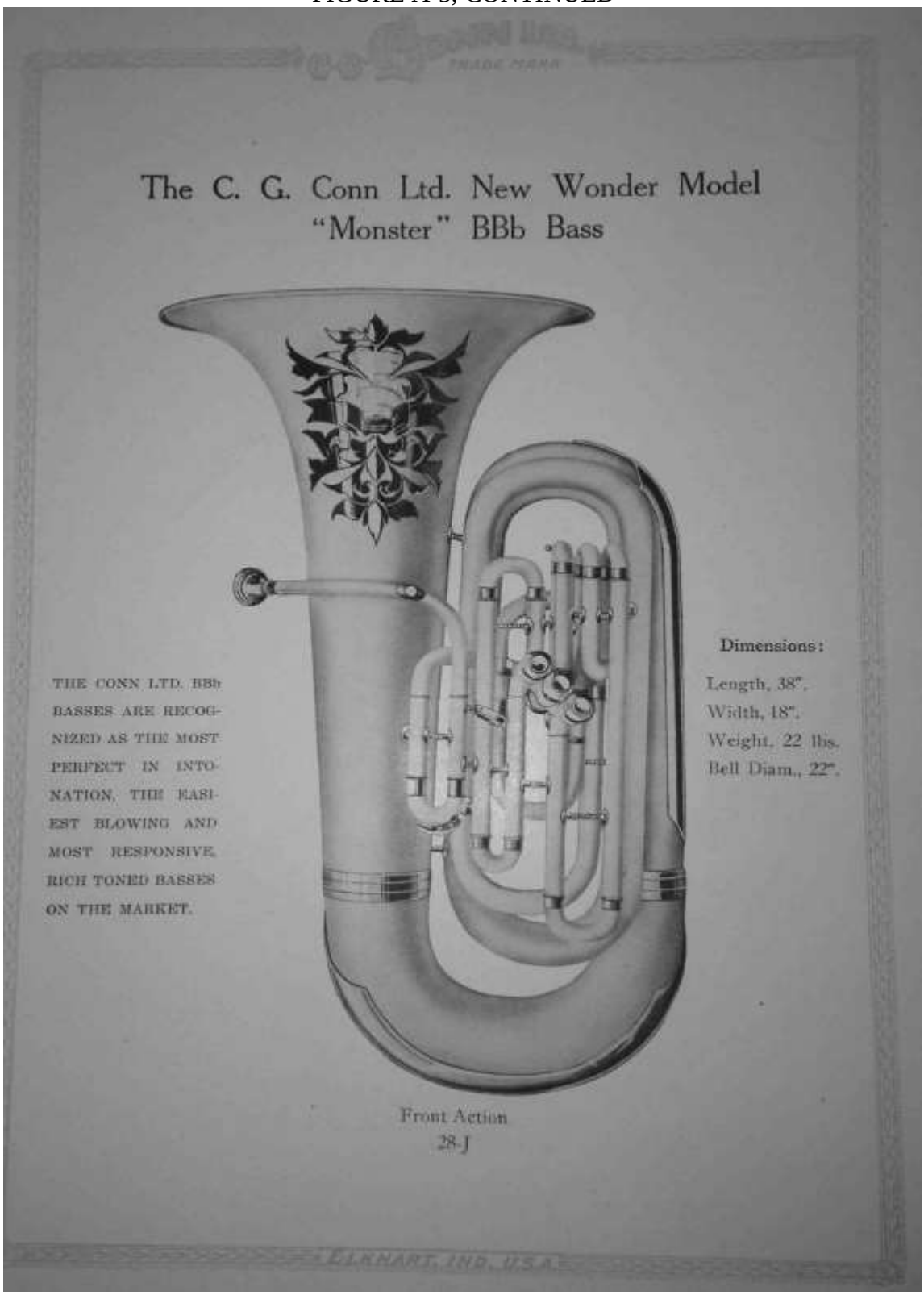


FIGURE A-5, CONTINUED

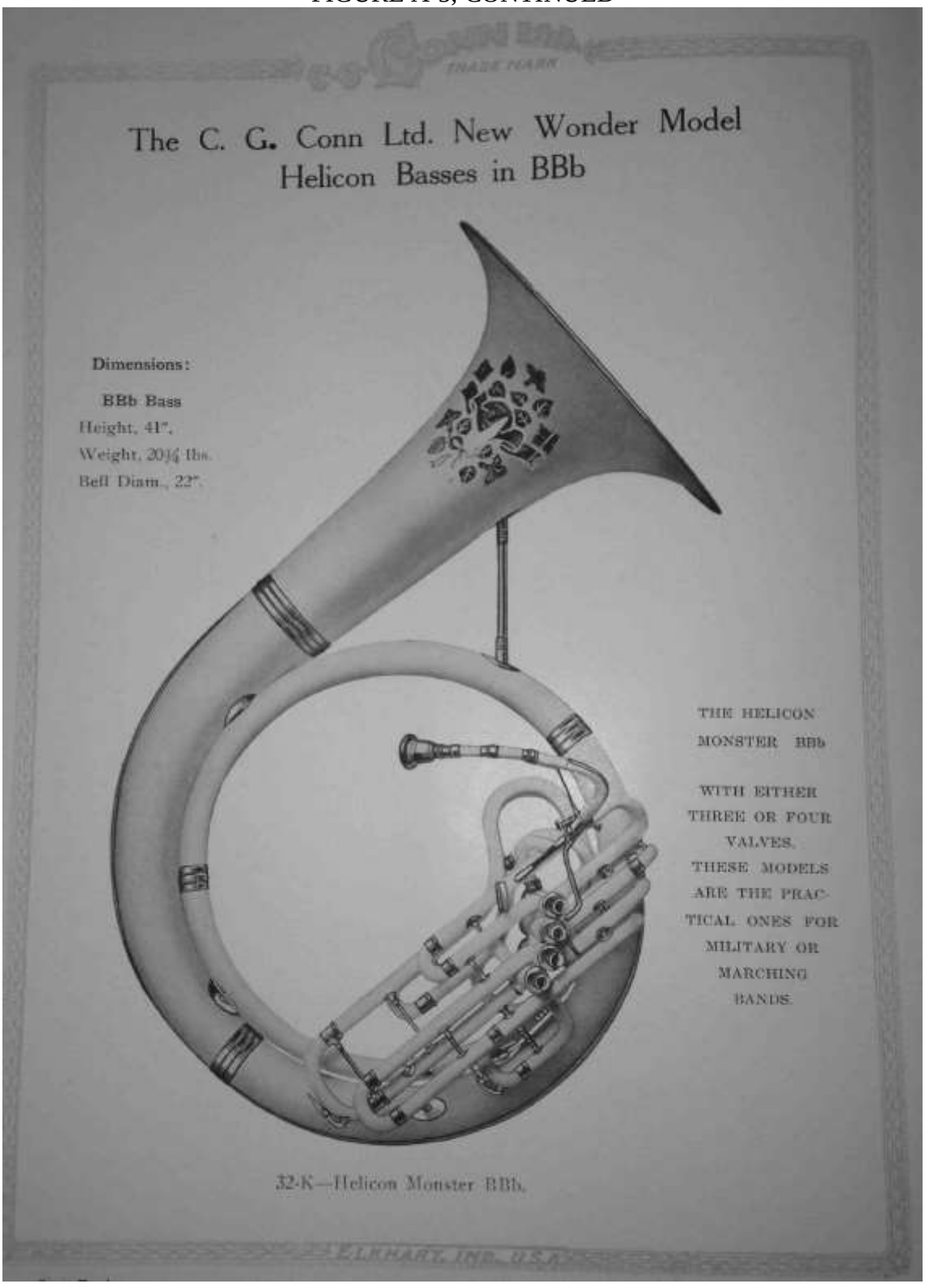


FIGURE A-5, CONTINUED

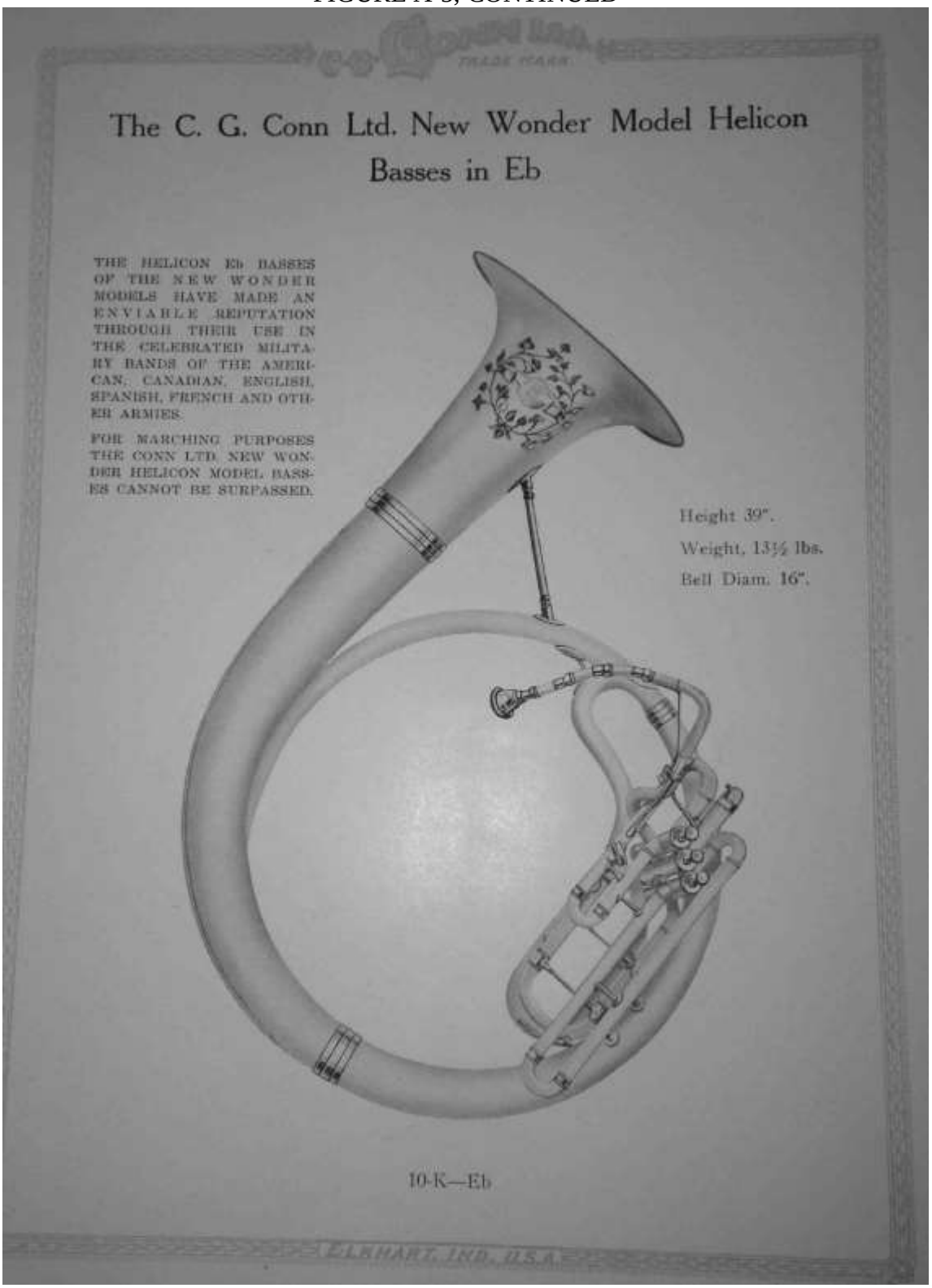


FIGURE A-5, CONTINUED

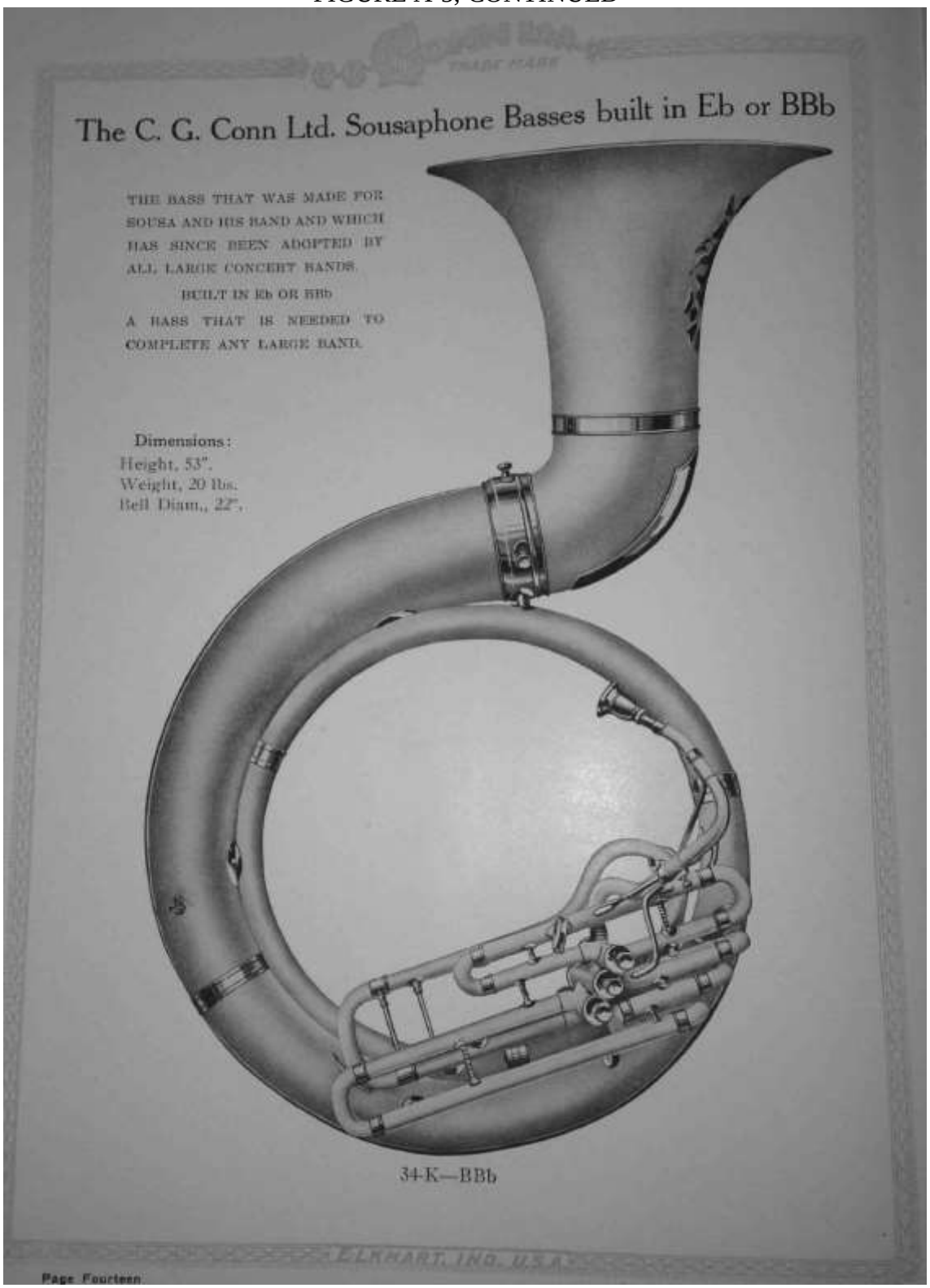


FIGURE A-5, CONTINUED

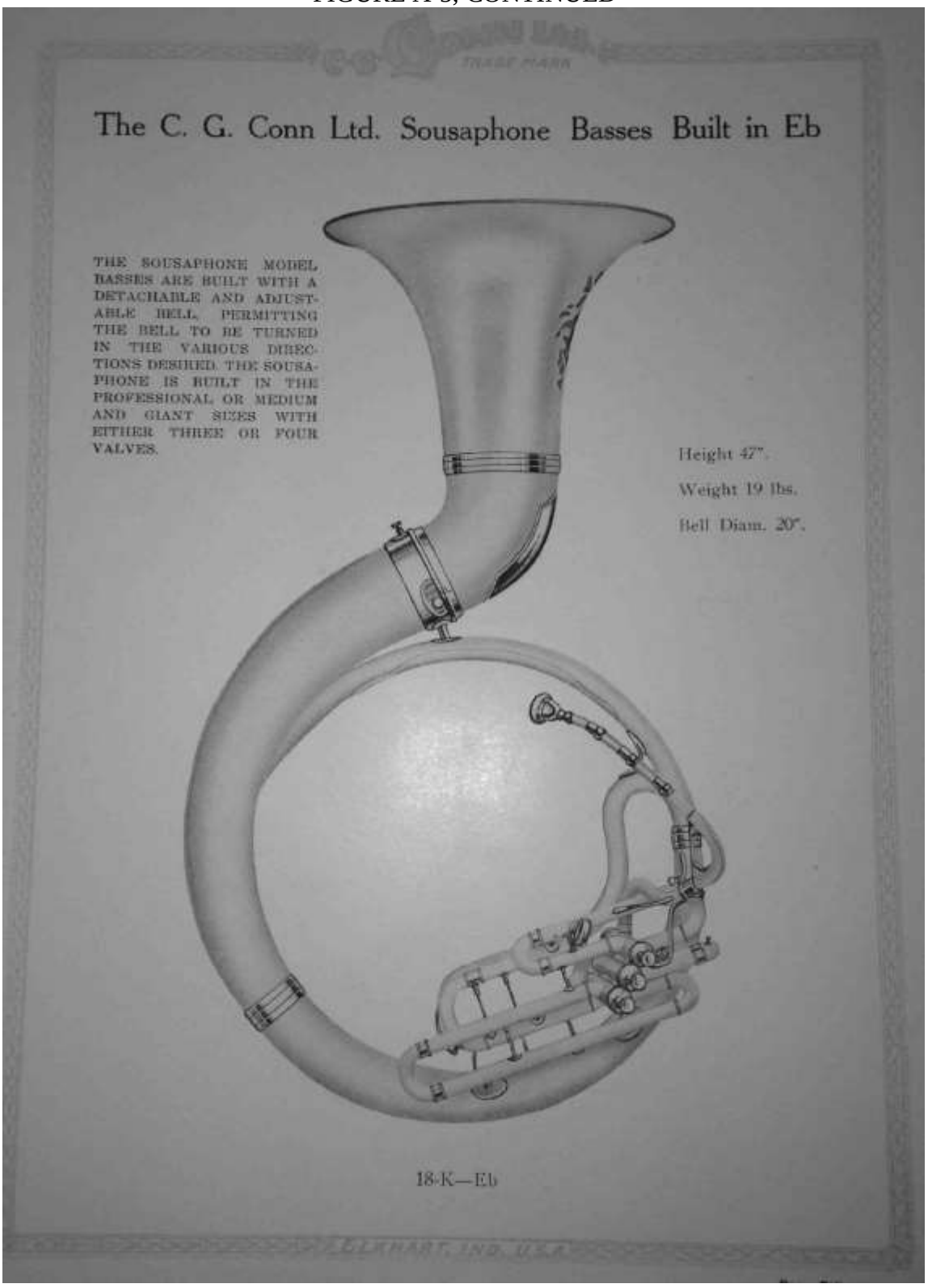


FIGURE A-5, CONTINUED

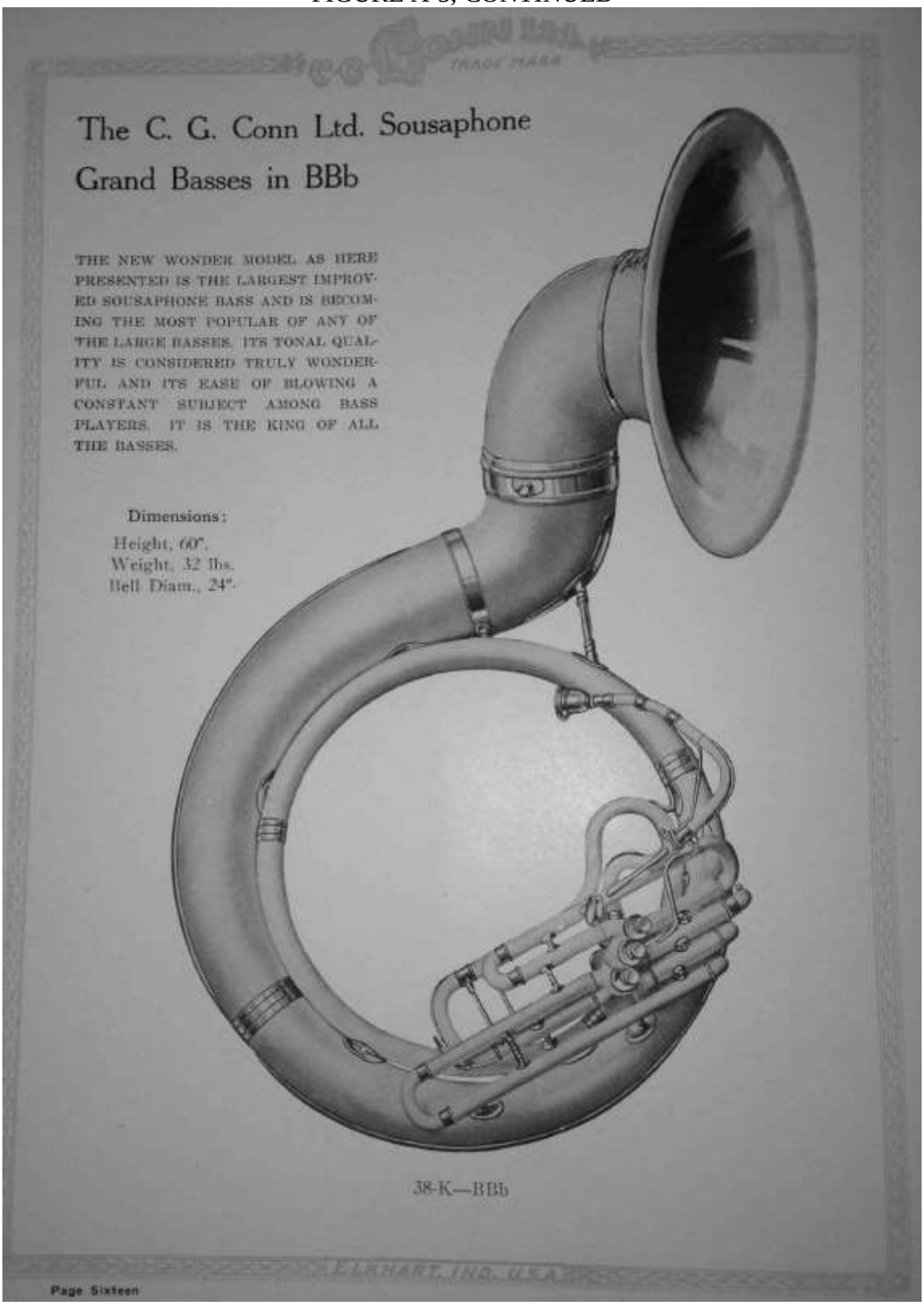


FIGURE A-5, CONTINUED

FIGURE A-5, CONTINUED

FIGURE A-5, CONTINUED

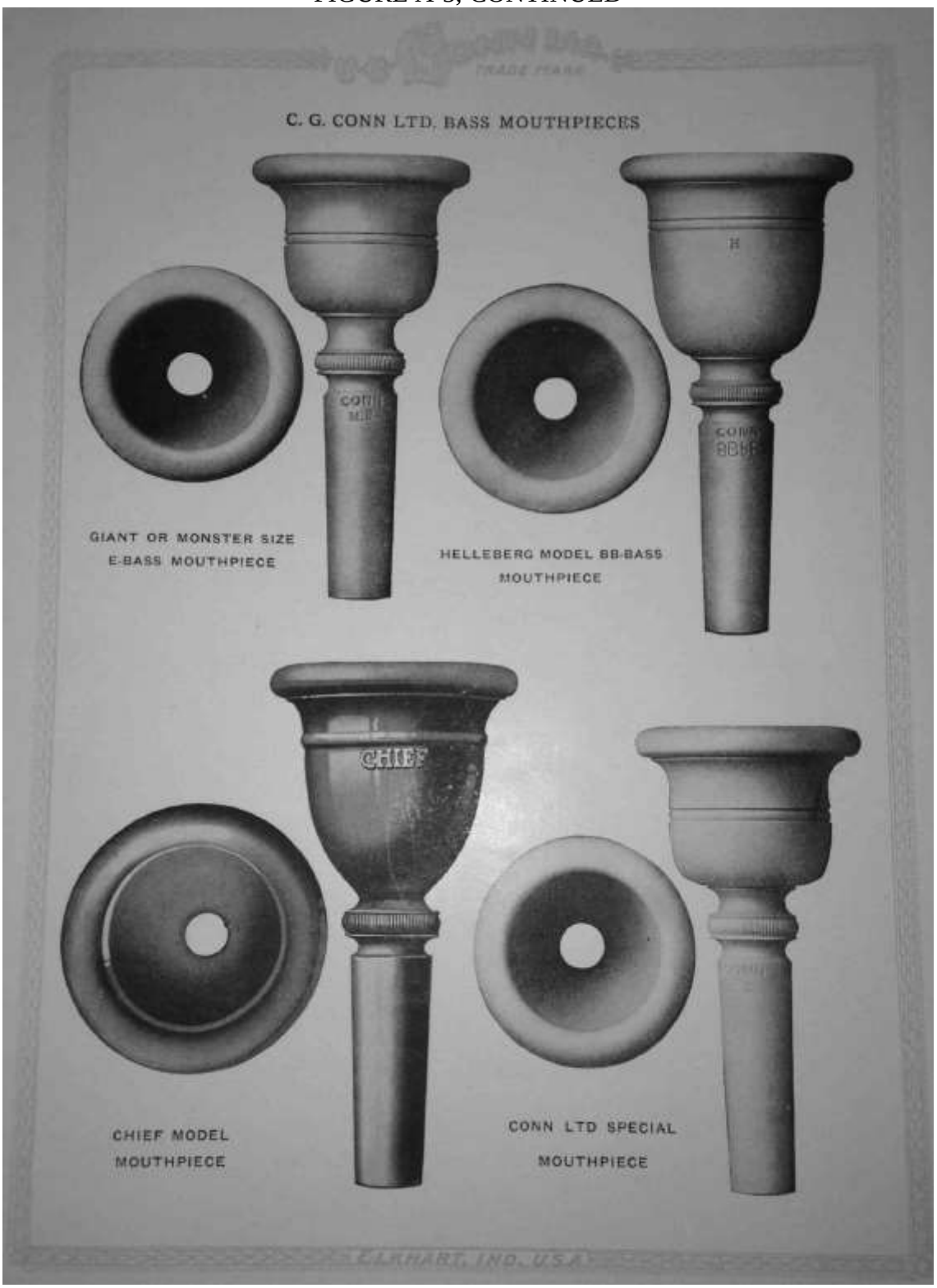


FIGURE A-5, CONTINUED

JOHN KUHN (Red Cloud)

Mr. Kuhn is world-wide renowned as a Sousaphone Virtuoso whose performance has never been equaled in pianissimo song renditions. His technique is marvelously faultless and the power of his tone, always full and rich, is such as to awe most bass performers of the day. Mr. Kuhn has been engaged with Conway, Kryl and Sousa as first bass player. Mr. Kuhn is a member of the Sioux Tribe of Indians and was born in Poplar, Mont. He attended the Fort Shaw school, the Haskell school and later the Carlisle School of Penn. He was a prominent member of the football squad as tackle and half-back. Throughout his entire career he has played a Conn Bass except for a short period. No greater booster than John Kuhn can be found for Conn Basses.

"No need of my telling you what I think of Conn Basses. There have none been built that can compare with them in each and every item of valuable points required by a Bass player who desires the very best to be produced by himself. Conn Basses are in general—all models—simply marvels in their tone, tone production, ample, easy attack, smoothness of scale and evenness of register. They surpass all others and really start where others finish, in my opinion."

John Kuhn

Frank M. Estep

FRED E. PFAFF

Mr. Pfaff of Quakertown, Pa., a member of the Bass section of Sousa's Band during the season of 1921-22 and later connected with Pryor's Band, has been using Conn Basses as his choice over others. Mr. Pfaff had been using another make until he had occasion to try a Conn and its trial immediately convinced him that the Conn would be his future instrument.

"The Bass arrived and to state that it is fine is but a light expression of its actual value. It is a great Bass and I am more than pleased with it in every particular."

Fred E. Pfaff

FRANK M. ESTEP

is Bass soloist with the Coon-Sanders Original "Night Hawk" Orchestra of Kansas City, Mo. This orchestra uses a complete set of Conn instruments, sold by the E. B. Guild Music Company, Conn band instrument distributors of that city. Mr. Estep heartily endorses the Conn Bass and believes it to be the best that can be produced.

"I wish to advise you that my Conn Sousaphone absolutely surpasses any Bass which I have ever owned heretofore in tone quality, superb valve action and ease of playing. Therefore, I heartily endorse this instrument and believe it to be the best that can be produced."

JOS. T. PARK, JR.

rising young Bass soloist of Winnipeg, Man., Canada, has recently purchased a new Sousaphone Grand. Mr. Park at the age of sixteen was Bass soloist with his father's 222nd Southern Manitoba Band which went overseas in the World War and won great honors. He has also been connected with the Kilties Band and quite recently with the Gus Edwards Novelty Orchestra.

"It is with pleasure that I say I am well pleased with your Sousaphone Grand Basses. They possess a rich full tone, and respond very quickly to either a piano or forte passage. I played one of your Helicon Basses in my father's band overseas when a boy of sixteen years, that gave me perfect satisfaction, but I am more than pleased with the new Sousaphone Grand."

DAVID DAPEER

Sousaphonist with Jack Denny's and the Metropolitan Orchestras of New York, the former now touring the Orpheum Circuit, is seen here with little "Billy" in the bell of the great Conn Bass. Both these artists enjoy the Conn Sousaphone.

"Am very well satisfied with my new Sousaphone Grand. It is perfect in tune and easy to blow. My leader, Mr. Jack Denny, is certainly very well pleased with it. The little fellow in the bell is vaudeville's tiniest headliner, "Little Billy," who is making the Orpheum tour with us."

Emil G. Peterson

EMIL G. PETERSON

more familiarly known as "Pete", is the Bass soloist with the famous Al. G. Fields Minstrels. Mr. Peterson has played on most every make, both domestic and foreign, and is a very capable judge as to the merits of a Bass. He has nothing but praise for the Conn Sousaphone which he uses. Mr. Peterson has played under the baton of Pat. Gilmore, Conterno and others who are great moulders of musicians.

"You certainly gave me the surprise of my life when you sent me such a fine Bass. It is undoubtedly the best instrument I have ever had. The tone and tone qualities are perfect. I hear nothing but praise whenever we play a concert."

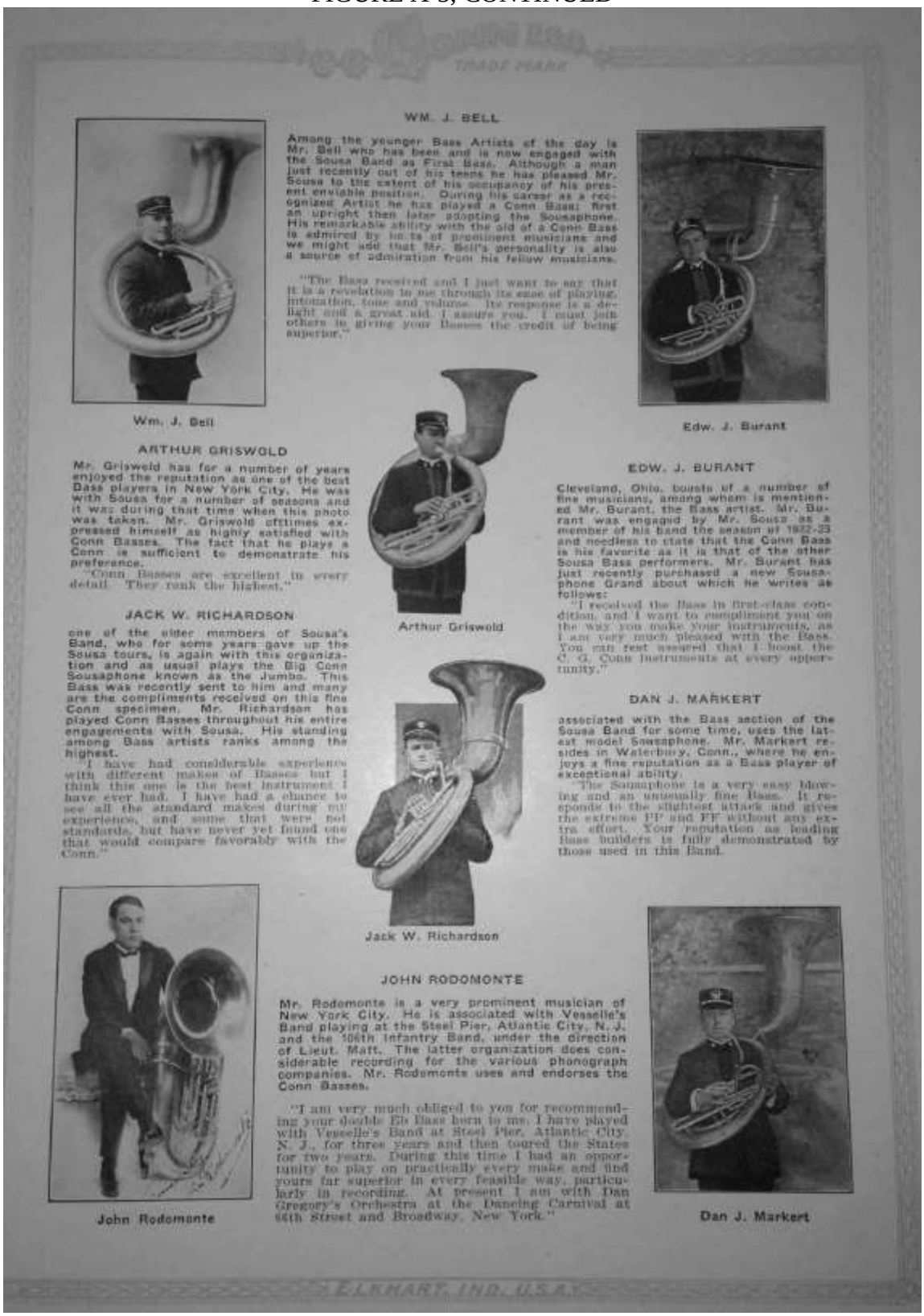
Jos. T. Park, Jr.

David Dapeer

ELKHART, IND., U.S.A.

Page Twenty-two

FIGURE A-5, CONTINUED



WM. J. BELL

Among the younger Bass Artists of the day is Mr. Bell who has been and is now engaged with the Sousa Band as First Bass. Although a man just recently out of his teens he has pleased Mr. Sousa to the extent of his occupancy of his present enviable position. During his career as a recognized Artist he has played a Conn Bass; first an upright then later adopting the Sousaphone. His remarkable ability with the aid of a Conn Bass is admired by an ex of prominent musicians and we might add that Mr. Bell's personality is also a source of admiration from his fellow musicians.

"The Bass received and I just want to say that it is a revelation to me through its ease of playing, intonation, tone and volume. Its response is a delight and a great aid. I assure you. I stand just others in giving your Basses the credit of being superior."

Wm. J. Bell

Edw. J. Burant

ARTHUR GRISWOLD

Mr. Griswold has for a number of years enjoyed the reputation as one of the best Bass players in New York City. He was with Sousa for a number of seasons and it was during that time when this photo was taken. Mr. Griswold ofttimes expressed himself as highly satisfied with Conn Basses. The fact that he plays a Conn is sufficient to demonstrate his preference.

"Conn Basses are excellent in every detail. They rank the highest."

Arthur Griswold

EDW. J. BURANT

Cleveland, Ohio, boasts of a number of fine musicians, among whom is mentioned Mr. Burant, the Bass artist. Mr. Burant was engaged by Mr. Sousa as a member of his band the season of 1922-23 and needless to state that the Conn Bass is his favorite as it is that of the other Sousa Bass performers. Mr. Burant has just recently purchased a new Sousaphone Grand about which he writes as follows:

"I received the Bass in first-class condition, and I want to compliment you on the way you make your instruments, as I am very much pleased with the Bass. You can rest assured that I boost the C. G. Conn instruments at every opportunity."

JACK W. RICHARDSON

one of the older members of Sousa's Band, who for some years gave up the Sousa tours, is again with this organization and as usual plays the Big Conn Sousaphone known as the Jumbo. This Bass was recently sent to him and many are the compliments received on this fine Conn specimen. Mr. Richardson has played Conn Basses throughout his entire engagements with Sousa. His standing among Bass artists ranks among the highest.

"I have had considerable experience with different makes of Basses but I think this one is the best instrument I have ever had. I have had a chance to see all the standard makes during my experience, and some that were not standards, but have never yet found one that would compare favorably with the Conn."

Jack W. Richardson

DAN J. MARKERT

associated with the Bass section of the Sousa Band for some time, uses the latest model Sousaphone. Mr. Markert resides in Waterbury, Conn., where he enjoys a fine reputation as a Bass player of exceptional ability.

"The Sousaphone is a very easy blowing and an unusually fine Bass. It responds to the slightest attack and gives the extreme PP and FF without any extra effort. Your reputation as leading Bass builders is fully demonstrated by those used in this Band.

John Rodomonte

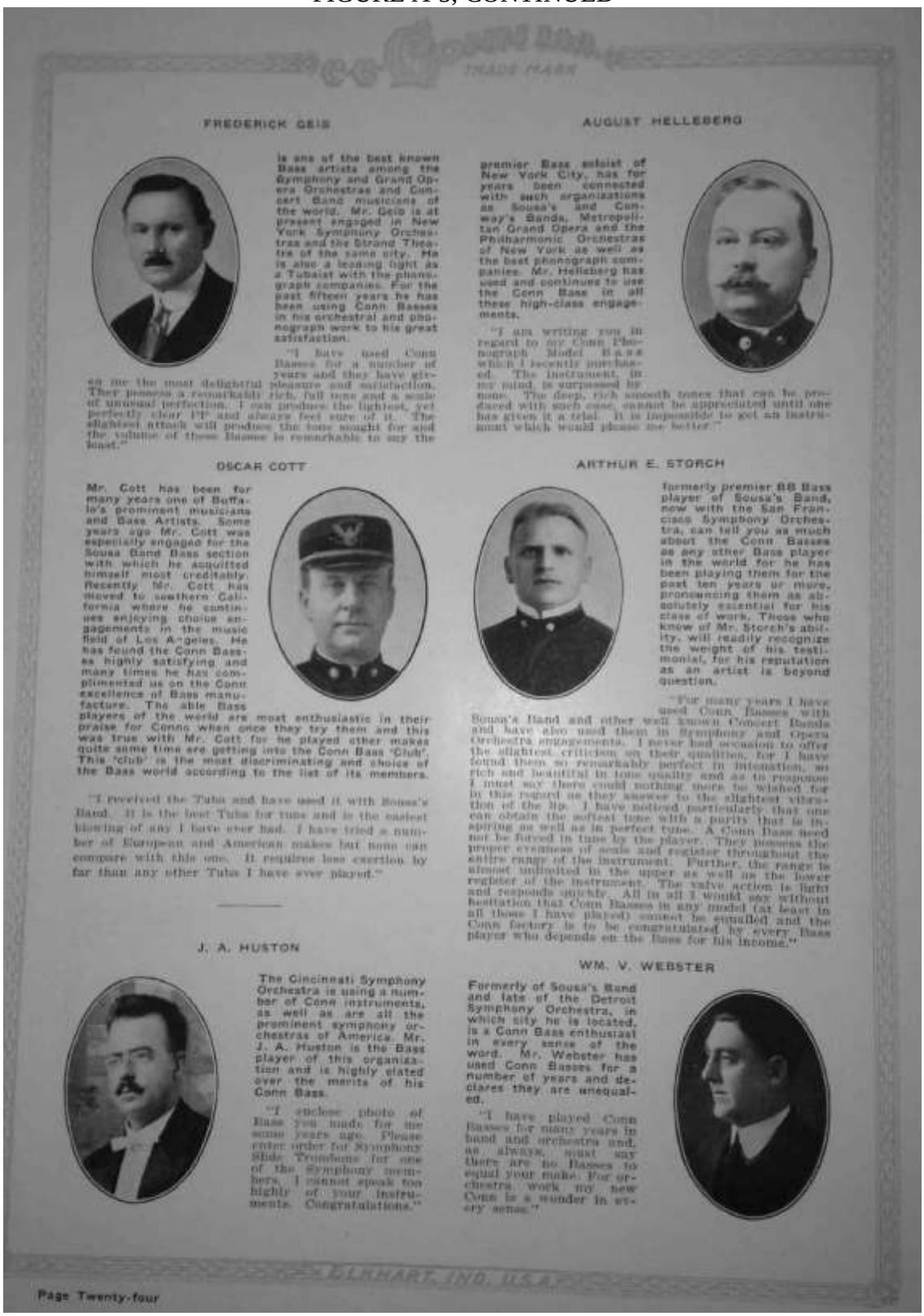
JOHN RODOMONTE

Mr. Rodomonte is a very prominent musician of New York City. He is associated with Vesselle's Band playing at the Steel Pier, Atlantic City, N. J. and the 106th Infantry Band, under the direction of Lieut. Matt. The latter organization does considerable recording for the various phonograph companies. Mr. Rodomonte uses and endorses the Conn Basses.

"I am very much obliged to you for recommending your double Eb Bass horn to me. I have played with Vesselle's Band at Steel Pier, Atlantic City, N. J., for three years and then toured the States for two years. During this time I had an opportunity to play on practically every make and find yours far superior in every feasible way, particularly in recording. At present I am with Dan Gregory's Orchestra at the Dancing Carnival at 44th Street and Broadway, New York."

Dan J. Markert

FIGURE A-5, CONTINUED



FREDERICK GEIS

is one of the best known Bass artists among the Symphony and Grand Opera Orchestras and Concert Band musicians of the world. Mr. Geis is at present engaged in New York Symphony Orchestras and the Strand Theatre of the same city. He is also a leading light as a Tubaist with the phonograph companies. For the past fifteen years he has been using Conn Basses in his orchestral and phonograph work to his great satisfaction.

"I have used Conn Basses for a number of years and they have given me the most delightful pleasure and satisfaction. They possess a remarkably rich, full tone and a scale of unusual perfection. I can produce the lightest, yet perfectly clear PP and always feel sure of it. The slightest attack will produce the tone sought for and the volume of these Basses is remarkable to say the least."

AUGUST HELLEBERG

premier Bass soloist of New York City, has for years been connected with such organizations as Sousa's and Conway's Bands, Metropolitan Grand Opera and the Philharmonic Orchestras of New York as well as the best phonograph companies. Mr. Helleberg has used and continues to use the Conn Bass in all these high-class engagements.

"I am writing you in regard to my Conn Phonograph Model Bass which I recently purchased. The instrument, in my mind, is surpassed by none. The deep, rich smooth tones that can be produced with such ease, cannot be appreciated until one has given it a trial. It is impossible to get an instrument which would please me better."

OSCAR COTT

Mr. Cott has been for many years one of Buffalo's prominent musicians and Bass Artists. Some years ago Mr. Cott was especially engaged for the Sousa Band Bass section with which he acquitted himself most creditably. Recently Mr. Cott has moved to southern California where he continues enjoying choice engagements in the music field of Los Angeles. He has found the Conn Basses highly satisfying and many times he has complimented us on the Conn excellence of Bass manufacture. The able Bass players of the world are most enthusiastic in their praise for Conns when once they try them and this was true with Mr. Cott for he played other makes quite some time are getting into the Conn Bass 'Club'. This 'club' is the most discriminating and choice of the Bass world according to the list of its members.

"I received the Tuba and have used it with Sousa's Band. It is the best Tuba for tune and is the easiest blowing of any I have ever had. I have tried a number of European and American makes but none can compare with this one. It requires less exertion by far than any other Tuba I have ever played."

ARTHUR E. STORCH

formerly premier BB Bass player of Sousa's Band, now with the San Francisco Symphony Orchestra, can tell you as much about the Conn Basses as any other Bass player in the world for he has been playing them for the past ten years or more, pronouncing them as absolutely essential for his class of work. Those who know of Mr. Storch's ability, will readily recognize the weight of his testimonial, for his reputation as an artist is beyond question.

"For many years I have used Conn Basses with Sousa's Band and other well known Concert Bands and have also used them in Symphony and Opera Orchestra engagements. I never had occasion to offer the slightest criticism on their qualities, for I have found them so remarkably perfect in intonation, so rich and beautiful in tone quality and as to response I must say there could nothing more be wished for in this regard as they answer to the slightest vibration of the lip. I have noticed particularly that one can obtain the softest tone with a purity that is inspiring as well as in perfect tune. A Conn Bass need not be forced in tune by the player. They possess the proper evenness of scale and register throughout the entire range of the instrument. Further, the range is almost unlimited in the upper as well as the lower register of the instrument. The valve action is light and responds quickly. All in all I would say without hesitation that Conn Basses in any model (at least in all those I have played) cannot be equalled and the Conn factory is to be congratulated by every Bass player who depends on the Bass for his income."

J. A. HUSTON

The Cincinnati Symphony Orchestra is using a number of Conn instruments, as well as are all the prominent symphony orchestras of America. Mr. J. A. Huston is the Bass player of this organization and is highly elated over the merits of his Conn Bass.

"I enclose photo of Bass you made for me some years ago. Please enter order for Symphony Slide Trombone for one of the Symphony members. I cannot speak too highly of your instruments. Congratulations."

WM. V. WEBSTER

Formerly of Sousa's Band and late of the Detroit Symphony Orchestra, in which city he is located, is a Conn Bass enthusiast in every sense of the word. Mr. Webster has used Conn Basses for a number of years and declares they are unequaled.

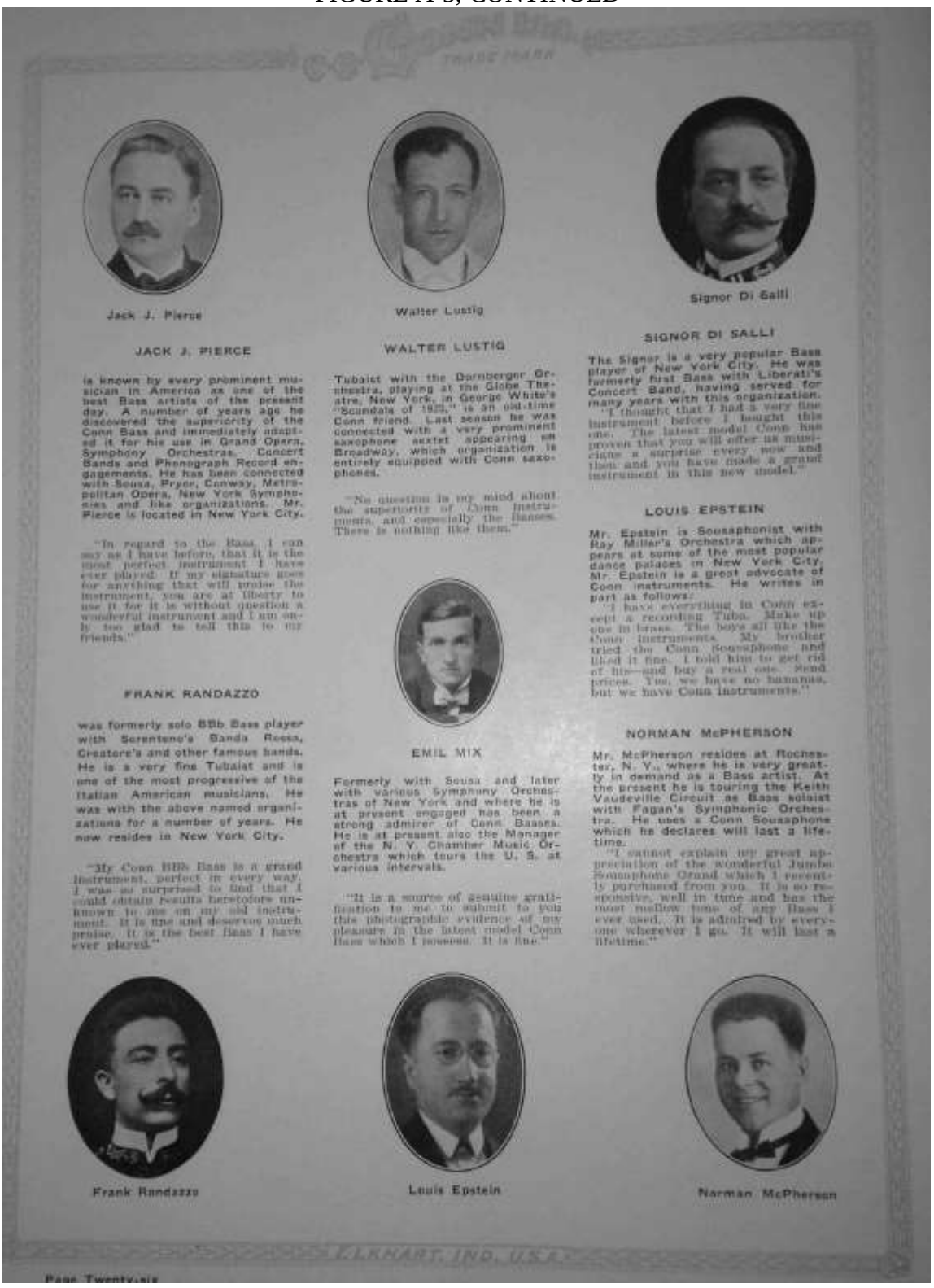
"I have played Conn Basses for many years in band and orchestra and, as always, must say there are no Basses to equal your make. For orchestra work my new Conn is a wonder in every sense."

ELKHART, IND., U.S.A.

Page Twenty-four

FIGURE A-5, CONTINUED

FIGURE A-5, CONTINUED



Jack J. Pierce

JACK J. PIERCE

is known by every prominent musician in America as one of the best Bass artists of the present day. A number of years ago he discovered the superiority of the Conn Bass and immediately adopted it for his use in Grand Opera, Symphony Orchestras, Concert Bands and Phonograph Record engagements. He has been connected with Sousa, Pryor, Conway, Metropolitan Opera, New York Symphonies and like organizations. Mr. Pierce is located in New York City.

"In regard to the Bass, I can say as I have before, that it is the most perfect instrument I have ever played. If my signature goes for anything that will praise the instrument, you are at liberty to use it for it is without question a wonderful instrument and I am only too glad to tell this to my friends."

FRANK RANDAZZO

was formerly solo BBb Bass player with Sorentino's Banda Rossa, Creatore's and other famous bands. He is a very fine Tubaist and is one of the most progressive of the Italian American musicians. He was with the above named organizations for a number of years. He now resides in New York City.

"My Conn BBb Bass is a grand instrument, perfect in every way. I was so surprised to find that I could obtain results heretofore unknown to me on my old instrument. It is fine and deserves much praise. It is the best Bass I have ever played."

Walter Lustig

WALTER LUSTIG

Tubaist with the Dornberger Orchestra, playing at the Globe Theatre, New York, in George White's "Scandals of 1923," is an old-time Conn friend. Last season he was connected with a very prominent saxophone sextet appearing on Broadway, which organization is entirely equipped with Conn saxophones.

"No question in my mind about the superiority of Conn instruments, and especially the Basses. There is nothing like them."

EMIL MIX

Formerly with Sousa and later with various Symphony Orchestras of New York and where he is at present engaged has been a strong admirer of Conn Basses. He is at present also the Manager of the N. Y. Chamber Music Orchestra which tours the U. S. at various intervals.

"It is a source of genuine gratification to me to submit to you this photographic evidence of my pleasure in the latest model Conn Bass which I possess. It is fine."

Signor Di Salli

SIGNOR DI SALLI

The Signor is a very popular Bass player of New York City. He was formerly first Bass with Liberati's Concert Band, having served for many years with this organization.

"I thought that I had a very fine instrument before I bought this one. The latest model Conn has proven that you will offer us musicians a surprise every now and then and you have made a grand instrument in this new model."

LOUIS EPSTEIN

Mr. Epstein is Sousaphonist with Ray Miller's Orchestra which appears at some of the most popular dance palaces in New York City. Mr. Epstein is a great advocate of Conn instruments. He writes in part as follows:

"I have everything in Conn except a recording Tuba. Make up one in brass. The boys all like the Conn instruments. My brother tried the Conn Sousaphone and liked it fine. I told him to get rid of his—and buy a real one. Send prices. Yes, we have no bananas, but we have Conn instruments."

NORMAN McPHERSON

Mr. McPherson resides at Rochester, N. Y., where he is very greatly in demand as a Bass artist. At the present he is touring the Keith Vaudeville Circuit as Bass soloist with Fagan's Symphonic Orchestra. He uses a Conn Sousaphone which he declares will last a lifetime.

"I cannot explain my great appreciation of the wonderful Jumbo Sousaphone Grand which I recently purchased from you. It is so responsive, well in tune and has the most mellow tone of any Bass I ever used. It is admired by everyone wherever I go. It will last a lifetime."

Frank Randazzo

Louis Epstein

Norman McPherson

ELKHART, IND. U.S.A.

Page Twenty-six

FIGURE A-5, CONTINUED

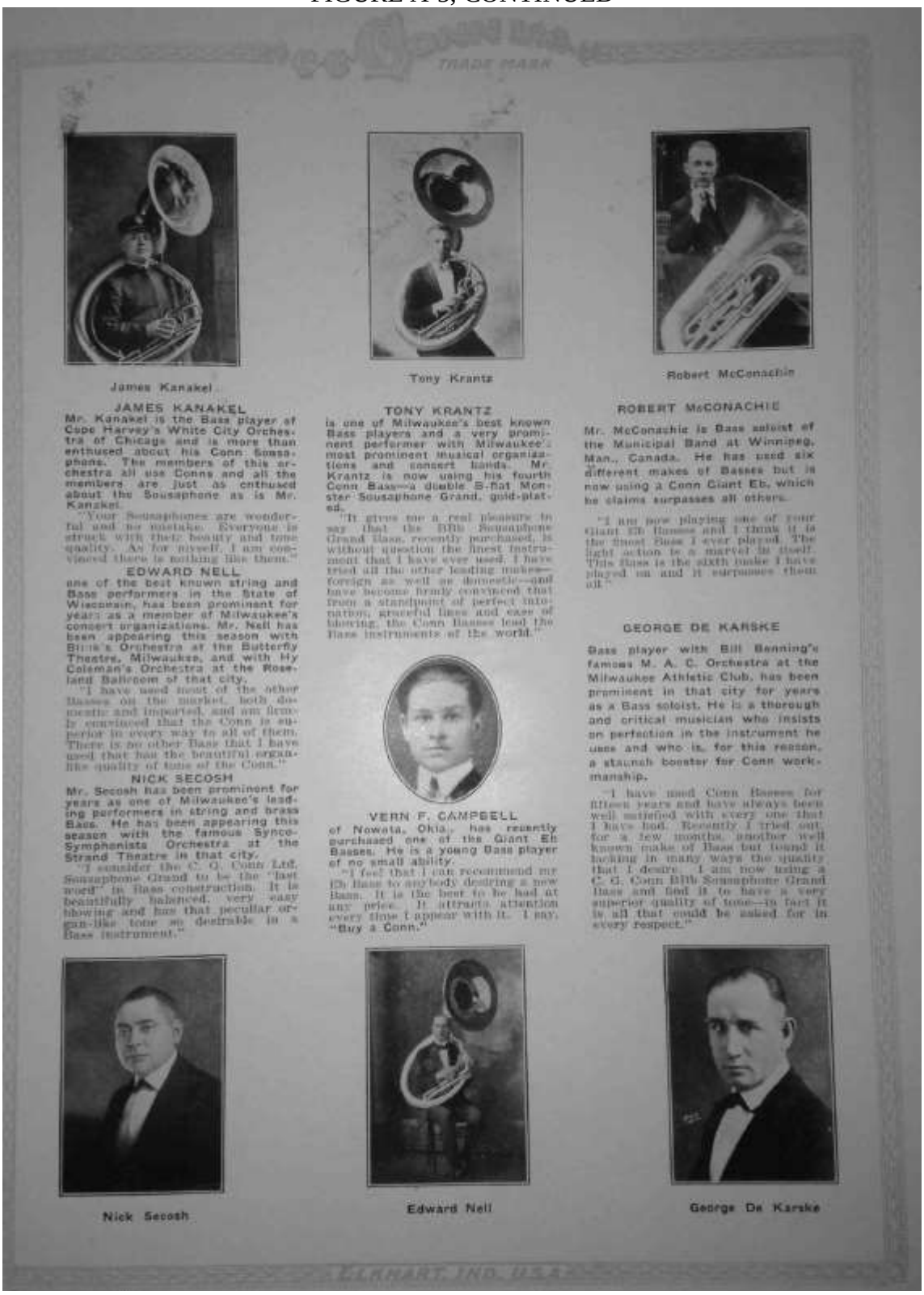
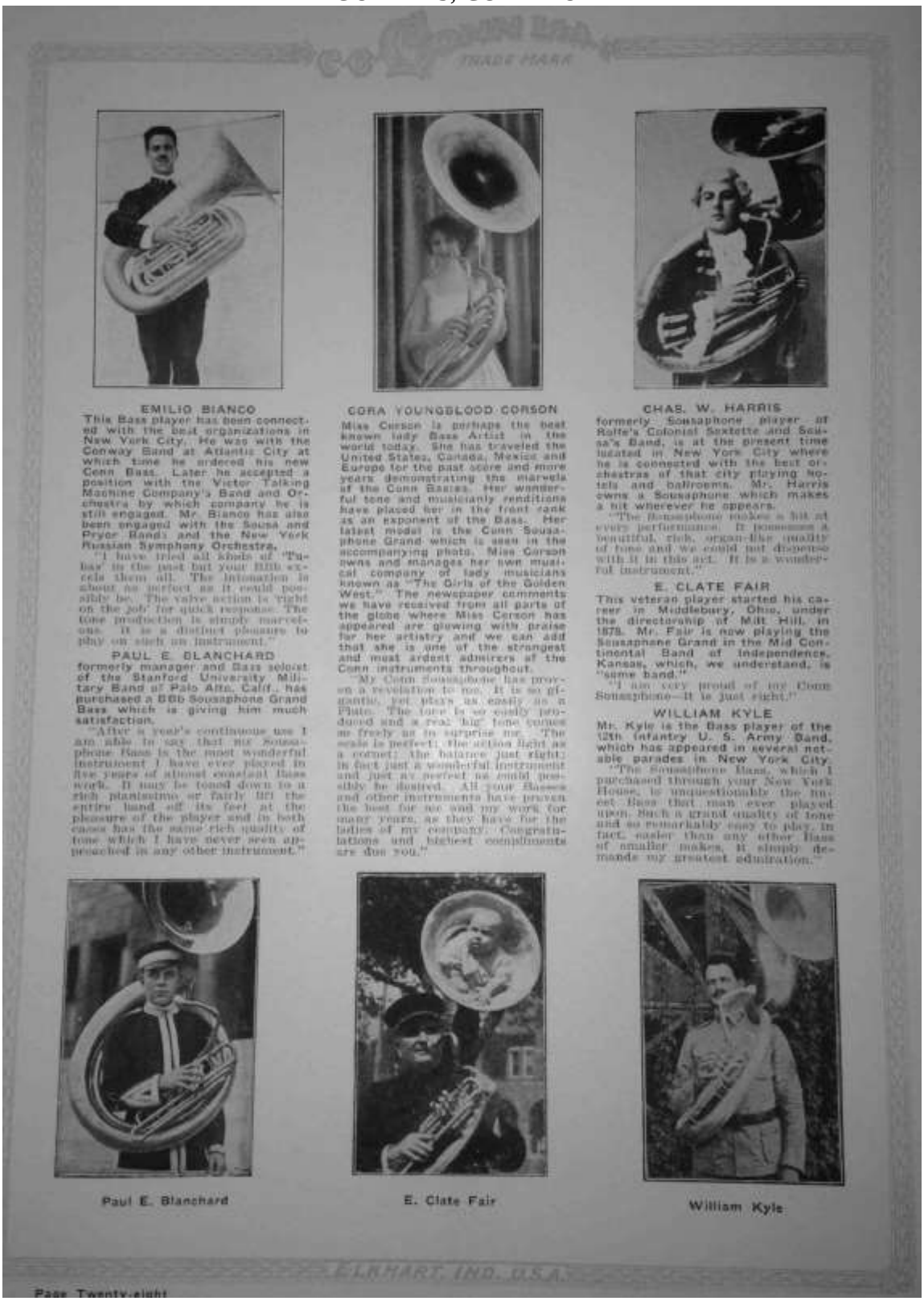


FIGURE A-5, CONTINUED



EMILIO BIANCO

This Bass player has been connected with the best organizations in New York City. He was with the Conway Band at Atlantic City at which time he ordered his new Conn Bass. Later he accepted a position with the Victor Talking Machine Company's Band and Orchestra by which company he is still engaged. Mr. Bianco has also been engaged with the Sousa and Pryor Bands and the New York Russian Symphony Orchestra.

"I have tried all kinds of 'Tubas' in the past but your fifth excels them all. The intonation is about as perfect as it could possibly be. The valve action is right on the job for quick response. The tone production is simply marvelous. It is a distinct pleasure to play on such an instrument."

PAUL E. BLANCHARD

formerly manager and Bass soloist of the Stanford University Military Band of Palo Alto, Calif., has purchased a BBb Sousaphone Grand Bass which is giving him much satisfaction.

"After a year's continuous use I am able to say that my Sousaphone Bass is the most wonderful instrument I have ever played in five years of almost constant Bass work. It may be toned down to a rich pianissimo or fairly lift the entire band off its feet at the pleasure of the player and in both cases has the same rich quality of tone which I have never seen approached in any other instrument."

CORA YOUNGBLOOD CORSON

Miss Corson is perhaps the best known lady Bass Artist in the world today. She has traveled the United States, Canada, Mexico and Europe for the past score and more years demonstrating the marvels of the Conn Basses. Her wonderful tone and musicianly renditions have placed her in the front rank as an exponent of the Bass. Her latest model is the Conn Sousaphone Grand which is seen in the accompanying photo. Miss Corson owns and manages her own musical company of lady musicians known as "The Girls of the Golden West." The newspaper comments we have received from all parts of the globe where Miss Corson has appeared are glowing with praise for her artistry and we can add that she is one of the strongest and most ardent admirers of the Conn instruments throughout.

"My Conn Sousaphone has proven a revelation to me. It is so gigantic, yet plays as easily as a Flute. The tone is so easily produced and a real 'big' tone comes so freely as to surprise me. The scale is perfect; the action light as a cornet; the balance just right; in fact just a wonderful instrument and just as perfect as could possibly be desired. All your Basses and other instruments have proven the best for me and my work for many years, as they have for the ladies of my company. Congratulations and highest compliments are due you."

CHAS. W. HARRIS

formerly Sousaphone player of Rolfe's Colonial Sextette and Sousa's Band, is at the present time located in New York City where he is connected with the best orchestras of that city playing hotels and ballrooms. Mr. Harris owns a Sousaphone which makes a hit wherever he appears.

"The Sousaphone makes a hit at every performance. It possesses a beautiful, rich, organ-like quality of tone and we could not dispense with it in this act. It is a wonderful instrument."

E. CLATE FAIR

This veteran player started his career in Middlebury, Ohio, under the directorship of Milt Hill, in 1878. Mr. Fair is now playing the Sousaphone Grand in the Mid Continental Band of Independence, Kansas, which, we understand, is "some band."

"I am very proud of my Conn Sousaphone—It is just right."

WILLIAM KYLE

Mr. Kyle is the Bass player of the 12th Infantry U. S. Army Band, which has appeared in several notable parades in New York City.

"The Sousaphone Bass, which I purchased through your New York House, is unquestionably the finest Bass that man ever played upon. Such a grand quality of tone and so remarkably easy to play, in fact, easier than any other Bass of smaller makes, it simply demands my greatest admiration."

Paul E. Blanchard

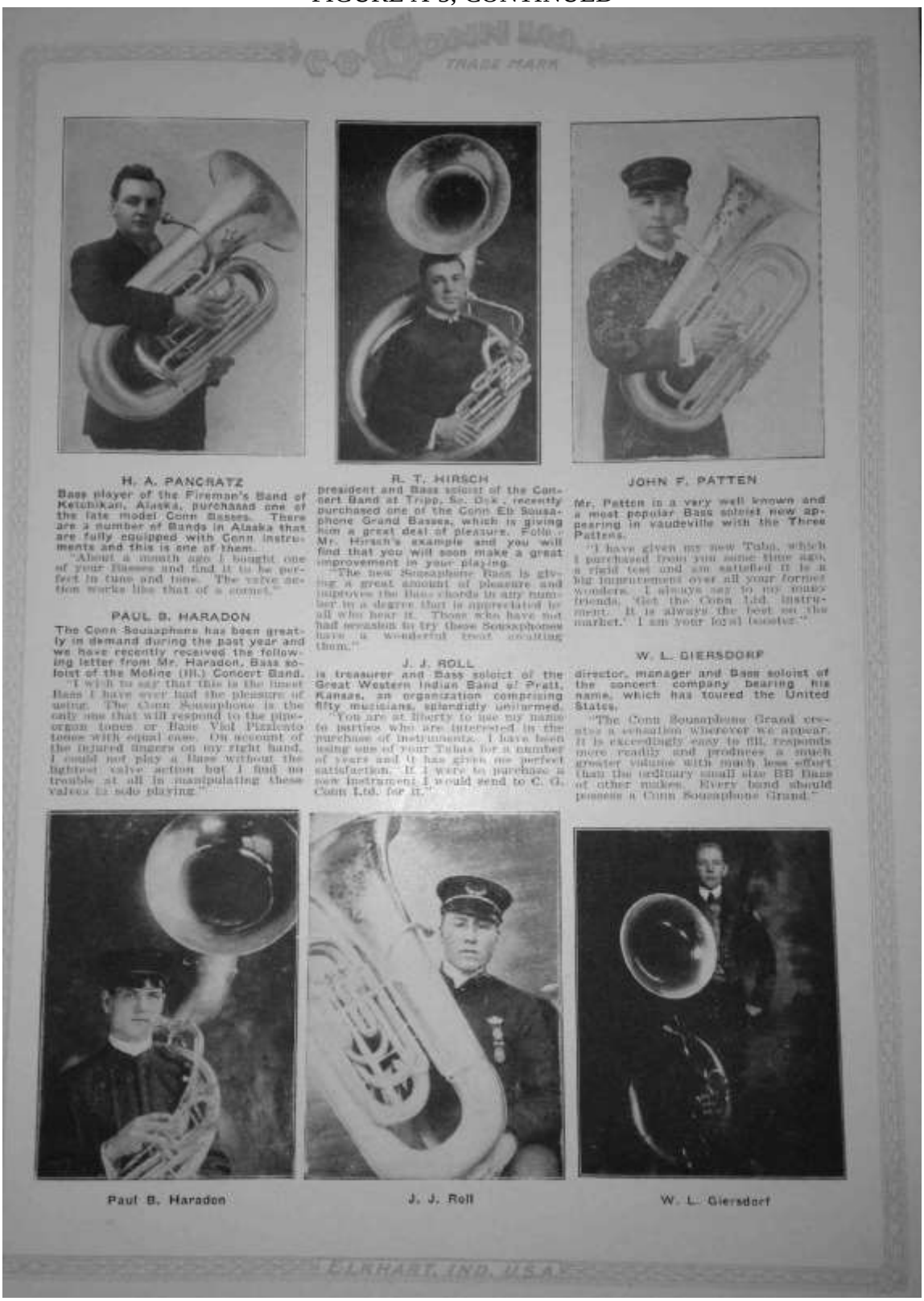
E. Clate Fair

William Kyle

ELKHART, IND., U.S.A.

Page Twenty-eight

FIGURE A-5, CONTINUED



H. A. PANCRATZ

Bass player of the Fireman's Band of Ketchikan, Alaska, purchased one of the late model Conn Basses. There are a number of Bands in Alaska that are fully equipped with Conn instruments and this is one of them.

"About a month ago I bought one of your Basses and find it to be perfect in tune and tone. The valve action works like that of a cornet."

PAUL B. HARADON

The Conn Sousaphone has been greatly in demand during the past year and we have recently received the following letter from Mr. Haradon, Bass soloist of the Moline (Ill.) Concert Band.

"I wish to say that this is the finest Bass I have ever had the pleasure of using. The Conn Sousaphone is the only one that will respond to the pipe-organ tones or Bass Viol Pizzicato tones with equal ease. On account of the injured fingers on my right hand, I could not play a Bass without the lightest valve action but I find no trouble at all in manipulating these valves in solo playing."

R. T. HIRSCH

president and Bass soloist of the Concert Band at Tripp, So. Dak., recently purchased one of the Conn Eb Sousaphone Grand Basses, which is giving him a great deal of pleasure. Follow Mr. Hirsch's example and you will find that you will soon make a great improvement in your playing.

"The new Sousaphone Bass is giving a great amount of pleasure and improves the Bass chords in any number in a degree that is appreciated by all who hear it. Those who have not had occasion to try these Sousaphones have a wonderful treat awaiting them."

J. J. ROLL

is treasurer and Bass soloist of the Great Western Indian Band of Pratt, Kansas, an organization comprising fifty musicians, splendidly uniformed.

"You are at liberty to use my name to parties who are interested in the purchase of instruments. I have been using one of your Tubas for a number of years and it has given me perfect satisfaction. If I were to purchase a new instrument I would send to C. G. Conn Ltd. for it."

JOHN F. PATTEN

Mr. Patten is a very well known and a most popular Bass soloist now appearing in vaudeville with the Three Pattens.

"I have given my new Tuba, which I purchased from you some time ago, a rigid test and am satisfied it is a big improvement over all your former wonders. I always say to my many friends, 'Get the Conn Ltd. instrument. It is always the best on the market.' I am your loyal booster."

W. L. GIERSDORF

director, manager and Bass soloist of the concert company bearing his name, which has toured the United States.

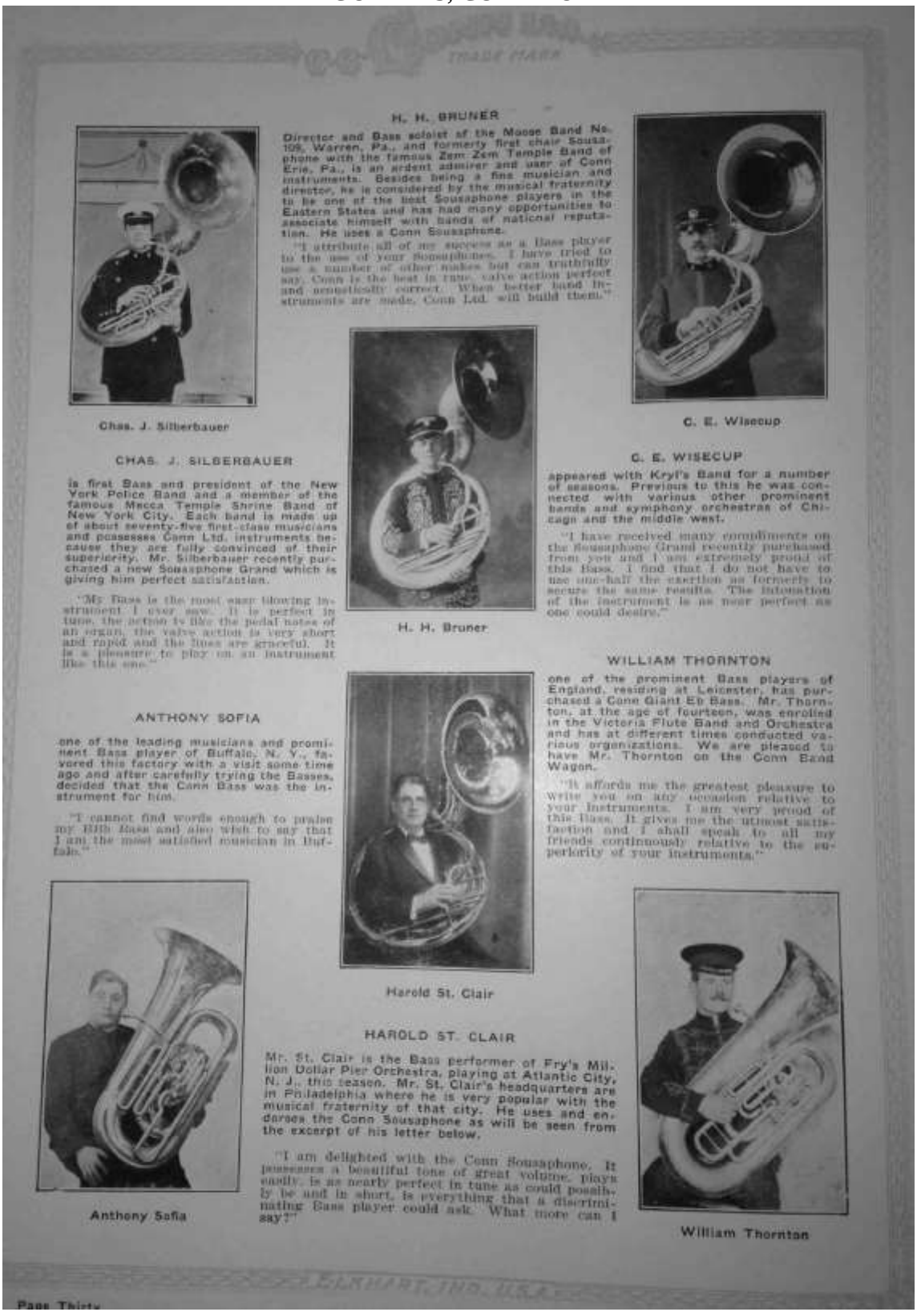
"The Conn Sousaphone Grand creates a sensation wherever we appear. It is exceedingly easy to fill, responds more readily and produces a much greater volume with much less effort than the ordinary small size BB Bass of other makes. Every band should possess a Conn Sousaphone Grand."

Paul B. Haradon

J. J. Roll

W. L. Giersdorf

FIGURE A-5, CONTINUED



H. H. BRUNER

Director and Bass soloist of the Moose Band No. 108, Warren, Pa., and formerly first chair Sousaphone with the famous Zem Zem Temple Band of Erie, Pa., is an ardent admirer and user of Conn instruments. Besides being a fine musician and director, he is considered by the musical fraternity to be one of the best Sousaphone players in the Eastern States and has had many opportunities to associate himself with bands of national reputation. He uses a Conn Sousaphone.

"I attribute all of my success as a Bass player to the use of your Sousaphones. I have tried to use a number of other makes but can truthfully say, Conn is the best in tone, valve action perfect and acoustically correct. When better band instruments are made, Conn Ltd. will build them."

Chas. J. Silberbauer

CHAS. J. SILBERBAUER

is first Bass and president of the New York Police Band and a member of the famous Mecca Temple Shrine Band of New York City. Each band is made up of about seventy-five first-class musicians and possesses Conn Ltd. instruments because they are fully convinced of their superiority. Mr. Silberbauer recently purchased a new Sousaphone Grand which is giving him perfect satisfaction.

"My Bass is the most easy blowing instrument I ever saw. It is perfect in tune, the action is like the pedal notes of an organ, the valve action is very short and rapid and the lines are graceful. It is a pleasure to play on an instrument like this one."

H. H. Bruner

C. E. Wisecup

C. E. WISECUP

appeared with Kryl's Band for a number of seasons. Previous to this he was connected with various other prominent bands and symphony orchestras of Chicago and the middle west.

"I have received many compliments on the Sousaphone Grand recently purchased from you and I am extremely proud of this Bass. I find that I do not have to use one-half the exertion as formerly to secure the same results. The intonation of the instrument is as near perfect as one could desire."

ANTHONY SOFIA

one of the leading musicians and prominent Bass player of Buffalo, N. Y., favored this factory with a visit some time ago and after carefully trying the Basses, decided that the Conn Bass was the instrument for him.

"I cannot find words enough to praise my Fifth Bass and also wish to say that I am the most satisfied musician in Buffalo."

Harold St. Clair

WILLIAM THORNTON

one of the prominent Bass players of England, residing at Leicester, has purchased a Conn Giant Eb Bass. Mr. Thornton, at the age of fourteen, was enrolled in the Victoria Flute Band and Orchestra and has at different times conducted various organizations. We are pleased to have Mr. Thornton on the Conn Band Wagon.

"It affords me the greatest pleasure to write you on any occasion relative to your Instruments. I am very proud of this Bass. It gives me the utmost satisfaction and I shall speak to all my friends continuously relative to the superiority of your instruments."

Anthony Sofia

HAROLD ST. CLAIR

Mr. St. Clair is the Bass performer of Fry's Million Dollar Pier Orchestra, playing at Atlantic City, N. J., this season. Mr. St. Clair's headquarters are in Philadelphia where he is very popular with the musical fraternity of that city. He uses and endorses the Conn Sousaphone as will be seen from the excerpt of his letter below.

"I am delighted with the Conn Sousaphone. It possesses a beautiful tone of great volume, plays easily, is as nearly perfect in tune as could possibly be and in short, is everything that a discriminating Bass player could ask. What more can I say?"

William Thornton

Page Thirty

FIGURE A-5, CONTINUED

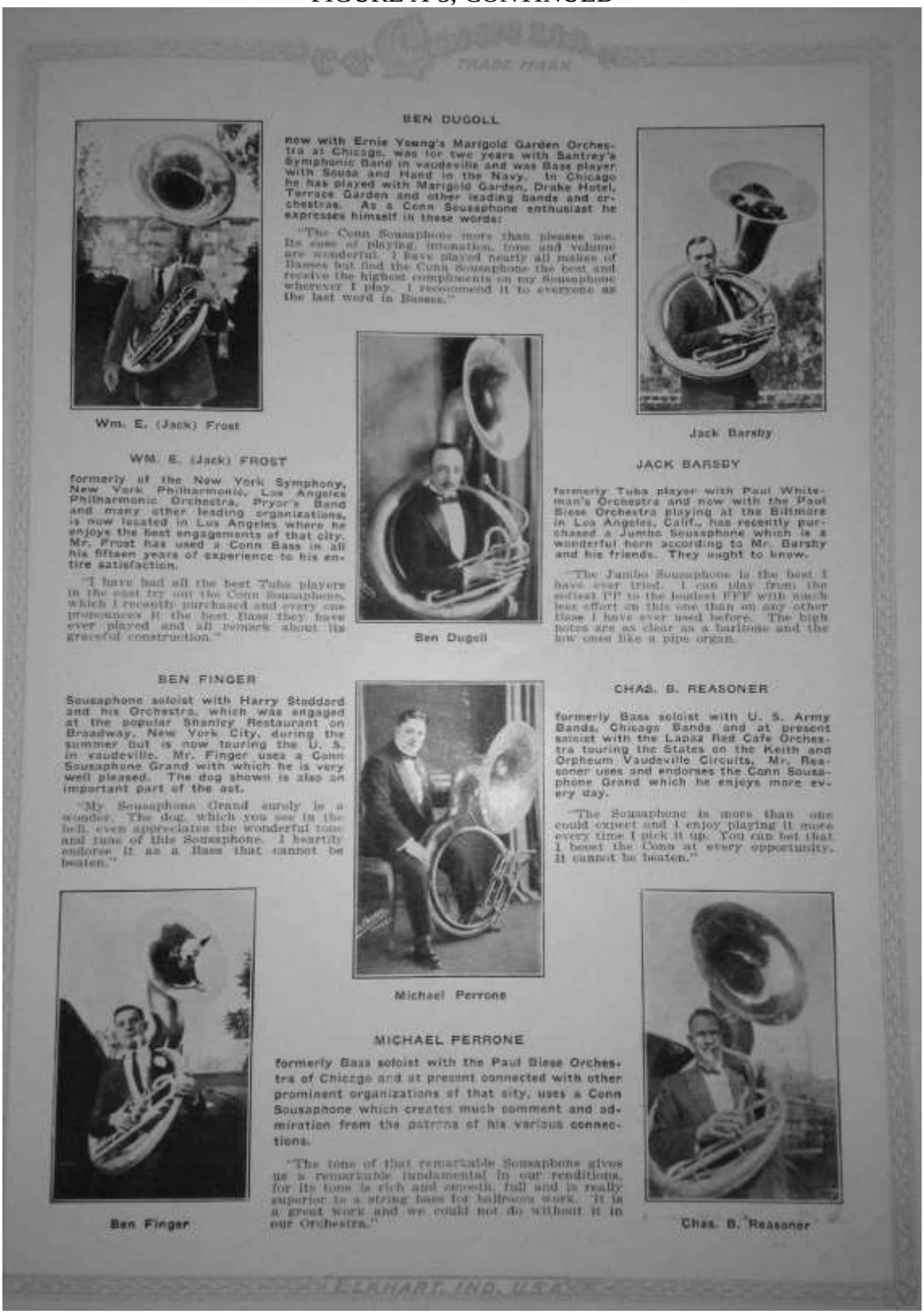


FIGURE A-5, CONTINUED

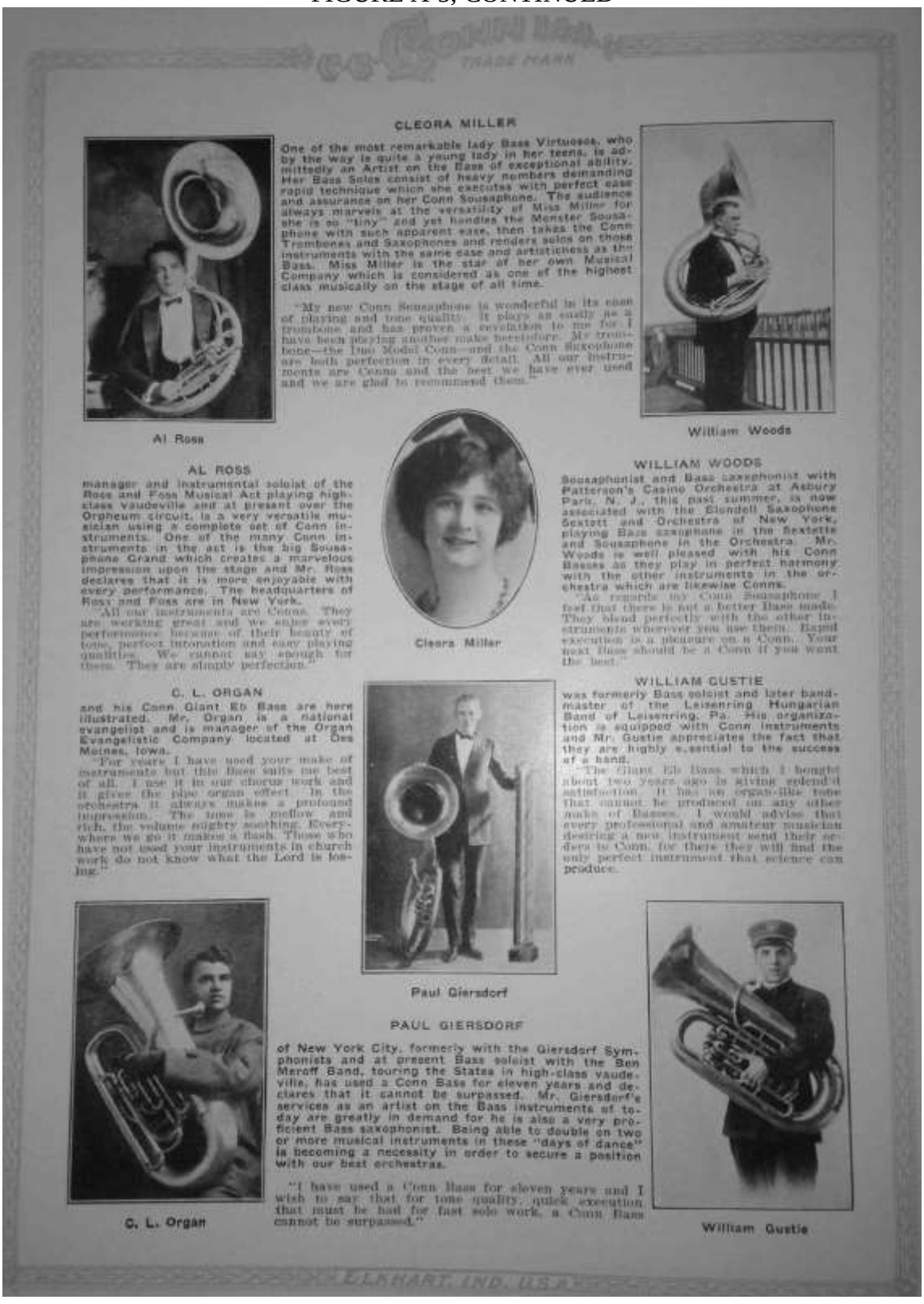


FIGURE A-5, CONTINUED

EUGENE BRAUNSDORF

Everyone who has heard the Detroit News Radio Orchestra broadcasting from Station WWJ, has heard Eugene Braunsdorf play on his Conn Sousaphone Grand. Mr. Braunsdorf is classed as one of the most efficient Bass players in the country today for he, as well as the Detroit News Radio Orchestra, is nationally known. The ability and record of Mr. Braunsdorf is hard to excel for he furnishes the entire bass for the Orchestra on his Conn Sousaphone. The demand and reputation for the Conn Sousaphones are becoming so great that it is impossible to fill all orders with any degree of immediate or early delivery. Customers are obliged to wait from one to three months for their Sousaphones owing to the great popularity of Conn Basses.

"About one year ago I purchased one of your Sousaphone Grand Fifth Basses. I use it in the orchestra of the Detroit News Radio, broadcasting from Station WWJ. The tone is mellow and rich. I cannot speak too highly of Conn Sousaphones."

ADAM PESTTA

To impart additional color and strengthen the impression of your orchestra, add one Conn Sousaphone to your organization. The Henry Theis Orchestra, playing at the Carleton Cafe, Detroit, Mich., has done this and its patrons are ever increasing in numbers. Mr. Pestta who handles the Sousaphone for the above orchestra is an accomplished musician and is very popular with the musical fraternity of Detroit. We are pleased to introduce Mr. Pestta as a passenger on the Conn Band wagon.

"The correctness of the Intonation, in other words, the perfection of the scale, the quality of the tone and the ease with which the Conn Sousaphone is played is nothing short of marvelous. I have one of your Sousaphones and to compute the value of it in an orchestra with any degree of accuracy is an impossibility. Congratulations."

GASTON BROHAN

Bass player of the Detroit Symphony Orchestra possesses a Conn Sousaphone and is more than pleased with it. Mr. Brohan has held considerable experience with various makes of Basses and is exceptionally well qualified to judge the merits of the several makes of Basses with which he has come in contact.

"I want you to know that I am more than satisfied with my Conn Sousaphone, which you sold me some time ago. In my observation of the various makes of brass instruments I have come to the conclusion that the Conn Sousaphone is far superior in tone quality to any other make. In fact, I believe that the Sousaphone is unique in possessing such a beautiful string-like quality of tone."

Gaston Brohan

R. E. CROZIER

Sousaphone player with Arthur Black's Pier Ballroom Orchestra of Detroit, is very profuse with his remarks regarding the Conn Sousaphone. Mr. Crozier has sent to this office some illustrations of very difficult passages, which space does not permit us to print, but all one has to do to realize his ability as a Bass player is to look at the different passages.

"It is with much pleasure and satisfaction that the writer be permitted to publicly congratulate the Conn institution upon the high degree of mechanical perfection attained in the production of the Sousaphone Model Bass. I am a member of Arthur Black's Pier Ballroom Orchestra, an organization consisting of fourteen classical scholars, who with Mr. Black as conductor have been holding sway at the Pier Ballroom for the past three years. Aside from the mechanical perfections the musical possibilities of the Conn Sousaphone are astonishing."

E. L. BROWN

formerly with Noel Pepping and the Buckingham Hotel Orchestra of St. Louis, Mo., is now playing the Bass harmony for Roy Bargy and his Orchestra of Chicago, a Benson organization which has made for itself an enviable reputation. Mr. Brown owns a Conn BBb Sousaphone which is giving him perfect satisfaction.

"It is indeed a pleasure to tell you that the new BBb Sousaphone Grand I purchased from you is giving perfect satisfaction. It is remarkable how easy the instrument plays and the beautiful quality of tone it has. I highly recommend C. G. Conn Ltd. Sousaphone Basses.

E. L. Brown

HELEN BROWN

sister of E. L. Brown, whose photograph appears on this page also, is a young and attractive Bass player doing solo work in and around St. Louis, Mo. Miss Brown, although very small, fits the Sousaphone Grand with perfect ease. She highly recommends Conn Sousaphones.

"I am using one of your BBb Sousaphone Grand Basses and highly recommend it to my friends. Although rather small in stature I can fill this horn with ease. My brother, E. L. Brown, and I are highly elated over your Basses."

Helen Brown

ELKHART, IND., U.S.A.

FIGURE A-5, CONTINUED

EARL W. FIELD

is at present with Sousa's Band with which organization he is playing the Conn Sousaphone. He was formerly with Kryl's Band as Bass soloist and later with the Seattle Symphony Orchestra during all of which engagements he has used Conn Basses of various models. He has just recently placed his order for a Conn Jumbo Sousaphone Grand. That's what he thinks of Conns.

"The Sousaphone you made for me has proven absolutely perfect in every respect. The tonal qualities and valve action are superb and the workmanship cannot be beaten. It exceeds my expectations."

C. M. Fremstead

C. M. FREMSTEAD

Mr. Fremstead is a well known Bass player of Jacksonville, Fla. He has also been Bass Soloist with several of the best bands around Ashville and Jackson and his judgment is worthy of consideration by prospective Bass buyers.

"I am being complimented on the beautiful tonal qualities of my Sousaphone, not mentioning its magnificent appearance, and I am only too glad to speak a good word for the Conn instruments."

Earl W. Field

J. G. TOMPKINS

Sgt. Mus. J. G. Tompkins, First Bass C.H.S.C.C. Band, Charleston, W. Va.

"The Eb Sousaphone Bass which I purchased from you has given me perfect service. I have used the instrument in road work, army bands and concert bands and have no trouble whatever. I have played every standard-make Bass that I could get my hands on and have found none equal to the Conn. It surely is a "bear" and anyone who gets a Conn Sousaphone should consider himself lucky."

J. G. Tompkins

HERMAN CONRAD

formerly Bass soloist with Sousa's and Pryor's Bands and more recently soloist with the Victor Talking Machine Company's Band, doing recording work in New York City, uses and recommends Conn Basses for this exacting work.

"After testing your Sousaphone I can decidedly say that it is the most perfect instrument I have ever played."

Herman Conrad

James J. Tortoriello

JAMES J. TORTORIELLO

Bass soloist with Joe Basile's Madison Square Garden Band of New York City, handles the Conn BB Bass with the same ease and grace as one who handles a Conn Victor Cornet. We take great pleasure in quoting Mr. Tortoriello's compliments on Conn Basses.

"My Conn Bass is the easiest playing instrument I have ever played. Its tone is rich and sonorous and it responds to the slightest effort as I play it with the most perfect ease imaginable. I can dance with it and never miss a note. What more could one wish?"

Henry Waak

BERT L. STRUNK

Bass soloist and manager of the Metropolitan Band of Philadelphia, Pa., is in the Conn Band wagon safe and sound. He purchased a Conn Sousaphone Bass which is giving the best of satisfaction to himself, director and the public.

"I am in the Conn Band Wagon to stay. Am one of the many thousand Conn Boys."

Bert L. Strunk

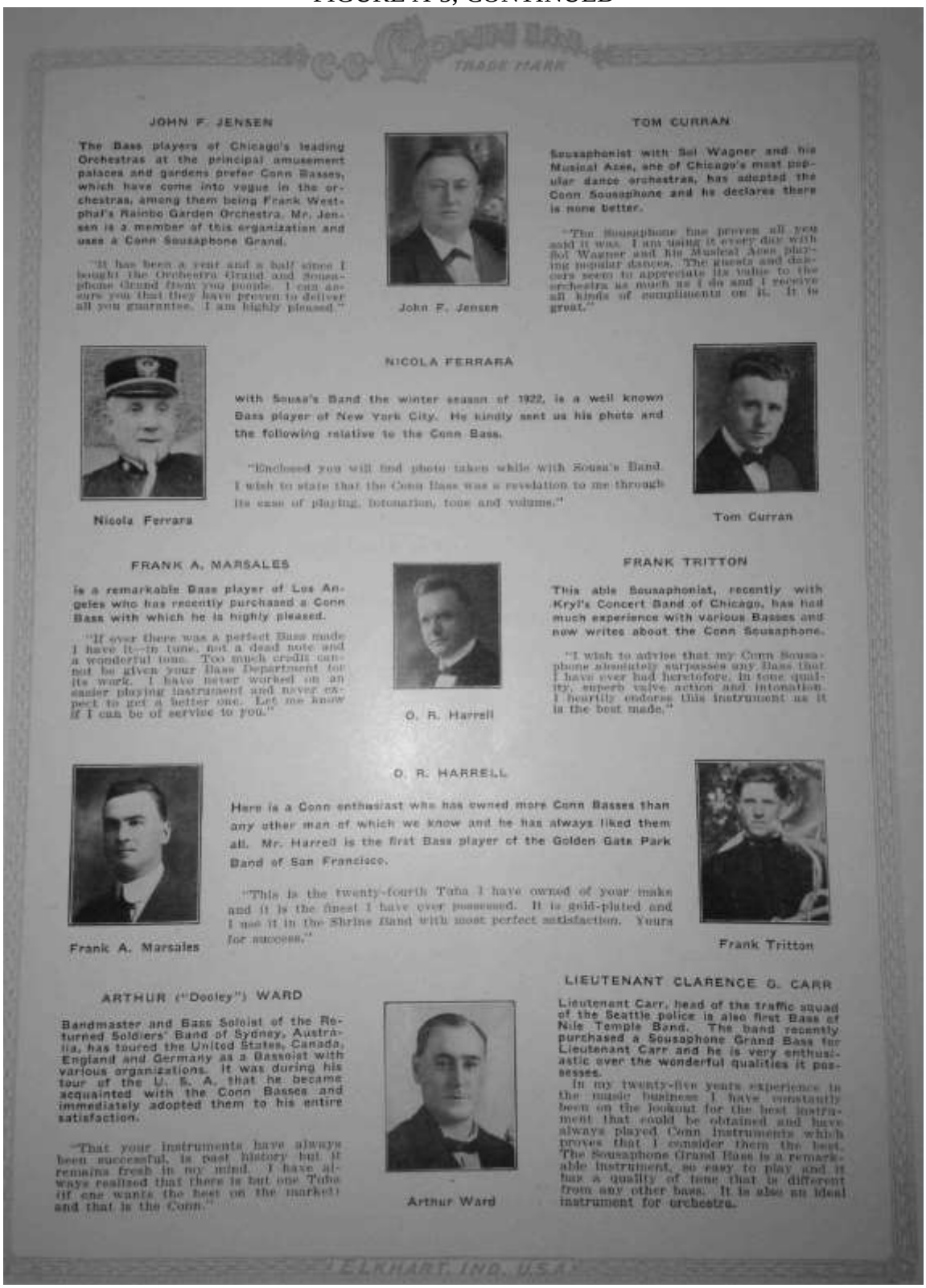
HENRY WAAK

was for several seasons featured with the B. A. Rolfe acts and high-class productions in Keith Vaudeville as well as Kryl's, Kilties', Liberati's and other well known bands. At present he is one of the features with the Vincent Lopez Orchestra playing at the Pennsylvania Hotel, New York City.

"The Sousaphone received and wish to say that it is a wonderful instrument. I can do anything on it with perfect ease. I congratulate you on turning out such a remarkably fine-toned instrument."

ELKHART, IND., U.S.A.

FIGURE A-5, CONTINUED



JOHN F. JENSEN

The Bass players of Chicago's leading Orchestras at the principal amusement palaces and gardens prefer Conn Basses, which have come into vogue in the orchestras, among them being Frank Westphal's Rainbo Garden Orchestra. Mr. Jensen is a member of this organization and uses a Conn Sousaphone Grand.

"It has been a year and a half since I bought the Orchestra Grand and Sousaphone Grand from you people. I can assure you that they have proven to deliver all you guarantee. I am highly pleased."

John F. Jensen

TOM CURRAN

Sousaphonist with Sol Wagner and his Musical Aces, one of Chicago's most popular dance orchestras, has adopted the Conn Sousaphone and he declares there is none better.

"The Sousaphone has proven all you said it was. I am using it every day with Sol Wagner and his Musical Aces playing popular dances. The guests and dancers seem to appreciate its value to the orchestra as much as I do and I receive all kinds of compliments on it. It is great."

Nicola Ferrara

NICOLA FERRARA

with Sousa's Band the winter season of 1922, is a well known Bass player of New York City. He kindly sent us his photo and the following relative to the Conn Bass.

"Enclosed you will find photo taken while with Sousa's Band. I wish to state that the Conn Bass was a revelation to me through its ease of playing, intonation, tone and volume."

Tom Curran

FRANK A. MARSALES

is a remarkable Bass player of Los Angeles who has recently purchased a Conn Bass with which he is highly pleased.

"If ever there was a perfect Bass made I have it—in tune, not a dead note and a wonderful tone. Too much credit cannot be given your Bass Department for its work. I have never worked on an easier playing instrument and never expect to get a better one. Let me know if I can be of service to you."

O. R. Harrell

FRANK TRITTON

This able Sousaphonist, recently with Kryl's Concert Band of Chicago, has had much experience with various Basses and now writes about the Conn Sousaphone.

"I wish to advise that my Conn Sousaphone absolutely surpasses any Bass that I have ever had heretofore, in tone quality, superb valve action and intonation. I heartily endorse this instrument as it is the best made."

Frank A. Marsales

O. R. HARRELL

Here is a Conn enthusiast who has owned more Conn Basses than any other man of which we know and he has always liked them all. Mr. Harrell is the first Bass player of the Golden Gate Park Band of San Francisco.

"This is the twenty-fourth Tuba I have owned of your make and it is the finest I have ever possessed. It is gold-plated and I use it in the Shrine Band with most perfect satisfaction. Yours for success."

Frank Tritton

ARTHUR ("Dooley") WARD

Bandmaster and Bass Soloist of the Returned Soldiers' Band of Sydney, Australia, has toured the United States, Canada, England and Germany as a Bassoist with various organizations. It was during his tour of the U. S. A. that he became acquainted with the Conn Basses and immediately adopted them to his entire satisfaction.

"That your instruments have always been successful, is past history but it remains fresh in my mind. I have always realized that there is but one Tuba (if one wants the best on the market) and that is the Conn."

Arthur Ward

LIEUTENANT CLARENCE G. CARR

Lieutenant Carr, head of the traffic squad of the Seattle police is also first Bass of Nile Temple Band. The band recently purchased a Sousaphone Grand Bass for Lieutenant Carr and he is very enthusiastic over the wonderful qualities it possesses.

In my twenty-five years experience in the music business I have constantly been on the lookout for the best instrument that could be obtained and have always played Conn instruments which proves that I consider them the best. The Sousaphone Grand Bass is a remarkable instrument, so easy to play and it has a quality of tone that is different from any other bass. It is also an ideal instrument for orchestra.

ELKHART, IND. U.S.A.

FIGURE A-5, CONTINUED

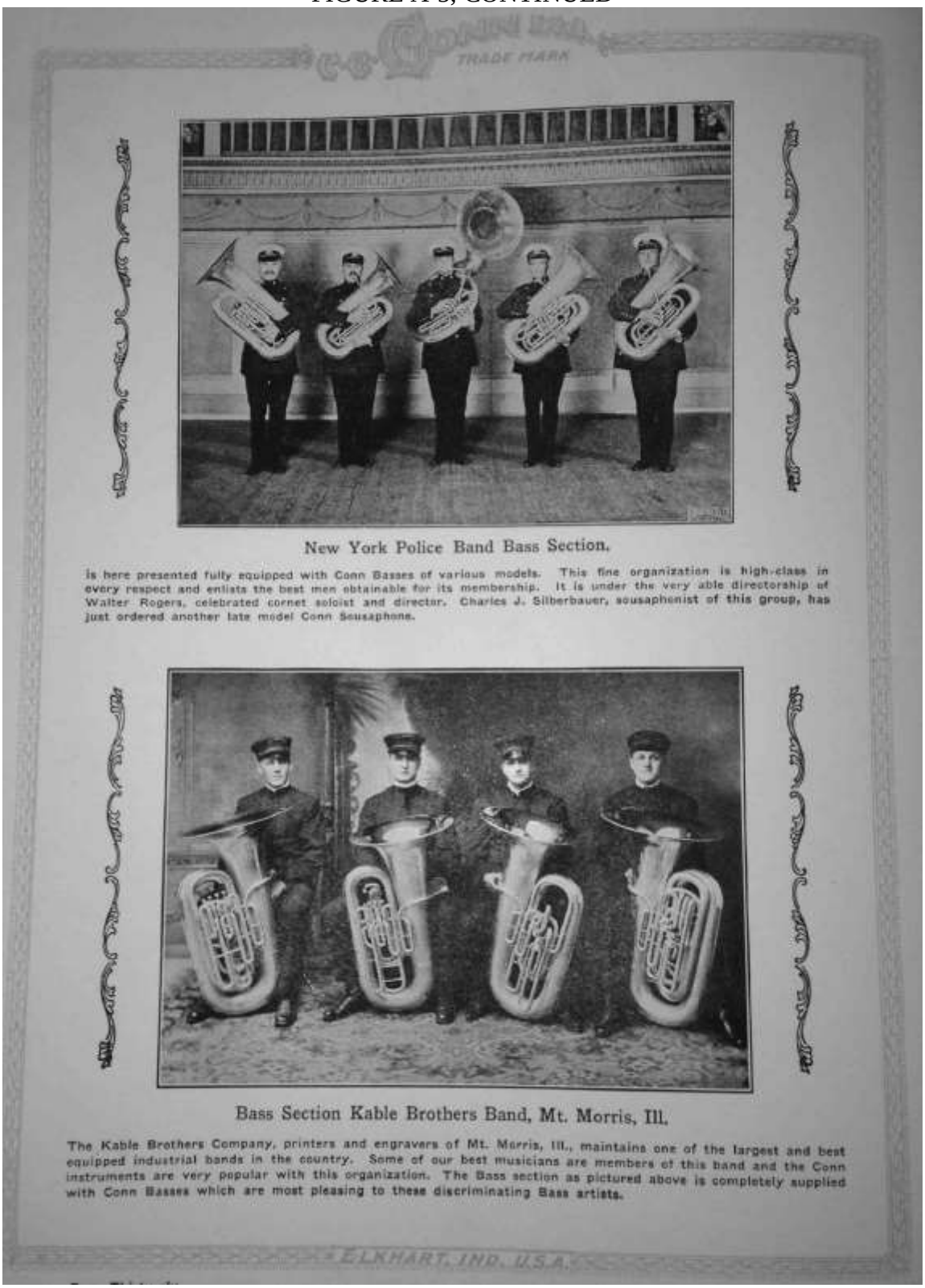
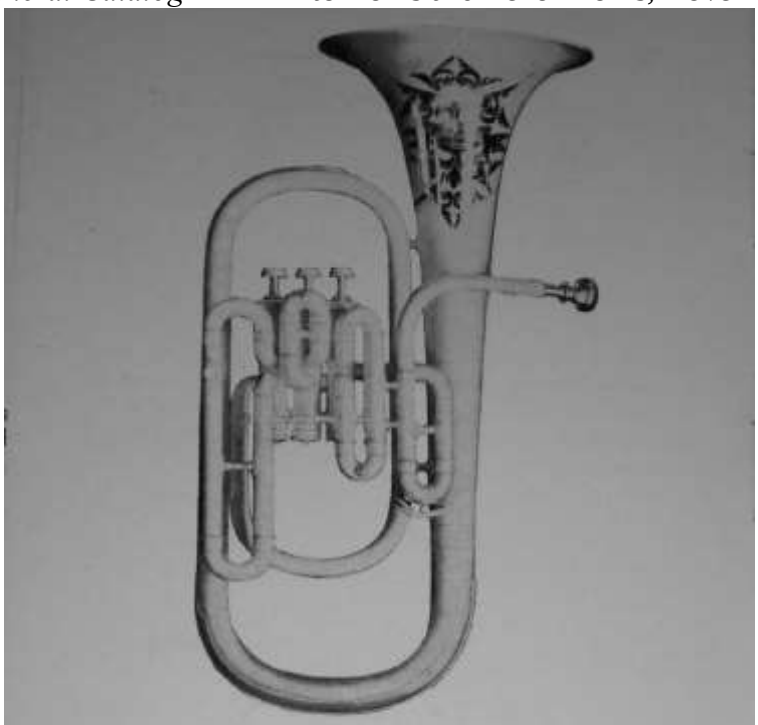


FIGURE A-6
Conn General Catalog "B" – Alto Horns and Tenor Horns, November 1924



Upright Alto in E♭—2C

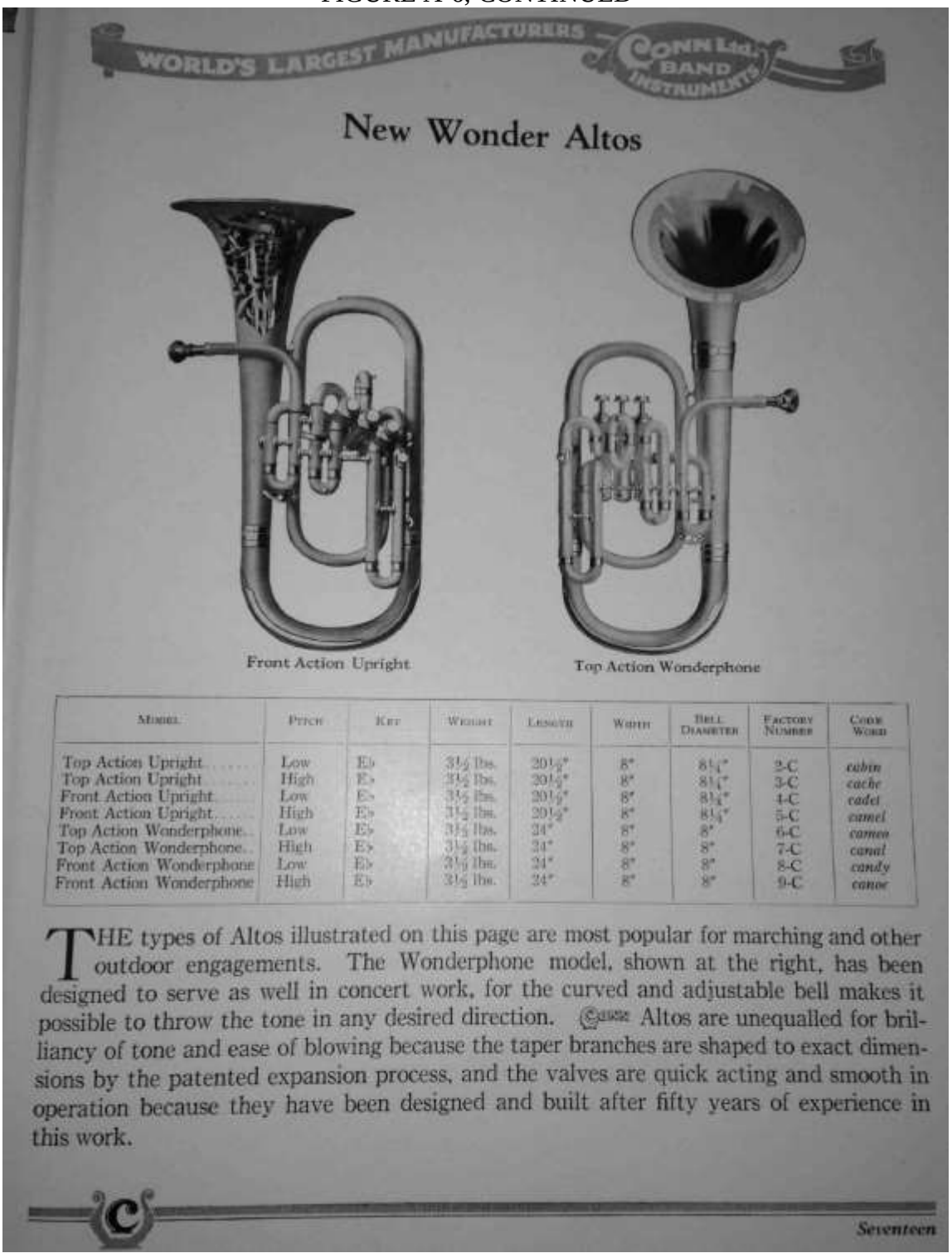
THIS is the ideal alto for marching and military bands, both because it is lighter and more compact to carry, and because it has the brilliant tone desired by military bands. On the march its three and one-half pounds are lightly carried and the extra pound or more on the other altos becomes noticeable to the player used to this light model. The bell is not only smaller, but it opens and flares in a manner which brings out a bright, military tone.

While built chiefly for the brass and military band, this alto can be used in the concert band and orchestra in the absence of French horns. Being the least expensive of the altos, this model is preferred where price is an important consideration.

The valves are top action and of the same light, snappy action as are used on all Conn piston valve instruments.

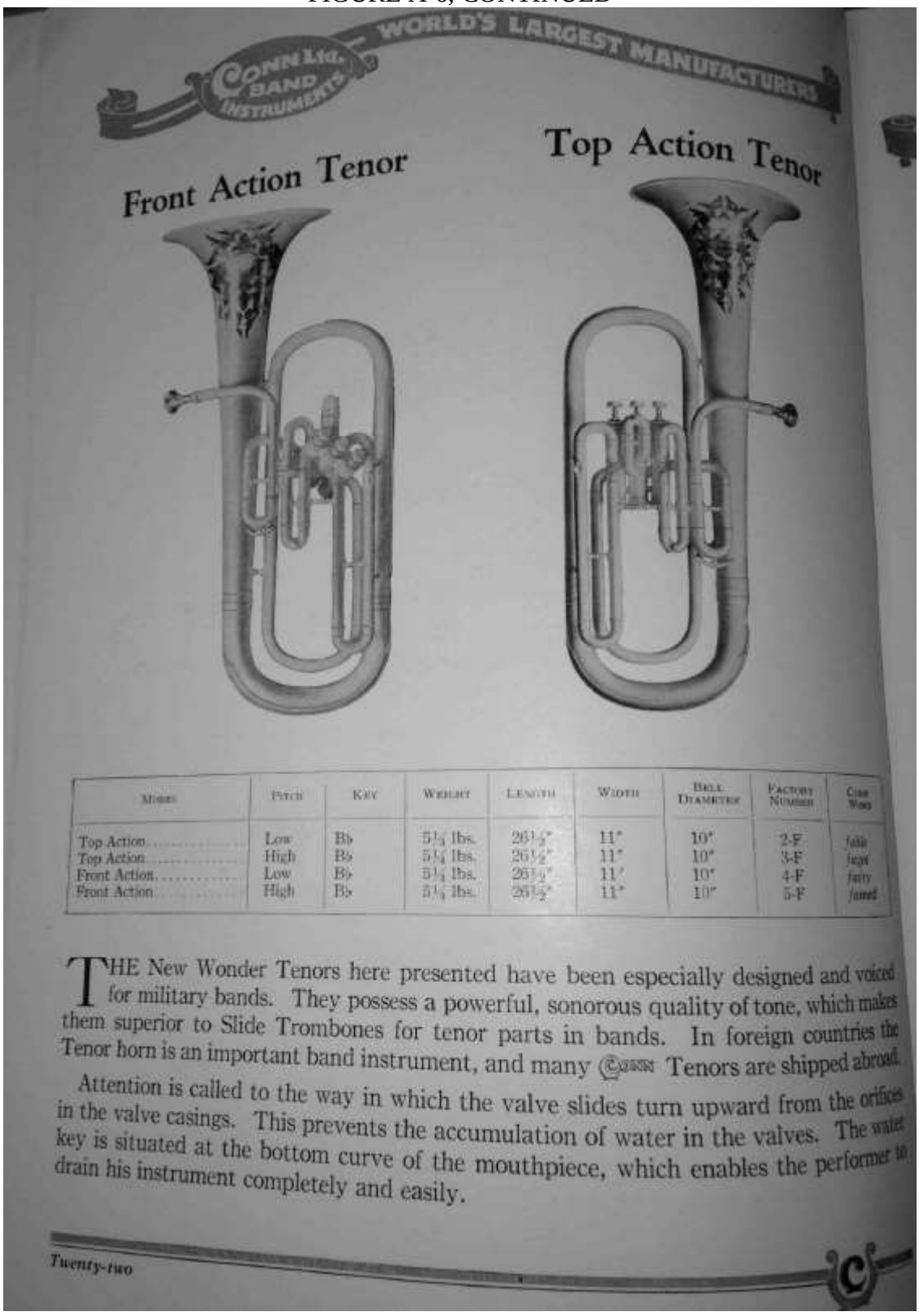
Model	*Pitch*	*Weight*	*Length*	*Width*	*Bell Diameter*	*Factory Number*	*Code Word*
Top Action Upright...	Low	3½ lbs.	20½"	8"	8¼"	2-C	*cabin*
Top Action Upright....	High	3½ lbs.	20½"	8"	8¼"	3-C	*cacko*

FIGURE A-6, CONTINUED



Model	Pitch	Key	Weight	Length	Width	Bell Diameter	Factory Number	Code Word
Top Action Upright	Low	E♭	3½ lbs.	20½"	8"	8¼"	2-C	*cabin*
Top Action Upright	High	E♭	3½ lbs.	20½"	8"	8¼"	3-C	*cache*
Front Action Upright	Low	E♭	3½ lbs.	20½"	8"	8¼"	4-C	*cadet*
Front Action Upright	High	E♭	3½ lbs.	20½"	8"	8¼"	5-C	*camel*
Top Action Wonderphone	Low	E♭	3½ lbs.	24"	8"	8"	6-C	*cameo*
Top Action Wonderphone	High	E♭	3½ lbs.	24"	8"	8"	7-C	*canal*
Front Action Wonderphone	Low	E♭	3½ lbs.	24"	8"	8"	8-C	*candy*
Front Action Wonderphone	High	E♭	3½ lbs.	24"	8"	8"	9-C	*canoe*

FIGURE A-6, CONTINUED



Model	Pitch	Key	Weight	Length	Width	Bell Diameter	Factory Number	Case Wood
Top Action	Low	B♭	5¼ lbs.	26½"	11"	10"	2-F	*fable*
Top Action	High	B♭	5¼ lbs.	26½"	11"	10"	3-F	*large*
Front Action	Low	B♭	5¼ lbs.	26½"	11"	10"	4-F	*fairy*
Front Action	High	B♭	5¼ lbs.	26½"	11"	10"	5-F	*famed*

THE New Wonder Tenors here presented have been especially designed and voiced for military bands. They possess a powerful, sonorous quality of tone, which makes them superior to Slide Trombones for tenor parts in bands. In foreign countries the Tenor horn is an important band instrument, and many CONN Tenors are shipped abroad.

Attention is called to the way in which the valve slides turn upward from the orifices in the valve casings. This prevents the accumulation of water in the valves. The water key is situated at the bottom curve of the mouthpiece, which enables the performer to drain his instrument completely and easily.

Twenty-two

FIGURE A-7
Conn Band and Orchestra Instruments, Catalog and Price List – Sept. 1940

FIGURE A-7, CONTINUED

ALMA ADAMS, bass tuba with Phil Spitalny's "Hour of Charm" Orch., uses Conn 20-K sousaphone.

CHARLES FORD, star bass player with Jan Garber, uses new 20-J short action bass

CHOICE OF THE ARTISTS

Conn made the first sousaphone in 1898 expressly for the Sousa band and has been the headquarters for fine basses and sousaphones for forty years. The newest achievement is the exclusive, patented short action Clickless Crysteel valves, found only on the 20-J, 22-J, 24-J, 26-J Recording basses and 20-K sousaphone. All other Conn basses and sousaphones have the regular long action, but they have the exclusive Crysteel feature, which gives a valve which is "smooth as crystal and hard as steel." The Clickless feature uses a pin guide instead of the old key in a slot, thereby eliminating much of the noise in old type valves. The short action feature reduces the stroke from 65/64ths to 44/64ths, thereby cutting down the work of the player and speeding up his technique nearly 33⅓! The patented off-center valve stem of the short action valves arches the finger tips and moves them 5/32nds closer together, fitting the natural position of the fingers and assisting in better performance.

Model	Cat. No.	Fin. 20 brass, gold lac.	Fin. 21 brass, clear lac.	Fin. 3 satin silver	Fin. 2 silver, gold bell
Bass, BBb, 3 valves, top, 24" bell	20-J	$330	$330	$350	$390
Bass, BBb, 3 valves, front, 24" bell	22-J	330	330	350	390
Bass, BBb, 4 valves, top, 24" bell	24-J	350	350	370	410
Bass, BBb, 4 valves, front, 24" bell	26-J	350	350	370	410
Sousaphone Grand, BBb, 3 valves, 26" bell	20K	320	320	335	380
Sousaphone Grand, BBb, 3 valves, 28" bell	58K	295	295	310	355
Lightweight Sousaphone, BBb, 3 valves, 24" bell	32-K	260	260	275	320
Sousaphone Grand, Eb, 3 valves, 24" bell	26-K	275	275	290	335
Bass, Eb, 3 valves, front, 22" bell	16-J	290	290	310	350

Prices do not include case. See page 55.

Above, the new Clickless Crystal, short action valves, used on 20-J, 22-J, 24-J, 26-J, and 20-K. Note patented guide pin which eliminates much of slap and click of old type valve with key in slot. Note also off-center stem, which arches the finger tips and moves them 5/32nds closer to fit natural position of fingers.

Below, short action valves cut stroke 1/3 of an inch, reducing work of player and speeding up his technique almost 33⅓! With these new and modern valves, the bass player now has a valve stroke which is only slightly longer than the valve stroke of the cornet player.

APPENDIX B

C.G. CONN TUBA-RELATED PATENTS

PATENTS IN CHRONOLOGICAL ORDER

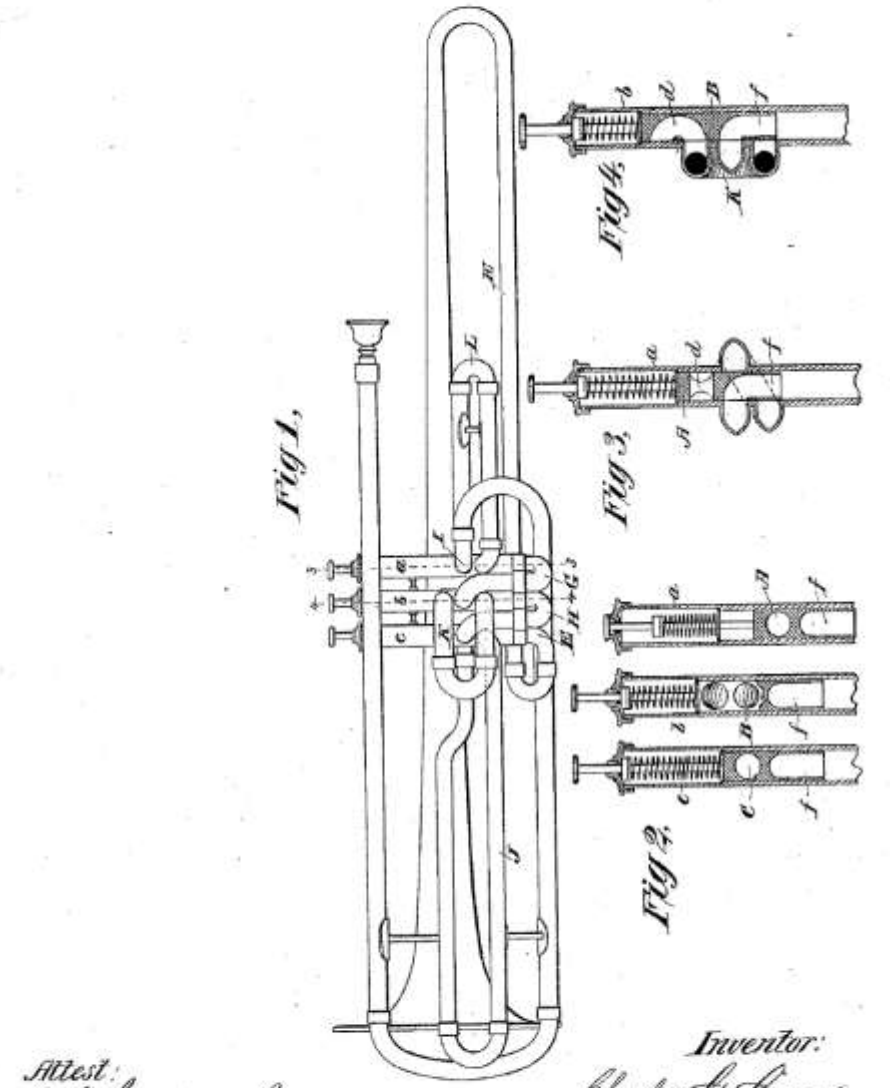
FIGURE B-1
PATENT FOR MODIFIED STÖLZEL PISTON VALVES

(Model.) 3 Sheets—Sheet 1.

C. G. CONN.

PISTON VALVE MUSICAL INSTRUMENT.

No. 249,012. Patented Nov. 1, 1881.



Attest:
Geo. T. Smallwood Jr.
L. M. Hopkins

Inventor:
Charles G. Conn.
by Knight Bros. Attys

FIGURE B-1, CONTINUED

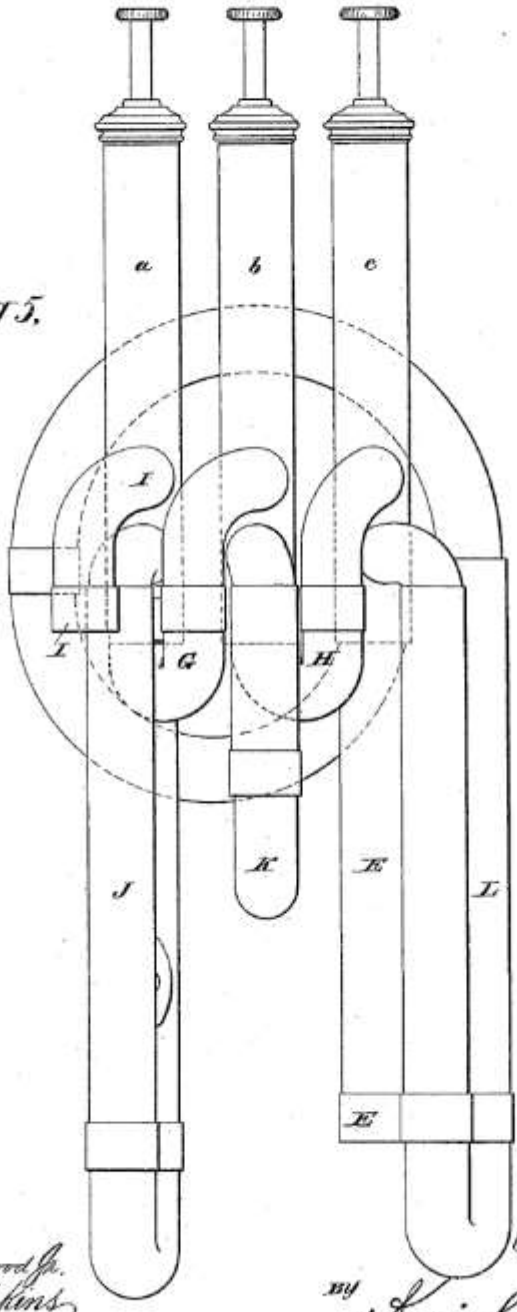
(Model.) 3 Sheets—Sheet 2.

C. G. CONN.

PISTON VALVE MUSICAL INSTRUMENT.

No. 249,012. Patented Nov. 1, 1881.

Fig 5.



Attest:
Geo. T. Smallwood Jr.
L. M. Hopkins

Inventor:
Charles G. Conn.
By Knight Bros. Attys

FIGURE B-1, CONTINUED

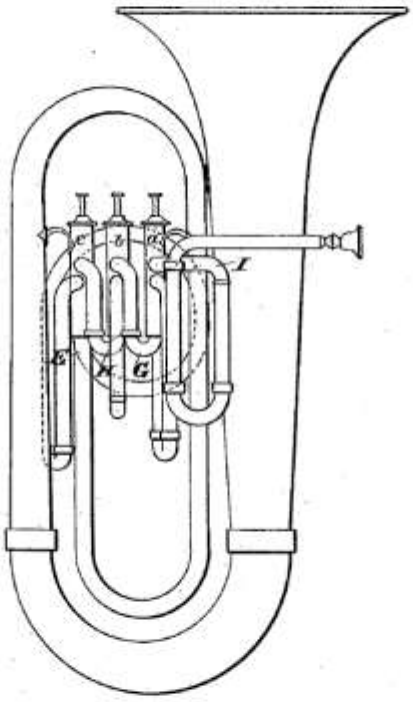
(Model.) 3 Sheets—Sheet 3.

C. G. CONN.

PISTON VALVE MUSICAL INSTRUMENT.

No. 249,012. Patented Nov. 1, 1881.

Fig 6.



Attest:
Geo. T. Smallwood Jr.
L. McP. Hopkins

Inventor:
Charles G. Conn
By Knight Bros
Attys

FIGURE B-1, CONTINUED

UNITED STATES PATENT OFFICE.

CHARLES G. CONN, OF ELKHART, INDIANA.

PISTON-VALVE MUSICAL INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 249,012, dated November 1, 1881.

Application filed April 2, 1881. (Model.)

To all whom it may concern:

Be it known that I, CHARLES G. CONN, a citizen of the United States, residing at Elkhart, in the county of Elkhart and State of Indiana, have invented a certain new and useful Improvement in Piston-Valve Musical Instruments, of which the following is a specification.

The object of my invention is to produce an instrument with a perfect clear-bore valve and a lighter and better valve-action than instruments of ordinary construction. To this end I construct my valve with a longitudinal bore, using the bottom of the valve-piston for one of the wind-passage apertures; but instead of connecting the adjacent valve-casings by a bend leading from the bottom of one valve to the bottom of the next, as has heretofore been done, I employ a pipe connected longitudinally with the bottom of one valve-casing and delivering transversely into the body of the next, and a pipe connected longitudinally with the bottom of the second valve-casing and delivering transversely into the body of the third, as hereinafter described.

In the accompanying drawings, Figure 1 is a side view of a trombone-à-piston illustrating the invention. Fig. 2 is a vertical section of the three valves thereof, the first valve being shown depressed and the other two in their upper or normal position. Fig. 3 is a vertical section through the first valve at 3 3, Fig. 1. Fig. 4 is a vertical section of the second valve at 4 4, Fig. 1. Fig. 5 is a side elevation of the central portion of a cornet embodying the invention. Fig. 6 is a side elevation of a bass-horn embodying the invention.

The ingress from the mouth-pipe is shown at I, and the egress to the bell at E.

A, B, and C are, respectively, the first, second, and third valves, and *a b c* their respective casings. The ingress-pipe I opens into the body or central part of the casing *a*, and the egress-pipe E leads from the bottom of the third casing, *c*.

G H are the direct air pipes or passages communicating from the bottom of the first valve-casing, *a*, to the body or central part of the second casing, *b*, and from the bottom of the second casing, *b*, to the center or body of the third casing, *c*.

The valves A, B, and C are, respectively, made, as shown, with a transverse air-passage, *d*, passing directly through from side to side, as in Fig. 3, or in knuckle form in and out on the same side, as shown in Fig. 4, as preferred or as the form of the piping may require, and a longitudinal passage, *f*, opening below through the bottom or lower end of the valve and above through a curved port in its side, so as in the normal or upper position of the valves to take the wind, which is delivered horizontally through the body of the casing by the pipe I, G, or H, and deliver it downward through the pipe G, H, or E, as the case may be.

J, K, and L are the valve-bends connected with the respective valve-casings for producing the valve-tones when the valves are depressed, at which time the wind, entering the casing horizontally, as before, instead of passing directly downward to the next communicating pipe, is carried through the passage *d* to the first end of the valve-bends J, K, or L, and after passing through this is delivered to the lateral opening or port of the longitudinal passage *f*, to be conducted to the next connecting-pipe G or H or the egress E.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

The combination, with valve-casings *a b c*, of the connecting-pipes G and H, leading from the bottom of one valve-casing to the body or central part of the next, and from the bottom of the second to the body or center of the third, and the valves A B C, formed with transverse or knuckle and longitudinal passages *d f*, the latter being arranged to communicate at their upper and lower ends with the upper and lower ends, respectively, of the connecting-pipes G and H, all substantially as shown and described.

CHARLES G. CONN.

Witnesses:
HENRY C. DODGE,
O. H. MAIN.

FIGURE B-2
PATENT FOR MODIFIED PÈRINET PISTON VALVES

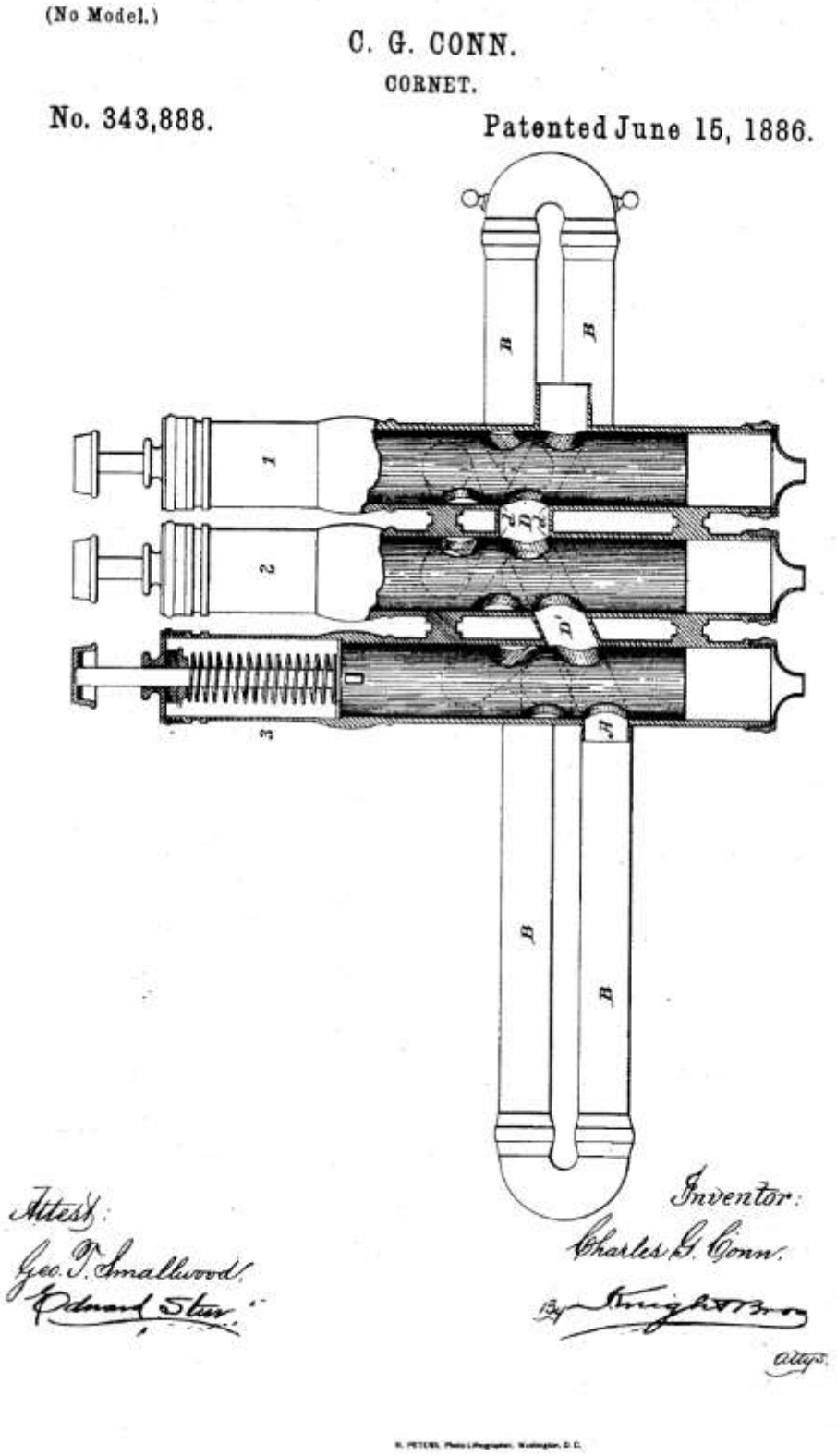


FIGURE B-2, CONTINUED

UNITED STATES PATENT OFFICE.

CHARLES G. CONN, OF ELKHART, INDIANA.

CORNET.

SPECIFICATION forming part of Letters Patent No. 343,888, dated June 15, 1886.

Application filed August 28, 1885. Serial No. 175,569. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. CONN, a citizen of the United States, residing at Elkhart, in the county of Elkhart and State of Indiana, have invented certain new and useful Improvements in Cornets and other Piston-Valve Musical Instruments, of which the following is a specification.

My improvements have in view the increasing of the directness of passage of air from one valve to another of a cornet or other piston-valve musical instrument. With this end in view I employ, in combination with a curved connecting-pipe between the first and second valve-cylinders, a straight diagonal pipe connecting the second and third valve-cylinders, starting on about the level of the first connecting-pipe and ending on about the level of the air-pipe.

In order that my invention may be more fully understood, I will proceed to describe it with reference to the accompanying drawing, which represents in section longitudinal of the valve-cylinders a portion of a cornet embodying my improvement.

The cornet is constructed with customary air-pipe, A, valve-bends B, and valve-cylinders 1 2 3. Connecting the valve-cylinders are pipes D D′, the first curved, as shown, to present at *d d* obtuse angles, so as to interrupt as little as possible the passage of the air, while the second, D′, is made straight and arranged diagonally between the cylinders 2 3 from opposite the valve-opening to pipe D to opposite the valve-opening to pipe A. These openings being arranged diagonally, the connecting-pipe D forms a direct continuation thereof, and thus offers no angles resisting the passage of the air.

It will be observed that the position of the connections D D′ may be reversed from that here shown, the diagonal connections D′ being arranged between the first and second valve-cylinders, and the curved connection D between the second and third valve-cylinders, without materially injuring the effectiveness of the connections as means of preventing the breaking up of the air passing therethrough. It will be seen that two of the valve-apertures are made in one direction with an upward inclination, and the third valve is made in the same direction with a downward inclination. This permits me to shorten the valve-piston one-half the width of the aperture, or nearly half an inch.

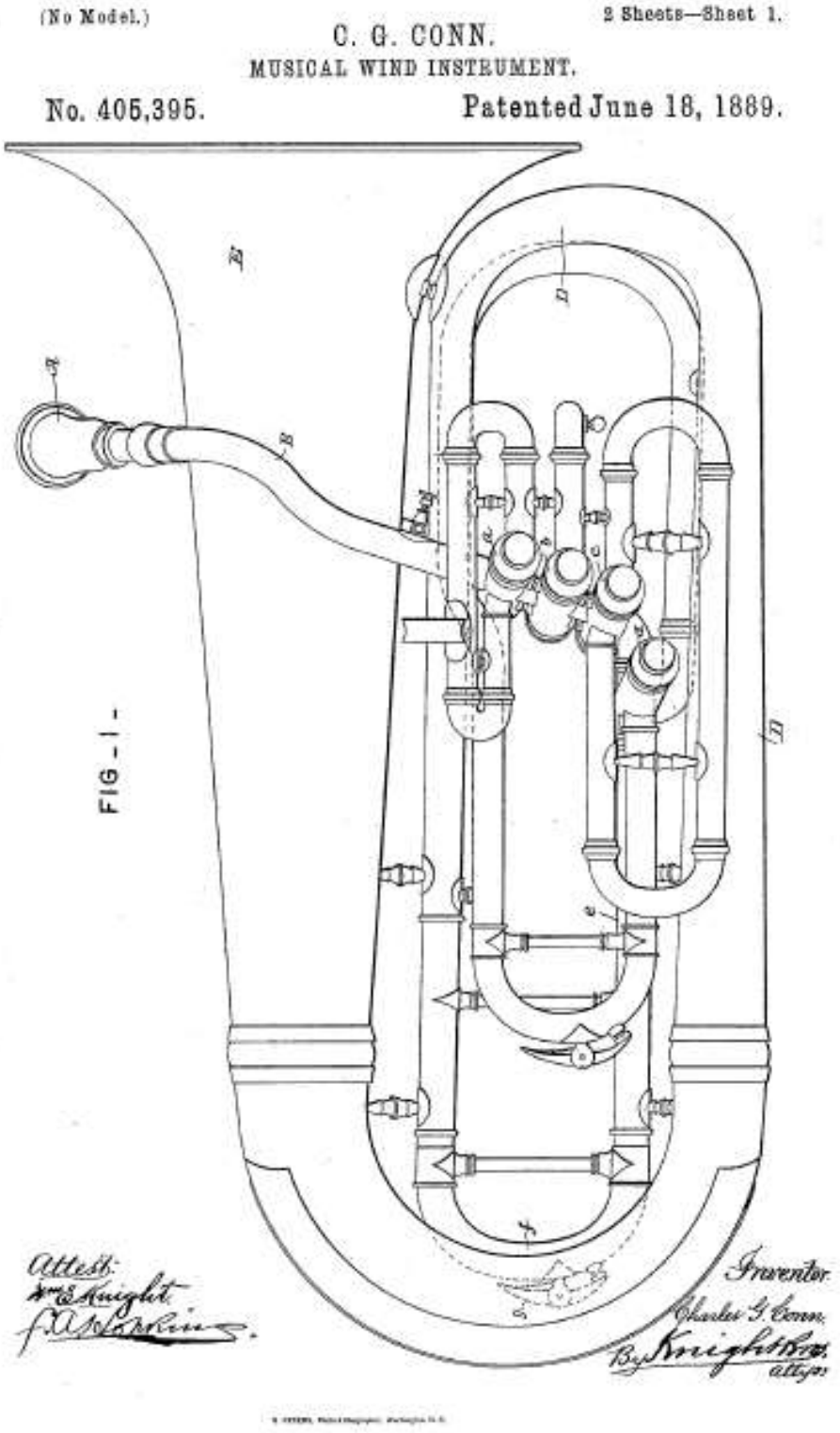
Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

In a cornet or other piston-valve musical instrument, in combination with a curved connecting-pipe between the first and second valve-cylinders, a diagonal connecting-pipe between the second and third valve-cylinders, both connecting-pipes lying in the plane of said cylinders and arranged substantially as and for the purpose set forth.

CHARLES G. CONN.

Witnesses:
E. C. BICKEL,
C. W. FISH.

FIGURE B-3:
PATENT FOR AMERICAN MODEL BAND INSTRUMENTS – FRONT-ACTION



(No Model.) 2 Sheets—Sheet 1.

C. G. CONN.

MUSICAL WIND INSTRUMENT.

No. 405,395. Patented June 18, 1889.

FIG - 1 -

Attest:
W. E. Knight
F. A. Lockwood

Inventor
Charles G. Conn
By Knight Bros.
Attys.

FIGURE B-3, CONTINUED

(No Model.) 2 Sheets—Sheet 2.

C. G. CONN.

MUSICAL WIND INSTRUMENT.

No. 405,395. Patented June 18, 1889.

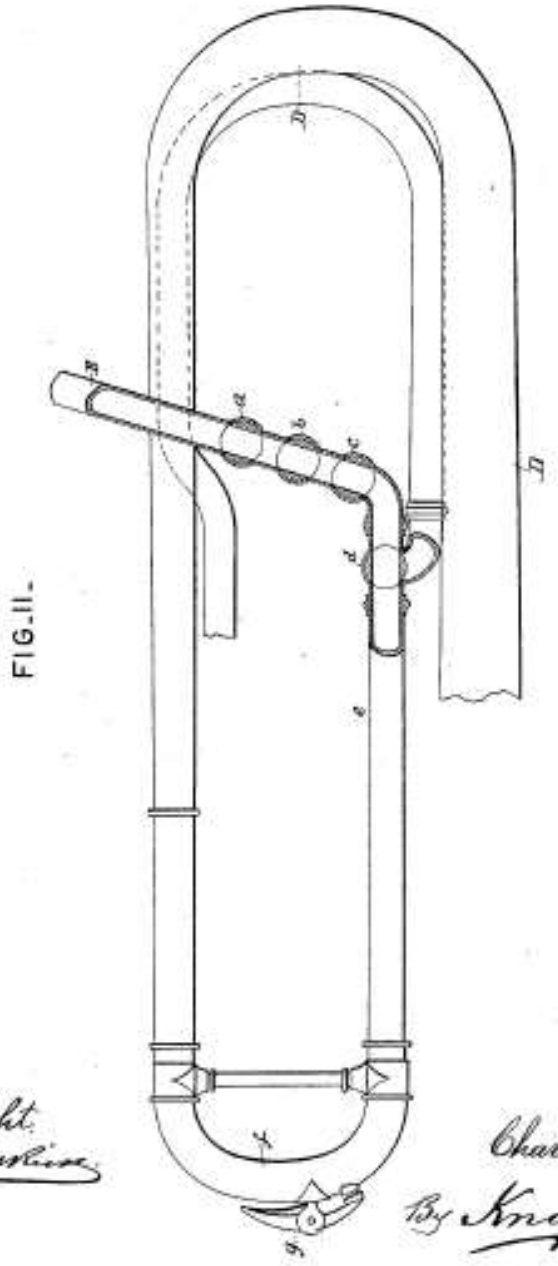


FIG. II.

Attest:
Wm. A. Knight.
F. A. Hopkins.

Inventor:
Charles G. Conn
By Knight Bros.
attys.

FIGURE B-3, CONTINUED

UNITED STATES PATENT OFFICE.

CHARLES G. CONN, OF ELKHART, INDIANA.

MUSICAL WIND-INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 405,395, dated June 18, 1889.

Application filed November 30, 1888. Serial No. 292,218. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. CONN, a citizen of the United States, residing at Elkhart, in the county of Elkhart and State of Indiana, have invented certain new and useful Improvements in Musical Wind-Instruments; and I do hereby declare that the following, taken in connection with the drawings which accompany and form a part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

Heretofore in piston-valve instruments the valves have been arranged parallel with the length of the piece and usually vertical with the body of the instrument. To obviate the many difficulties of piston-valves placed in this position I have invented a new style.

My invention, which is mainly applicable to large instruments intended to be carried in front and across the body of the musician, relates to two improvements—first, a new and more convenient disposition and arrangement of the piston-valves and keys, which inclines the bell of the instrument to the left, leaving the view unobstructed for reading music or marching, and, second, the forming of a direct and nearly vertical passage from the mouth-piece to the water-key in the tuning-slide, to facilitate the easy passage and removal of water. The first of these objects is accomplished by arranging the piston-valves in planes nearly perpendicular to the other tubes and diagonally across the piece, and the second by having the ports of all the valve-pistons opening upward, reference being had to the instrument in the position it assumes while being played.

In order that the invention may be fully understood, I will proceed to describe the same with reference to the accompanying drawings, in which—

Figure I represents a front view of an instrument, with my improvements attached, in the position it assumes while being played. Fig. II represents a detached portion of the piece, broken away in part, showing the direct passage from the mouth-piece to the water-key.

Like letters of reference in both the figures indicate the same parts.

a, *b*, *c*, and *d* are valve-cases arranged in planes nearly perpendicular to the other tubes and diagonally across the piece.

e is a tube leading from valve-case *d* to tuning-slide *f*, in which is a water-key *g*.

A is the mouth-piece, and B the tube leading from A to the first valve-case *a*.

D is the tube extending from the tuning-slide *f* to the bell E. Referring to Fig. 2, it will be seen that the passage from the mouth-piece A to the tuning-slide *f* is very nearly vertical and very direct.

By the use of this new system I am enabled to make a shorter and lighter piston, because the tuning-slide is placed so low in the tubing of the instrument, instead of having it in the tubing before the valves are reached. Consequently the valves are smaller in diameter and the instrument more regularly conic, as it should be.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A musical wind-instrument having valves placed diagonally across the piece, for the purpose set forth.

2. A musical wind-instrument having a direct air-passage from the mouth-piece through the diagonally-arranged valves to the water-key in the tuning-slide, as and for the purpose set forth.

3. The combination of a musical wind-instrument having valves placed diagonally across the piece with a direct air-passage through said valves from the mouth-piece to the water-key in the tuning-slide, substantially as set forth.

CHARLES G. CONN.

Witnesses:
E. C. BICKEL,
C. W. FISH.

FIGURE B-4
PATENT FOR WONDER MODEL BAND INSTRUMENTS – TOP-ACTION

(No Model.) 2 Sheets—Sheet 1.

C. G. CONN.

MUSICAL WIND INSTRUMENT.

No. 436,696. Patented Sept. 16, 1890.

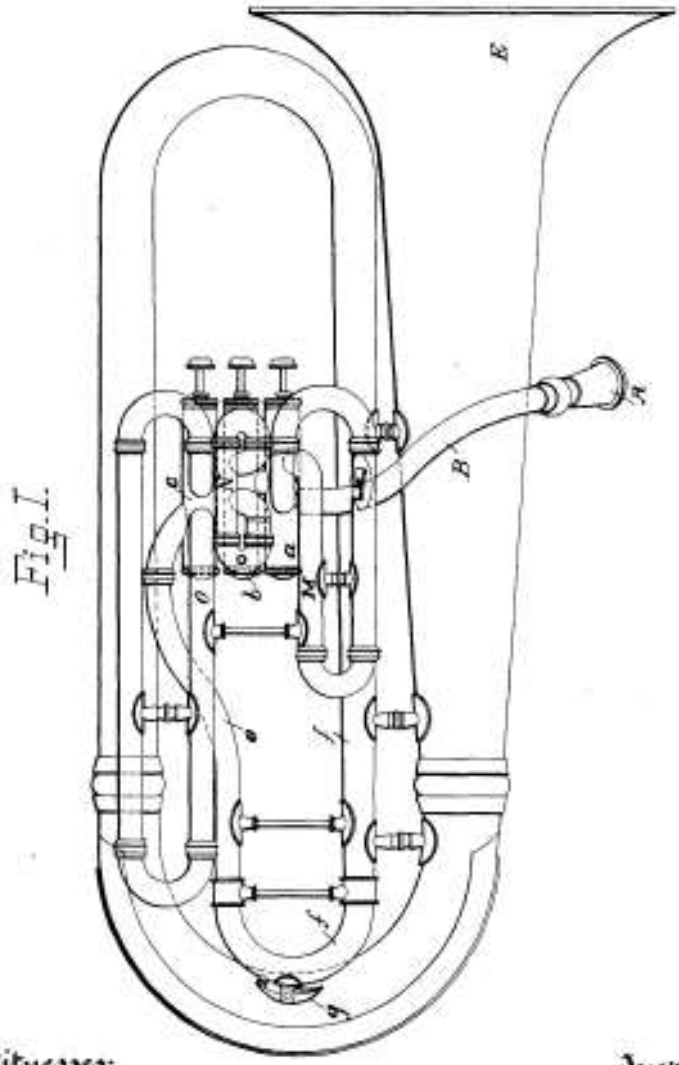


Fig. 1.

Witnesses:
John J. Lepper.
William C. Knight.

Inventor:
Chas. G. Conn.

By Attorneys:
Knight Bros.

FIGURE B-4, CONTINUED

(No Model.) 2 Sheets—Sheet 2.

C. G. CONN.

MUSICAL WIND INSTRUMENT.

No. 436,696. Patented Sept. 16, 1890.

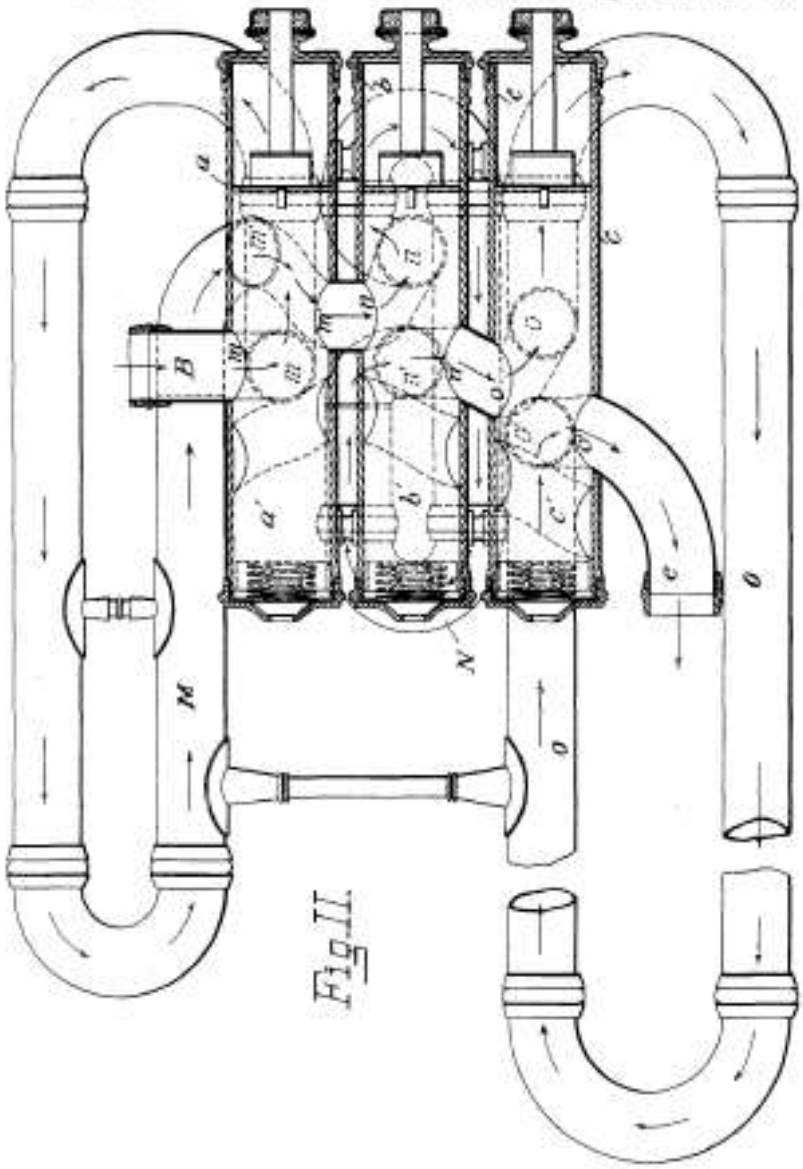


Fig II

Witnesses:
John G. Lefferd
William E. Knight

Inventor:
Chas. G. Conn.
By Attorneys
Knight Bros

FIGURE B-4, CONTINUED

UNITED STATES PATENT OFFICE.

CHARLES G. CONN, OF ELKHART, INDIANA.

MUSICAL WIND-INSTRUMENT.

SPECIFICATION forming part of Letters Patent No. 436,696, dated September 16, 1890.

Application filed February 6, 1890. Serial No. 339,449. (No model.)

To all whom it may concern:

Be it known that I, CHARLES G. CONN, a citizen of the United States, residing at Elkhart, in the county of Elkhart and State of Indiana, have invented certain new and useful Improvements in Musical Wind-Instruments; and I do hereby declare that the following, taken in connection with the drawings which accompany and form a part of the specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

In Letters Patent of the United States No. 405,395, granted to me June 18, 1889, for improvements in musical wind-instruments, I have shown and described an instrument having a direct air-passage from the mouth-piece through the valves to the water-key in the tuning-slide, whereby the greater part of the water accumulating in the instrument is led directly to said water-key. This arrangement has produced very satisfactory results, but does not obviate one of the greatest objections performers make to the use of the instrument—that is, the accumulation of water in the valve-slides.

The object of my present invention, which is an improvement on my patent above referred to, is to remedy this great defect in wind-instruments of the larger class by excluding all the water from the valve-slides, which will thereby more effectively accumulate in the tuning-slide. To accomplish this result I so construct the valve-slides that when the valves are depressed the air is made to enter said slides in an upward direction, so that it is impossible for any water which may be in the valves to run into the slides.

I have represented my improvement applied to the common form of piston-valve instrument, in which the valves are arranged parallel with the length of the piece; but the improvement can be applied to other forms of instruments equally as well—such, for example, as illustrated in my patent above referred to.

In order that my invention may be fully understood, I will describe the same more particularly, with reference to the accompanying drawings, in which—

Figure I represents a front view of an instrument embodying my improvement. Fig. II represents a detached portion of the piece, part being in section, showing the passage through the valve-slides when the valves are depressed.

Like letters of reference indicate the same parts in both figures.

a b c are the valve-cases, having the ordinary valve-pistons *a' b' c'* working in them to throw the valve-slides into and out of play.

A is the mouth-piece, and B the tube leading from A to the first valve-case *a*.

f is the tuning-slide, having situated at its lowest point the customary water-key *g*, and *e* is the tube leading from valve-case *c* to the tuning-slide.

Thus far the instrument is the same as described in my former patent, there being (when the valves are in their normal or outer position) a direct air-passage from the mouth-piece through the valves to the tuning-slide.

Referring now to Fig. II of the drawings, which relates more particularly to the present improvement, M, N, and O are the valve-slides attached, respectively, to the valve-cases *a*, *b*, and *c*. When the valve-pistons are depressed, air enters the valve-slides M, N, and O through inlet-ports *m*, *n*, and *o*, respectively, and passes out of said slides through exit-ports *m'*, *n'*, and *o'*, respectively. In each case the valve-slide is formed with an upward crook or turn at its inlet end, so as to avoid the possibility of water passing from the valves to the valve-slides.

The direction of the air through the valve-slides when the valves are depressed is indicated by arrows in Fig. II.

Instruments formed according to my improvement have a better wind-passage and shorter valve-action than ordinarily, for the reason that the tuning-slide is placed in the body or main tube of the instrument, thereby affording the opportunity of using a smaller bore through the valves, and consequently a shorter action.

Having thus fully described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. A musical wind-instrument having an upwardly-extending connection between the valve and valve-slide, as herein set forth.

2. A musical wind-instrument having the valve-slides so arranged relatively to the

FIGURE B-4, CONTINUED

valves that the air passing from the valves to the valve-slides is made to flow in an upward direction, whereby water is excluded from the valve-slides, as herein set forth.

3. The combination of a musical wind-instrument having a direct air-passage from the mouth-piece to the water-key in the tuning-slide with valve-slides having upwardly-extending entry-connections between the valves and valve-slides, whereby all water is excluded from the valve-slides and led directly to the water-key in the tuning-slide, as herein set forth.

CHARLES G. CONN.

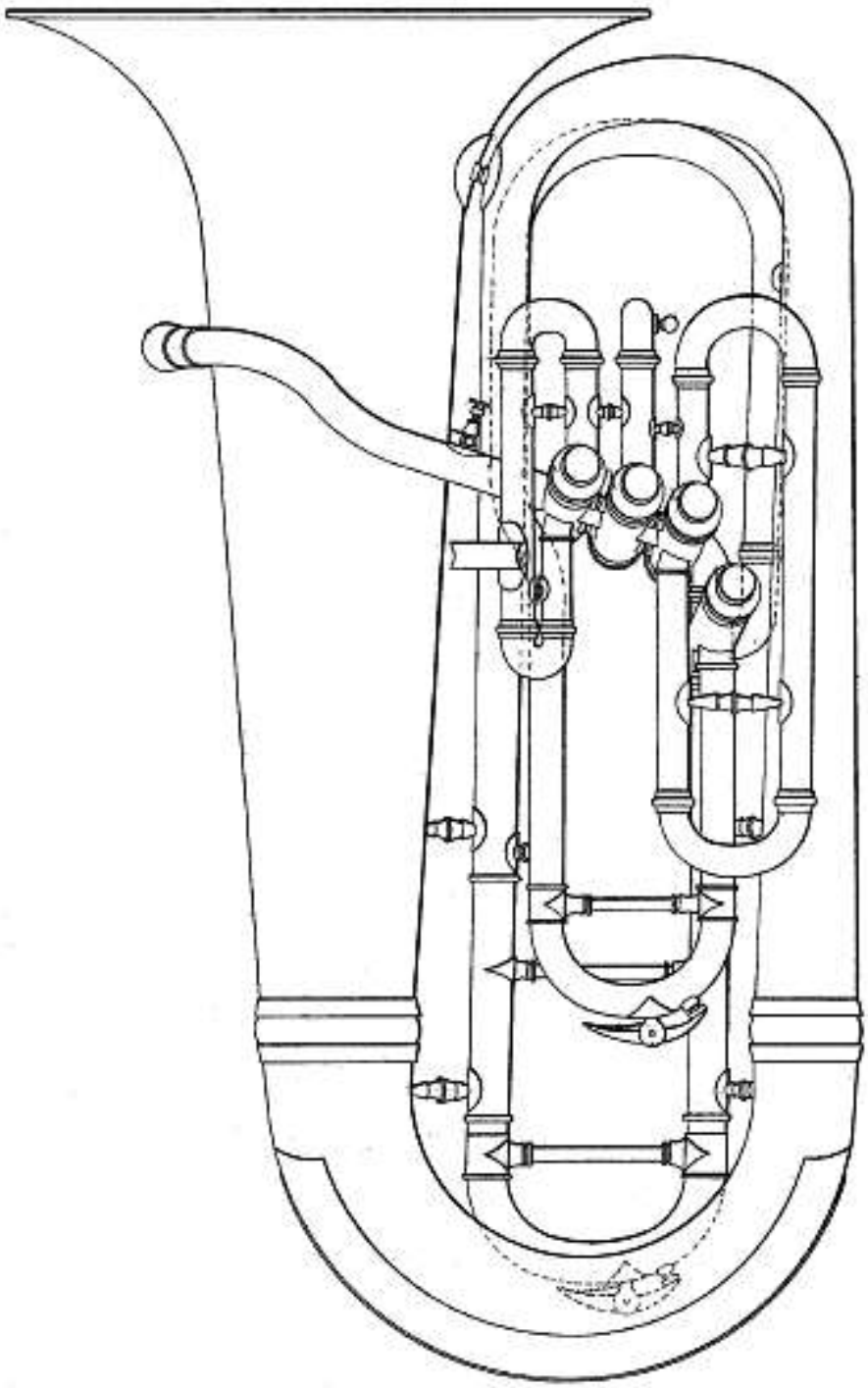
Witnesses:
GEO. T. BARNEY,
ROYAL MORRIS.

APPENDIX C

DIAGRAMS OF MEASUREMENT POINTS ON FRONT-ACTION TUBAS

FIGURE C-1

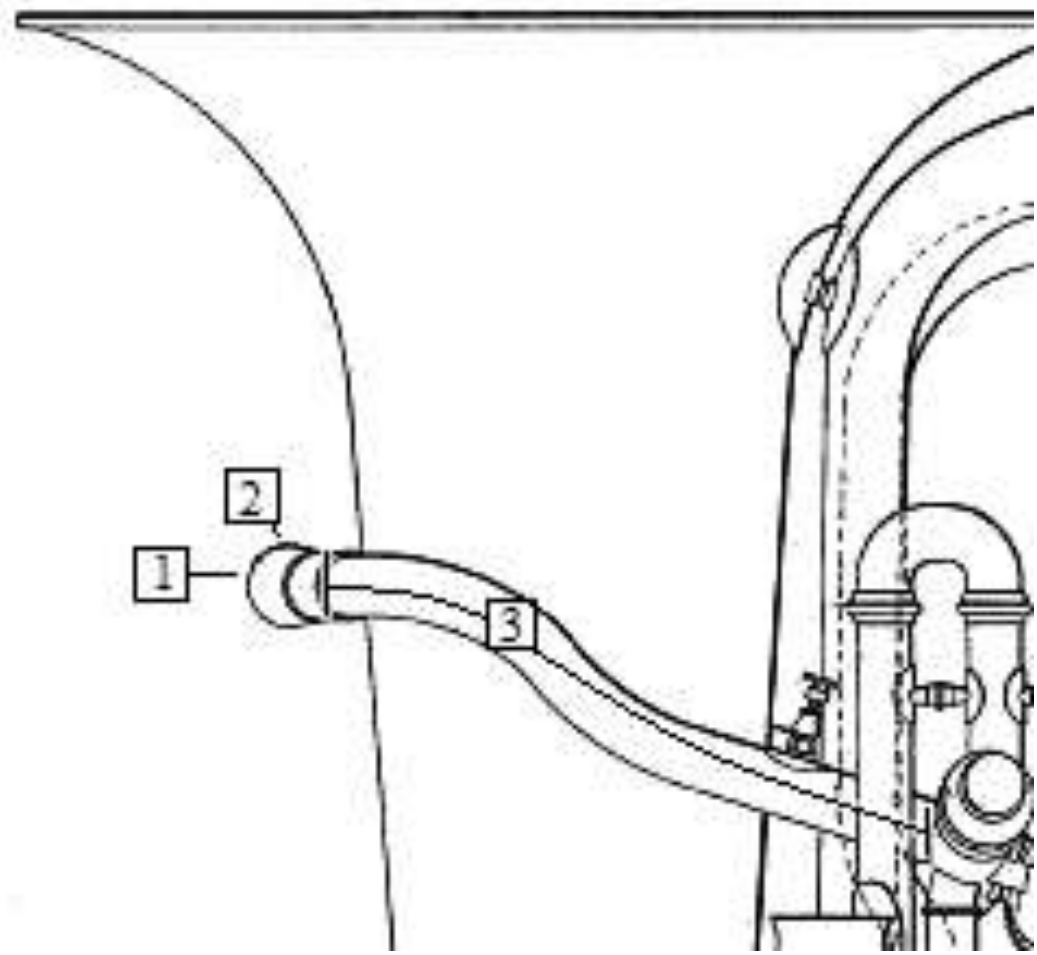
FRONT-ACTION/CONN AMERICAN MODEL



Figures C-2 through C-9 (with the exception of Figure A-3) will be drawn from this reference image.

FIGURE C-2

FRONT-ACTION MEASUREMENT POINTS 1 – 3



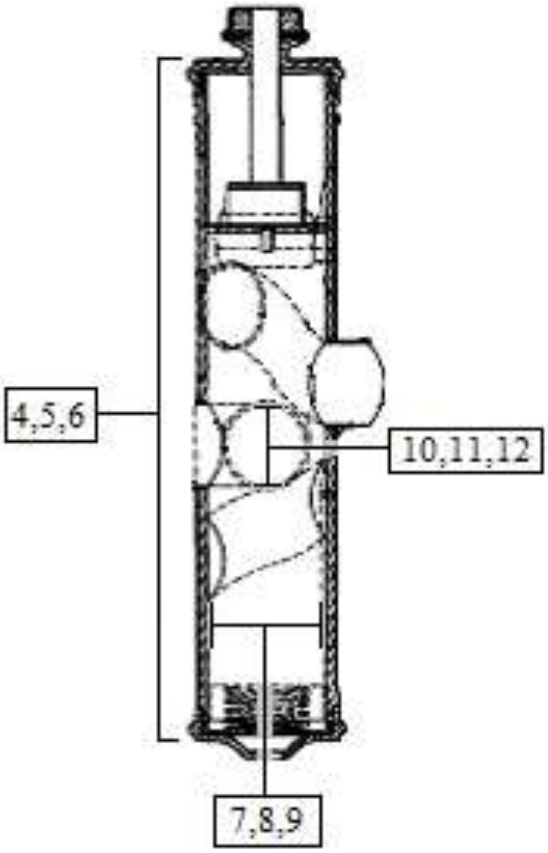
1. Diameter of interior of mouthpiece receiver

2. Diameter of exterior of mouthpiece receiver

3. Length of lead-pipe from termination of receiver to either valve entry or primary tuning slide

FIGURE C-3

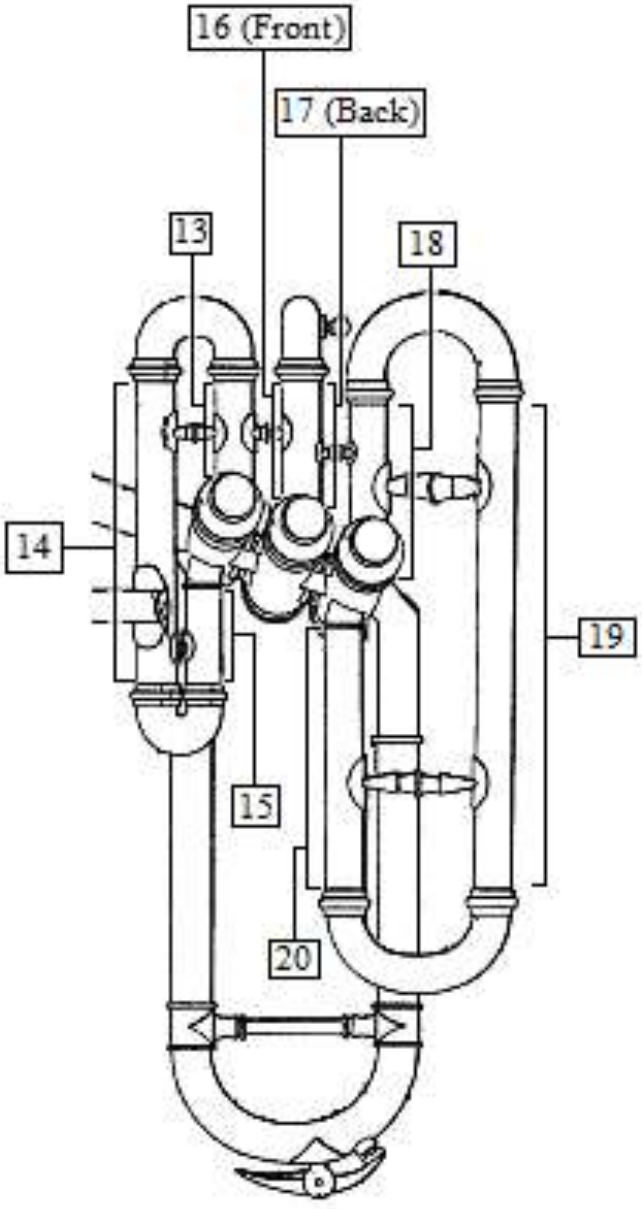
FRONT-ACTION MEASUREMENT POINTS 4 – 12



4. Length of 1st valve casing
5. Length of 2nd valve casing
6. Length of 3rd valve casing
7. Diameter of 1st valve piston
8. Diameter of 2nd valve piston
9. Diameter of 3rd valve piston
10. Diameter of 1st valve port
11. Diameter of 2nd valve port
12. Diameter of 3rd valve port

FIGURE C-4

FRONT-ACTION MEASUREMENT POINTS 13 – 20



13. Length of 1st section of 1st valve tubing

14. Length of 2nd section of 1st valve tubing

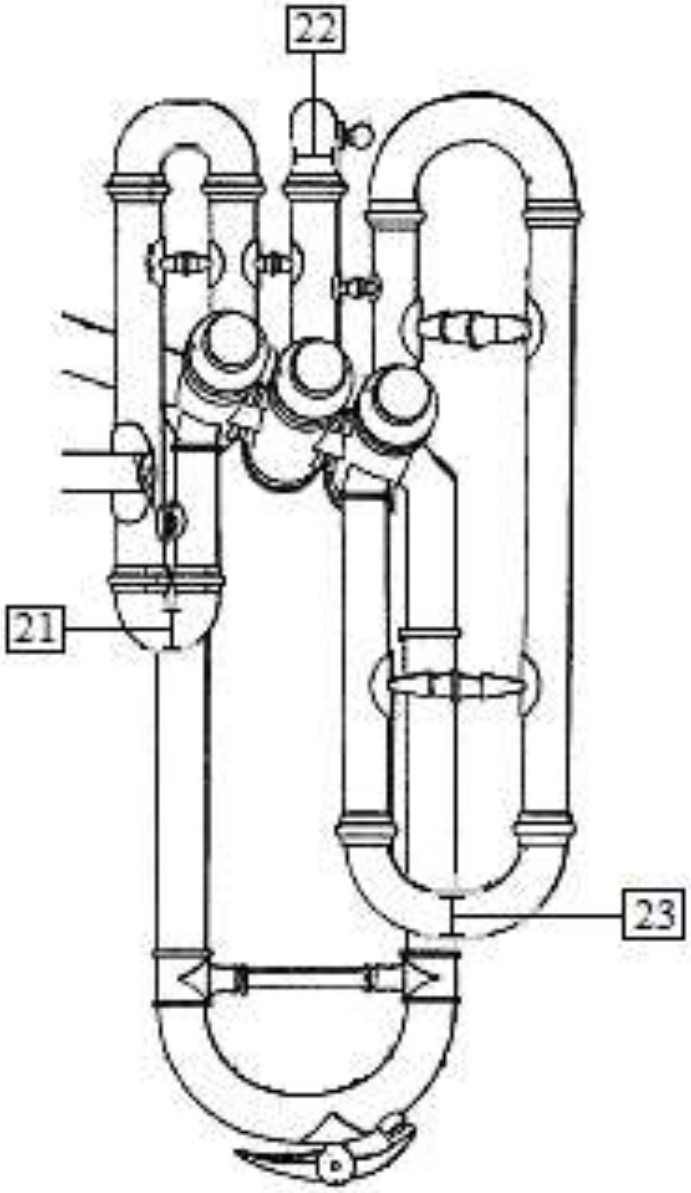
15. Length of 3rd section of 1st valve tubing

16. Length of 1st section of 2nd valve tubing

17. Length of 2nd section of 2nd valve tubing (located behind the 1st section in this image)
18. Length of 1st section of 3rd valve tubing
19. Length of 2nd section of 3rd valve tubing
20. Length of 3rd section of 3rd valve tubing

FIGURE C-5

FRONT-ACTION MEASUREMENT POINTS 21 – 23



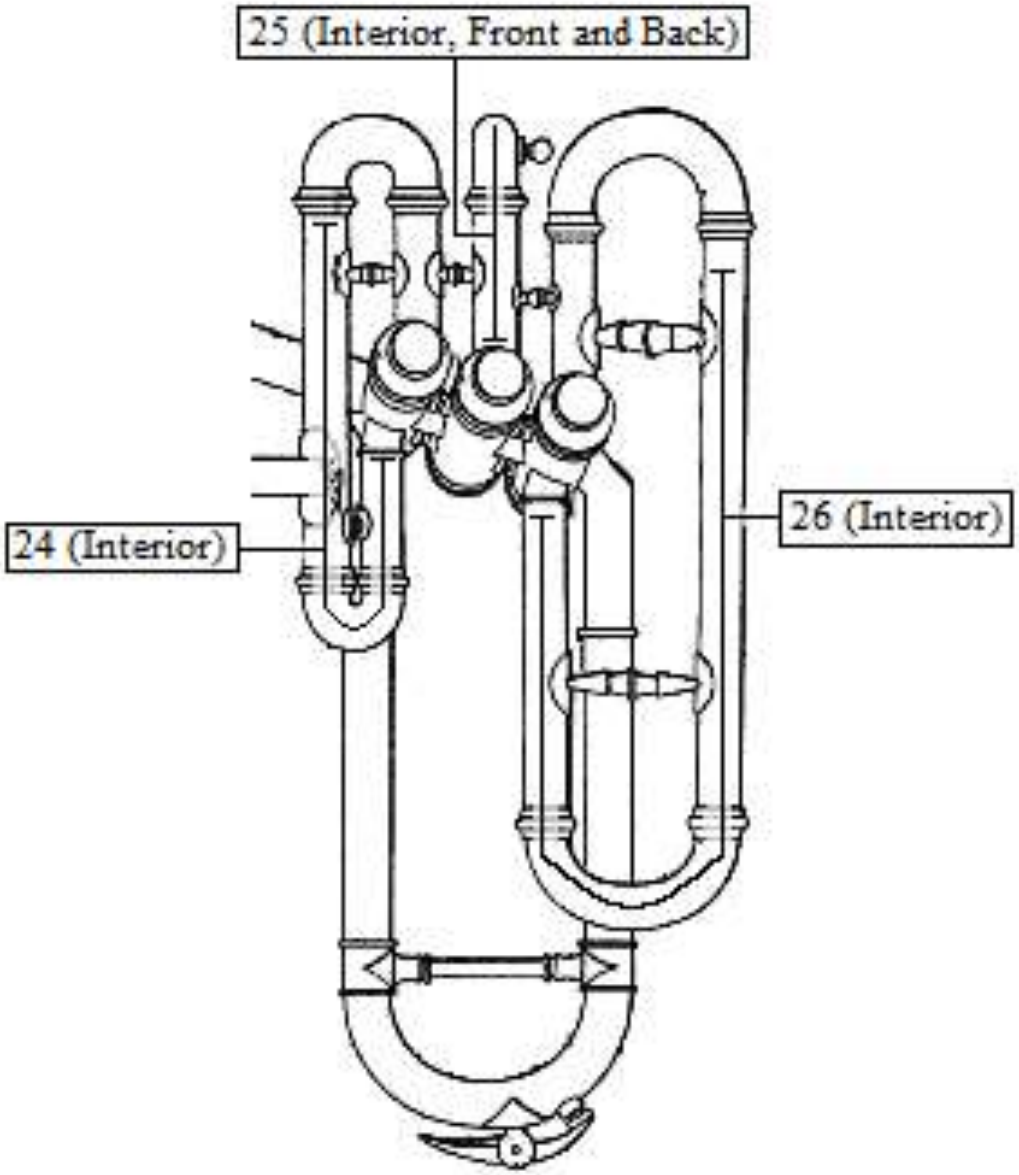
21. External diameter of 1st valve tuning slide between ferrules

22. External diameter of 2nd valve tuning slide between ferrules

23. External diameter of 3rd valve tuning slide between ferrules

FIGURE C-6

FRONT-ACTION MEASUREMENT POINTS 24 – 26



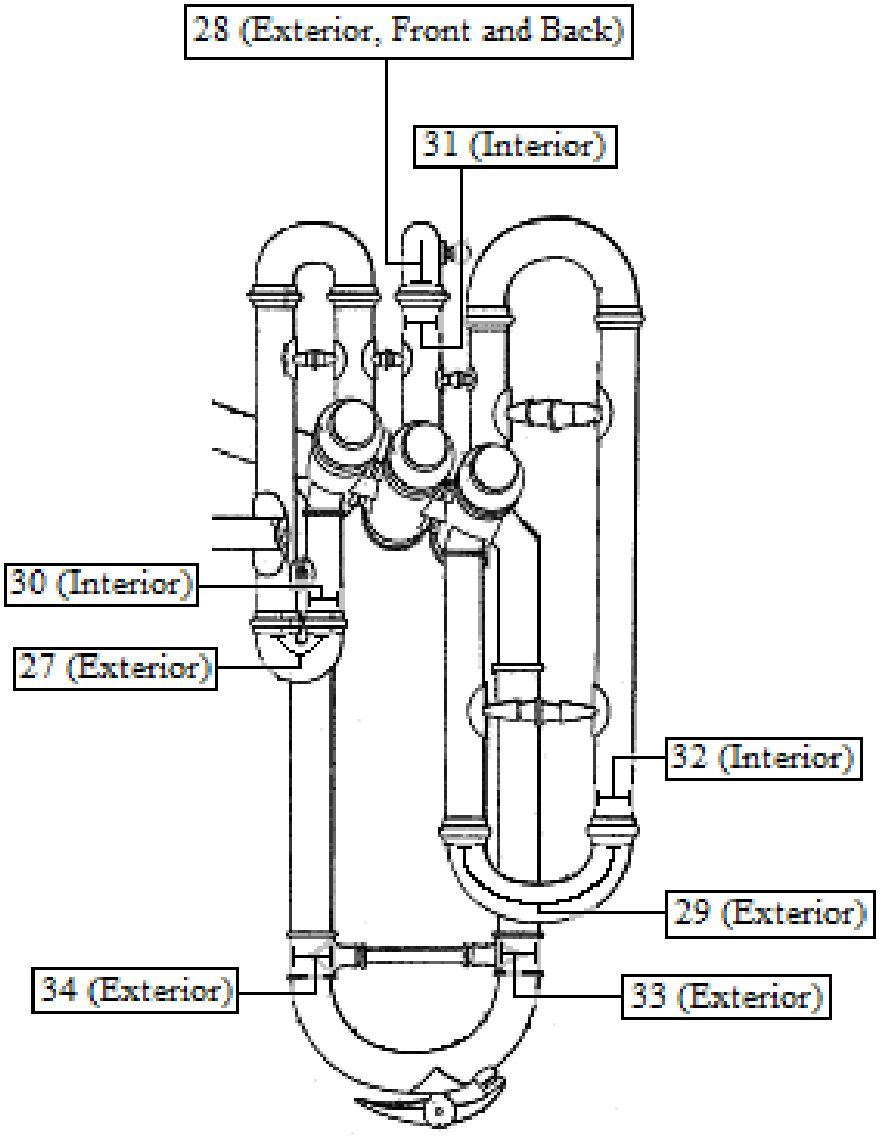
24. Length of the 1st valve tuning slide, taken along the innermost curve

25. Length of the 2nd valve tuning slide, taken along the innermost curve

26. Length of the 3rd valve tuning slide, taken along the innermost curve

FIGURE C-7

FRONT-ACTION MEASUREMENT POINTS 27 – 34



27. Length of 1st valve tuning slide, from ferrule to ferrule

28. Length of 2nd valve tuning slide, from ferrule to ferrule

29. Length of 3rd valve tuning slide, from ferrule to ferrule

30. Internal diameter of 1st valve tuning slide casing bore

31. Internal diameter of 2nd valve tuning slide casing bore

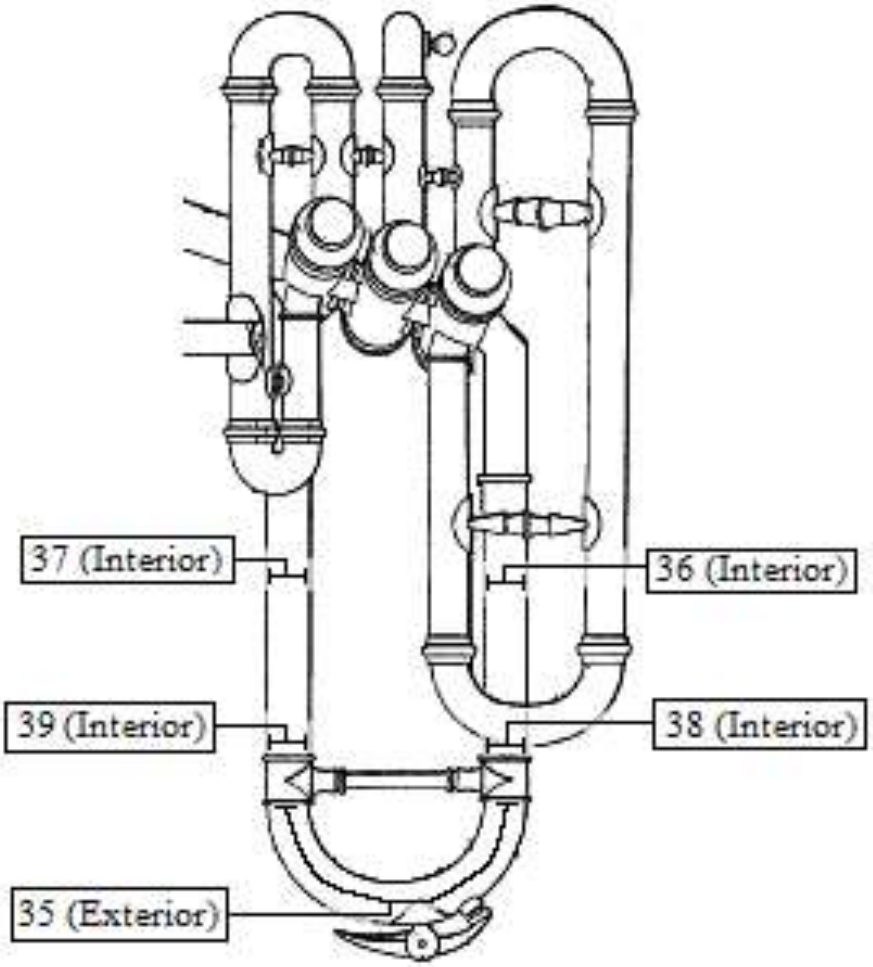
32. Internal diameter of 3rd valve tuning slide casing bore

33. Exteral diameter of the 1st ferrule of the primary tuning slide

34. External diameter of the 2nd ferrule of the primary tuning slide

FIGURE C-8

FRONT-ACTION MEASUREMENT POINTS 35-39



35. Length of primary tuning slide from ferrule to ferrule

36. Interior diameter of 1st section of primary tuning slide

37. Interior diameter of 2nd section of primary tuning slide

38. Interior diameter of 1st section of primary tuning slide casing bore

39. Interior diameter of 2nd section of primary tuning slide casing bore

FIGURE C-9

FRONT-ACTION MEASUREMENT POINTS 40 – 47

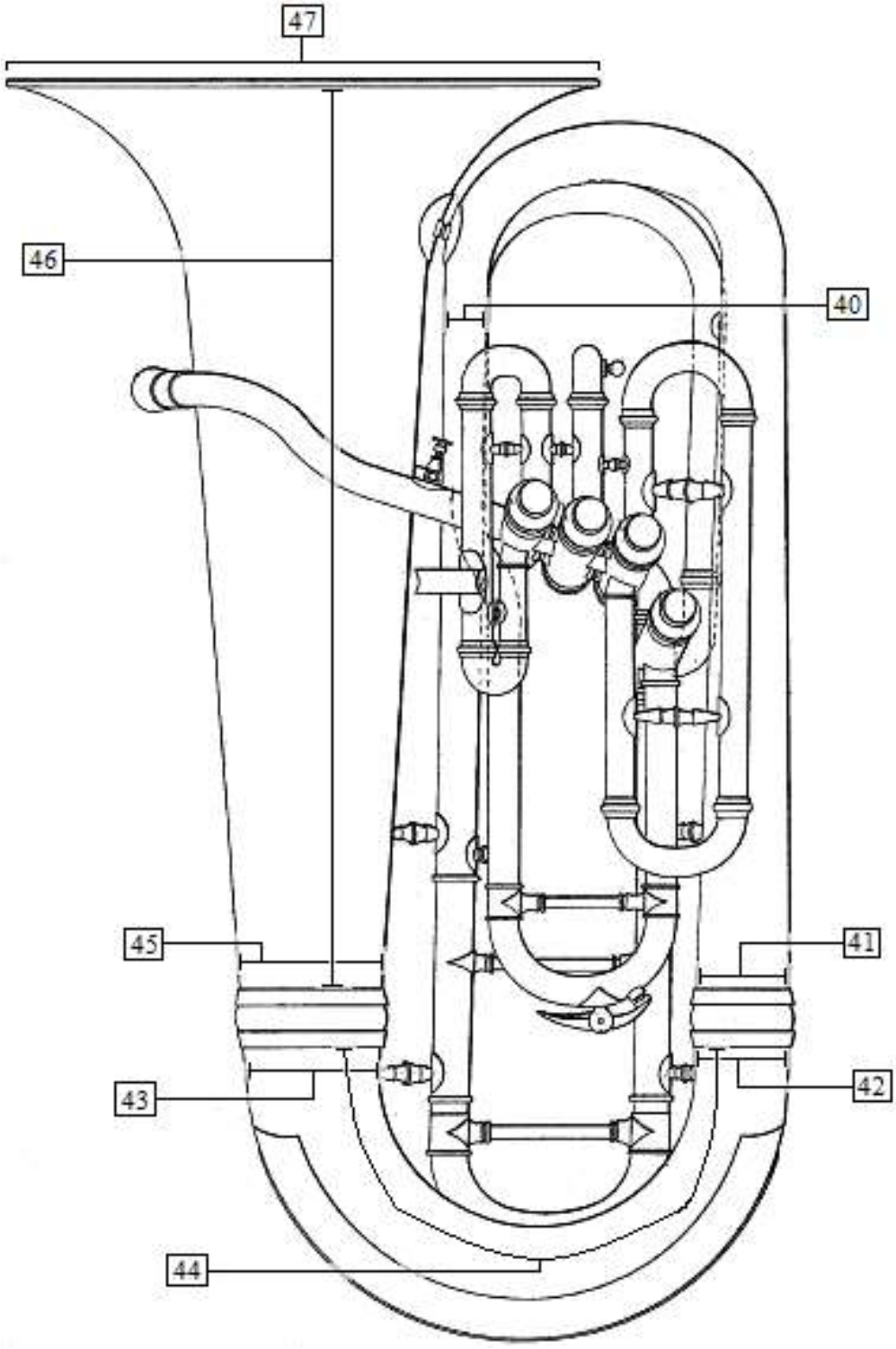


FIGURE C-9, CONTINUED

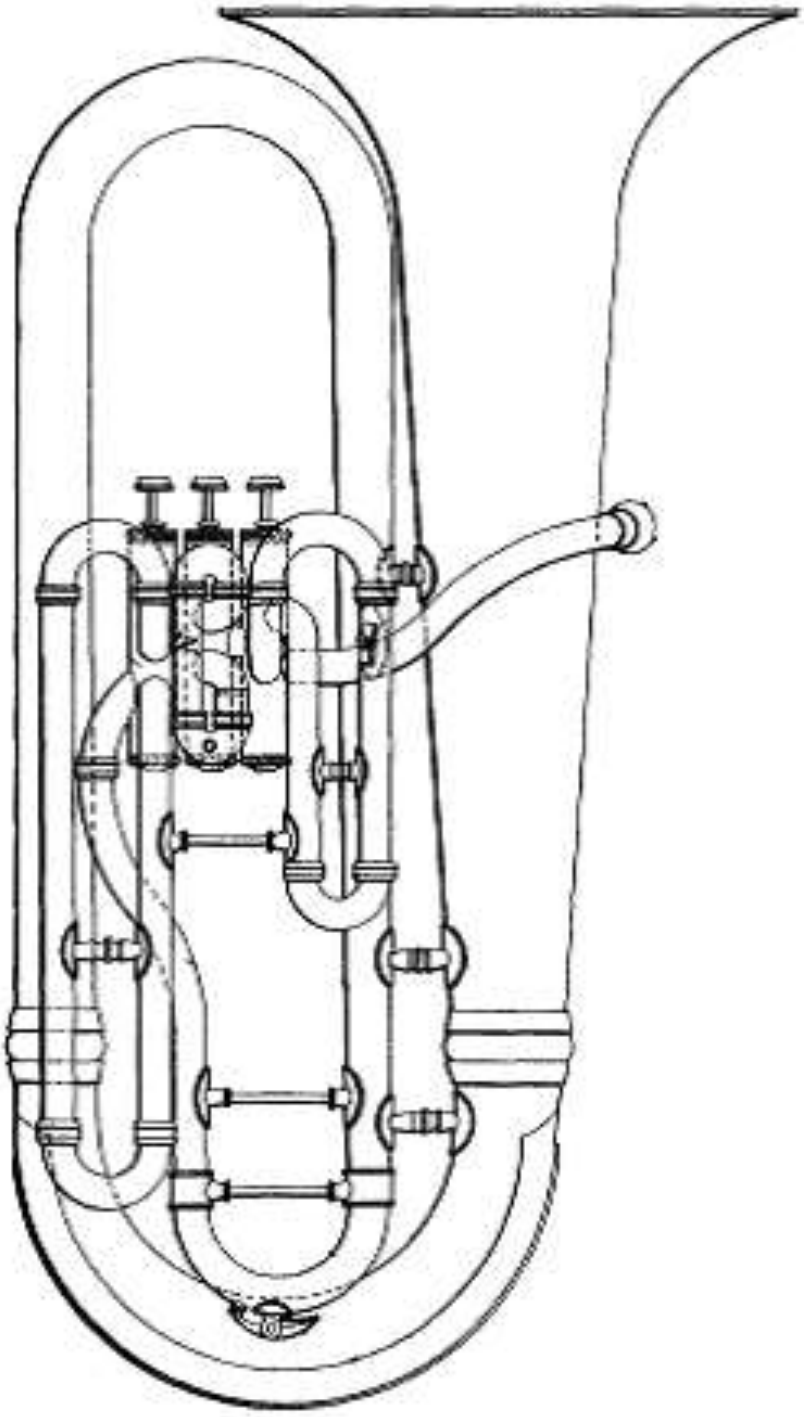
40. Circumference of 1st section of the 2nd bough at ferrule
41. Circumference of 2nd section of the 2nd bough at ferrule
42. Circumference of 1st section of the primary bough at ferrule
43. Circumference of 2nd section of the primary bough at ferrule
44. Length of primary bough taken along bough plate from ferrule to ferrule
45. Cirumference of bell at ferrule
46. Length of bell from ferrule to rim
47. Bell diameter

APPENDIX D

DIAGRAMS OF MEASUREMENT POINTS ON TOP-ACTION TUBAS

FIGURE D-1

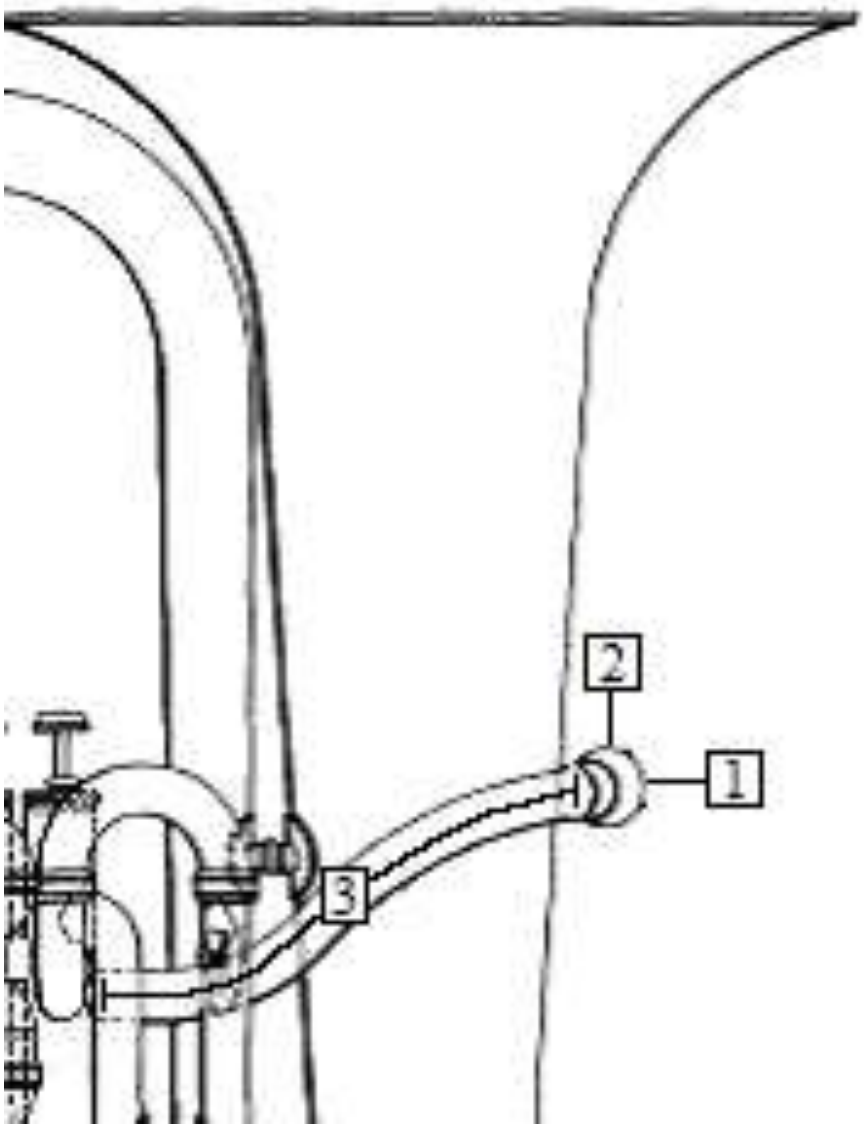
TOP-ACTION/CONN WONDER MODEL



Figures D-2 through D-9 (with the exception of Figure D-3) will be drawn from this reference image.

FIGURE D-2

TOP-ACTION MEASUREMENT POINTS 1 – 3



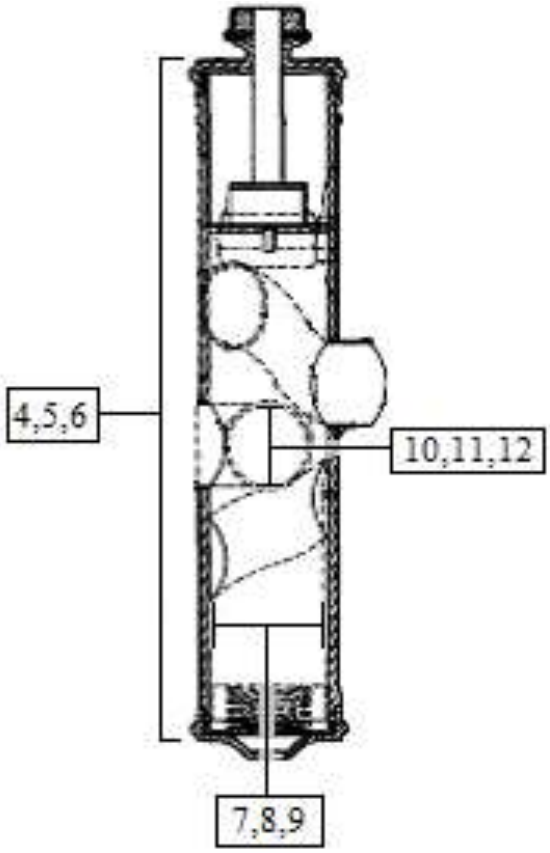
1. Diameter of interior of mouthpiece receiver

2. Diameter of exterior of mouthpiece receiver

3. Length of lead-pipe from termination of receiver to either valve entry or primary tuning slide

FIGURE D-3

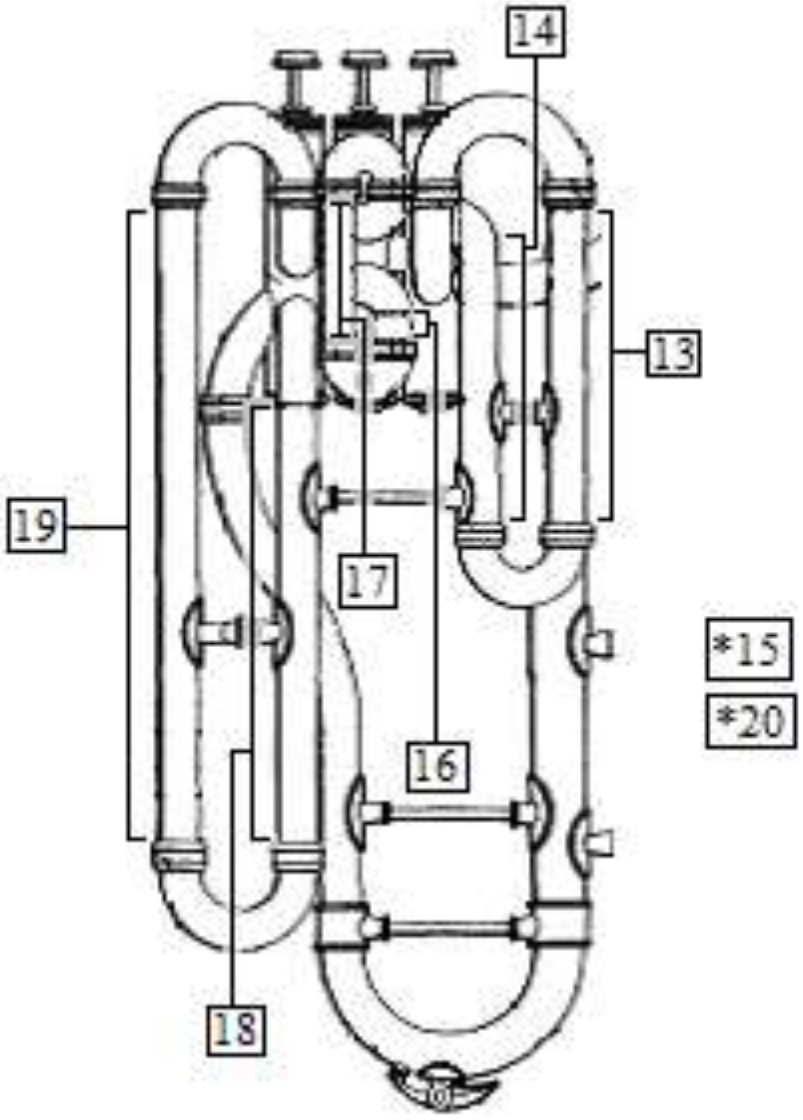
TOP-ACTION MEASUREMENT POINTS 4 – 12



4. Length of 1st valve casing
5. Length of 2nd valve casing
6. Length of 3rd valve casing
7. Diameter of 1st valve piston
8. Diameter of 2nd valve piston
9. Diameter of 3rd valve piston
10. Diameter of 1st valve port
11. Diameter of 2nd valve port
12. Diameter of 3rd valve port

FIGURE D-4

TOP-ACTION MEASUREMENT POINTS 13 – 20



13. Length of 1st section of 1st valve tubing

14. Length of 2nd section of 1st valve tubing

*15. Length of 3rd section of 1st valve tubing is not present on top-action Eb tubas

16. Length of 1st section of 2nd valve tubing

17. Length of 2nd section of 2nd valve tubing (located behind the 1st section in this image)

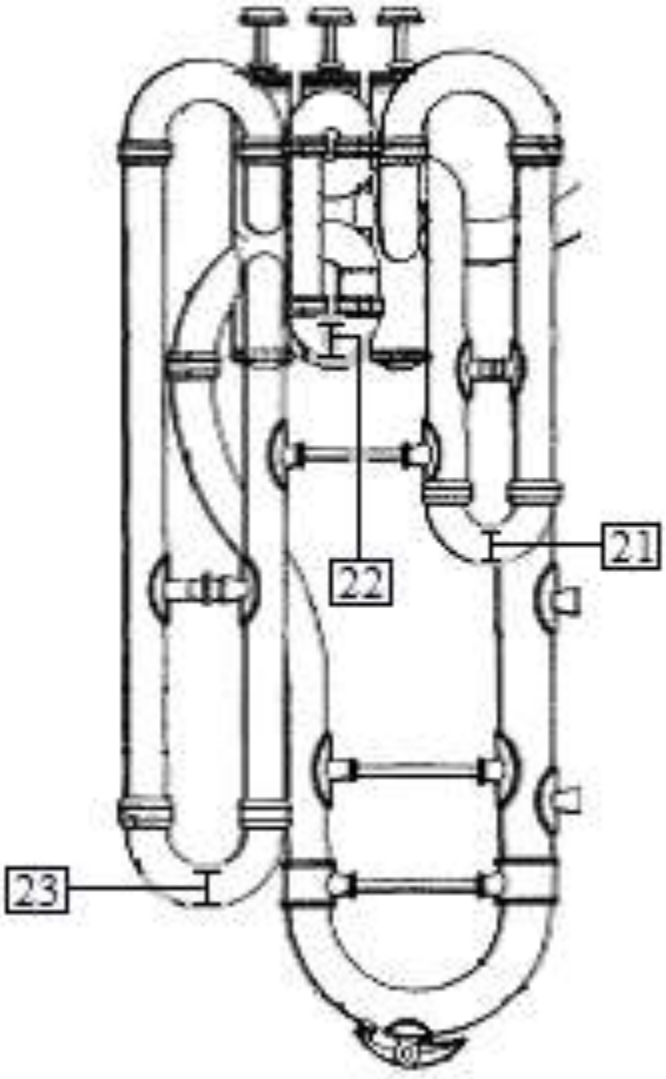
18. Length of 1st section of 3rd valve tubing

19. Length of 2nd section of 3rd valve tubing

*20. Length of 3rd section of 3rd valve tubing is not present on top-action Eb tubas

FIGURE D-5

TOP-ACTION MEASUREMENT POINTS 21 – 23



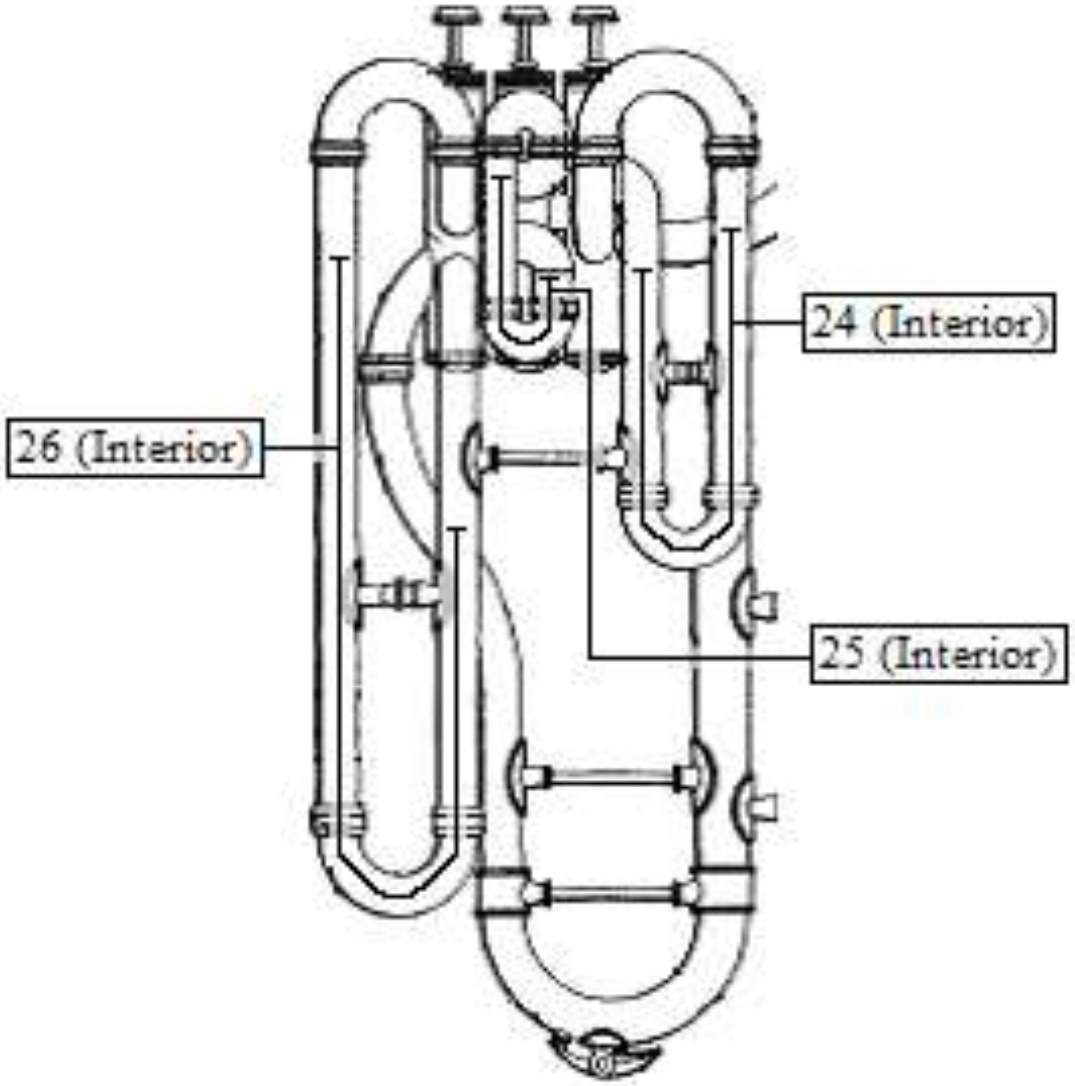
21. External diameter of 1st valve tuning slide between ferrules

22. External diameter of 2nd valve tuning slide between ferrules

23. External diameter of 3rd valve tuning slide between ferrules

FIGURE D-6

TOP-ACTION MEASUREMENT POINTS 24 – 26



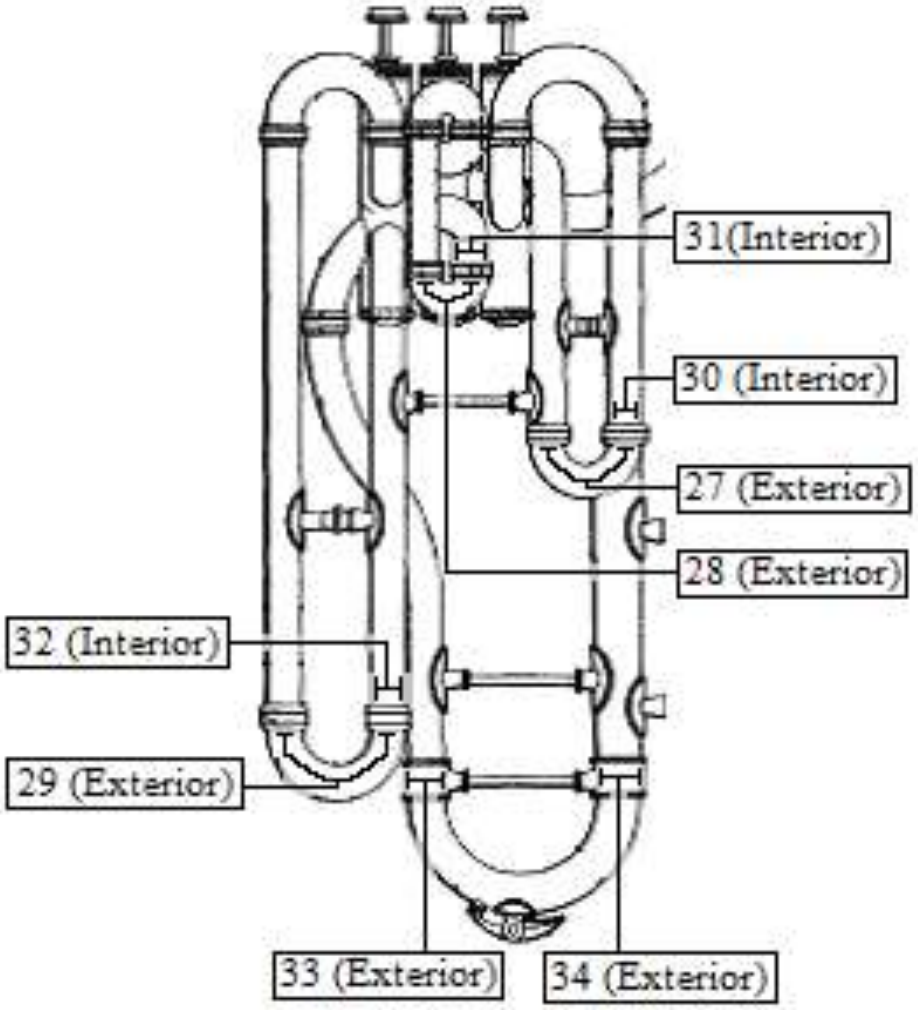
24. Length of the 1st valve tuning slide, taken along the innermost curve

25. Length of the 2nd valve tuning slide, taken along the innermost curve

26. Length of the 3rd valve tuning slide, taken along the innermost curve

FIGURE D-7

TOP-ACTION MEASUREMENT POINTS 27 – 34



27. Length of 1st valve tuning slide, from ferrule to ferrule

28. Length of 2nd valve tuning slide, from ferrule to ferrule

29. Length of 3rd valve tuning slide, from ferrule to ferrule

30. Internal diameter of 1st valve tuning slide casing bore

31. Internal diameter of 2nd valve tuning slide casing bore

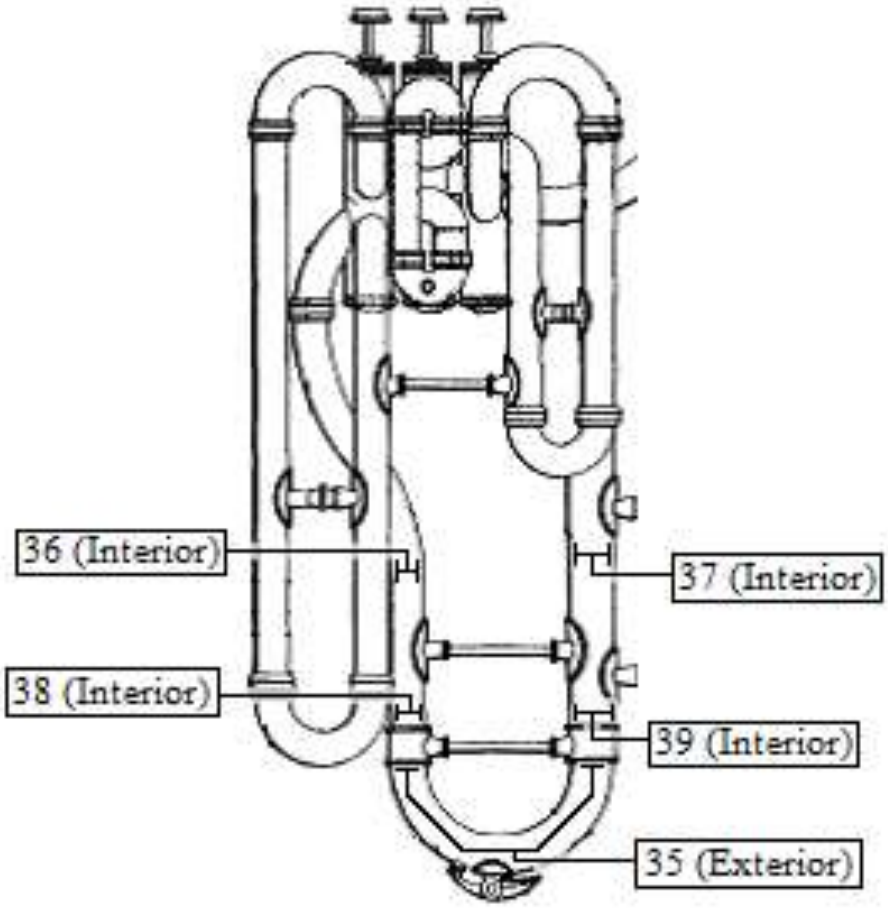
32. Internal diameter of 3rd valve tuning slide casing bore

33. Exteral diameter of the 1st ferrule of the primary tuning slide

34. External diameter of the 2nd ferrule of the primary tuning slide

FIGURE D-8

TOP-ACTION MEASUREMENT POINTS 35-39



35. Length of primary tuning slide from ferrule to ferrule

36. Interior diameter of 1st section of primary tuning slide

37. Interior diameter of 2nd section of primary tuning slide

38. Interior diameter of 1st section of primary tuning slide casing bore

39. Interior diameter of 2nd section of primary tuning slide casing bore

FIGURE D-9

TOP-ACTION MEASUREMENT POINTS 40-47

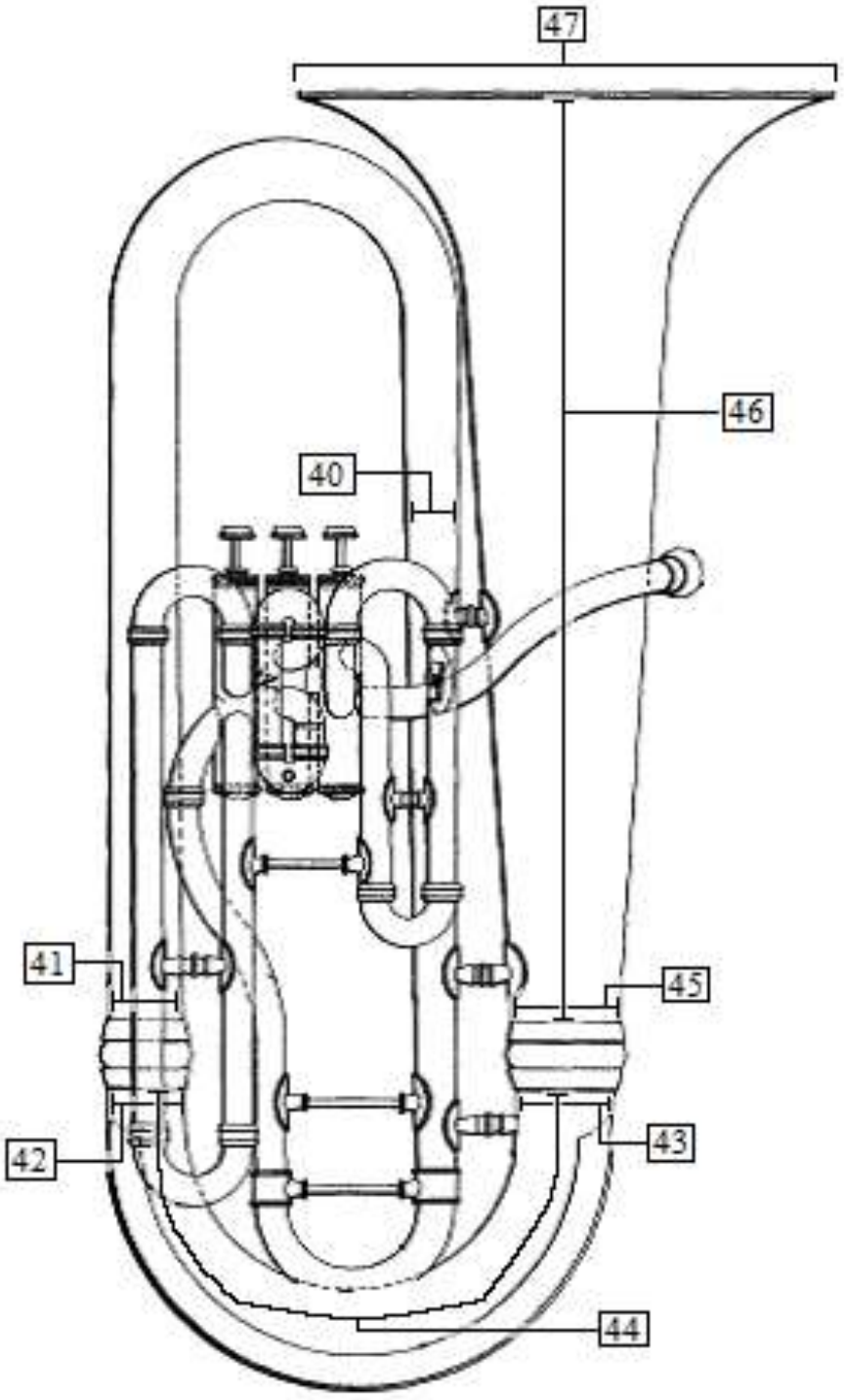


FIGURE D-9, CONTINUED

40. Circumference of 1st section of the 2nd bough at ferrule
41. Circumference of 2nd section of the 2nd bough at ferrule
42. Circumference of 1st section of the primary bough at ferrule
43. Circumference of 2nd section of the primary bough at ferrule
44. Length of primary bough taken along bough plate from ferrule to ferrule
45. Cirumference of bell at ferrule
46. Length of bell from ferrule to rim
47. Bell diameter

APPENDIX E

PHOTOGRAPHS OF PROCEDURES AND INSTRUMENTS

FIGURE E-1

BOUGH CIRCUMFERENCE MEASUREMENT

FIGURE E-2

BELL DIAMETER MEASUREMENT

FIGURE E-3

BELL LENGTH MEASUREMENT

FIGURE E-4

FRONT-ACTION VALVE APPARATUS

FIGURE E-5

UPPER TUBING OF FRONT-ACTION VALVE APPARATUS

FIGURE E-6

TOP-ACTION VALVE APPARATUS

FIGURE E-7

EXAMPLE OF BOUGH DAMAGE

FIGURE E-8

EXAMPLE OF COMMON BELL DAMAGE

FIGURE E-9

EXAMPLE OF BELL WIDENING (DAMAGE)

APPENDIX F

MEASUREMENTS AND FIELD RESEARCH DATA

FIGURE F-1

MEASUREMENTS AT 0.001 INCHES

Measurement Number	Serial Number	17793	18616	28941	31856	62905	70393	71782	161839	163855	173734	178831	183987	188071	204222
	Date	ca. 1890	1890	ca. 1894	ca. 1895	1901	ca. 1901	ca. 1902	1918	ca.1918	ca. 1920	ca. 1921	ca. 1921	1922	ca. 1923
	NMM Number	2565	254	4147	106	270	129	120	353	126	348	5965	2637	1344	10018
	Model	American Model Eb Bass	New American Model Eb Bass	The New American Model Eb Bass	New American Model Eb Bass	New Wonder Model Eb Bass	New Wonder Model Eb Bass		Professional Model Eb Bass	"Giant" Model Contra Eb Bass	"Professional" Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Monster Eb Bass	New Wonder Model Monster Eb Bass
	Action Type	Front	Front	Front	Front	Top	Top	Front	Top	Top	Top	Front	Top	Front	Front
1	Receiver Diameter Int	0.515	0.516	0.531	0.517	0.534	0.468	0.537	0.522	0.565	0.525	0.519	0.526	0.569	0.549
2	Receiver Diameter Ext	0.681	0.685	0.701	0.680	0.686	0.699	0.672	0.705	0.732	0.708	0.704	0.702	0.736	0.740
3	Lead-pipe Length	9.563	9.375	9.250	8.688	8.438	8.875		9.438	10.250	11.750	9.188	9.750	11.063	10.375
4	Piston Casing Height 1	4.113	4.010	4.038	4.191	4.760	4.690		4.125	4.694	3.983	4.095	4.176	4.519	4.595
5	Piston Casing Height 2	4.177	4.123	4.103	4.122	4.687	4.802		4.049	4.727	4.007	4.113	4.161	4.628	4.594
6	Piston Casing Height 3	4.177	4.119	4.071	4.058	4.536	4.792		4.104	4.695	4.139	4.107	4.161	4.628	4.596
7	Piston Diameter 1	0.883	0.894	0.894	0.888	0.886		0.897	0.880	1.046	0.881	0.887		1.048	1.040
8	Piston Diameter 2	0.879	0.887	0.887	0.891	0.888	0.890	0.896	0.880	1.042	0.882	0.889	0.884	1.047	1.039
9	Piston Diameter 3	0.880	0.888	0.885	0.891			0.895	0.879			0.884	0.884	1.048	1.041
10	Port Diameter 1	0.592	0.598	0.613	0.618	0.631		0.563	0.611	0.683	0.605	0.599		0.687	0.688
11	Port Diameter 2	0.610	0.602	0.594	0.619	0.618	0.609	0.586	0.616	0.671	0.606	0.605	0.610	0.683	0.683
12	Port Diameter 3	0.593	0.600	0.632	0.614			0.600	0.611			0.607	0.608	0.688	0.681
13	1 Valve length 1	2.537	1.960	2.072	2.082	6.220	6.246	6.875	7.688	6.625	7.688	2.504	7.250	6.230	6.196
14	1 Valve length 2	6.386	6.378	6.750	6.875	4.420	4.426	3.815	5.015	2.994	5.022	7.188	4.419	3.804	3.798
15	1 Valve length 3	3.309	3.302	3.677	3.820							3.761			
16	2 Valve length 1	2.906	2.894	2.885	2.879	0.742	0.784	2.908	1.999	2.292	1.989	3.000	2.183	3.190	3.107
17	2 Valve length 2	2.533	2.539	2.533	2.543	2.864	2.869	2.512	2.380	1.636	2.372	3.373	1.811	2.882	2.874
18	3 Valve length 1	3.159	3.153	3.135	3.270	9.938	9.938	3.286	10.750	9.063	10.625	3.894	13.000	3.688	2.998
19	3 Valve length 2	12.438	12.375	13.250	13.125	13.125	13.063	13.250	13.438	12.813	13.375	13.500	10.250	12.125	12.313
20	3 Valve length 3	8.313	8.250	8.875	8.938			8.938				8.313		7.625	7.625
21	Valve ferrule diameter 1	0.647	0.657	0.659	0.670	0.662	0.669	0.667	0.666	0.742	0.662	0.666	0.668	0.741	0.744
22	Valve ferrule diameter 2	0.653	0.647	0.665	0.671	0.668	0.666	0.671	0.673	0.734		0.676	0.672	0.746	0.742
23	Valve ferrule diameter 3	0.664	0.657	0.662	0.669	0.663	0.666	0.685	0.668	0.747	0.656	0.665	0.670	0.747	0.746
24	Valve slide length 1	9.250	9.563	10.375	10.375	11.438			11.375	2.813		9.375	9.063	11.875	9.875
25	Valve slide length 2		6.500	6.313	6.563	2.625			5.063	4.875		7.188	4.500	6.875	6.813
26	Valve slide length 3		8.750	21.125	11.375	11.688			12.125	11.313		10.813	11.250	10.375	11.438
27	Short V. slide length 1	1.063	1.375	1.063	1.250	0.938		1.063	1.188	1.313		1.250	1.250	1.250	1.250
28	Short V. slide length 2	0.688	0.750	0.500	0.875	0.250		0.500	0.438	0.563		0.813	0.438	0.563	0.500
29	Short V. slide length 3	1.375	2.250	1.188	1.500	1.813		1.188	2.188	1.938		1.313	2.063	2.250	2.188
30	1 Valve bore	0.594	0.639	0.652	0.652	0.658		0.639	0.658	0.736		0.659	0.658	0.736	0.743
31	2 Valve bore		0.614	0.636	0.647	0.658		0.641	0.662	0.732		0.667	0.650	0.741	0.745
32	3 Valve bore		0.640	0.660	0.649	0.657		0.655	0.661	0.730		0.663	0.661	0.736	0.740
33	PTS ferrule diameter 1		0.641	0.665	0.655	0.706	0.701		0.618		0.639	0.629	0.625	0.708	0.705
34	PTS ferrule diameter 2	0.676	0.686	0.692	0.700	0.726	0.725		0.677		0.669	0.661	0.668	0.744	0.740
35	PTS length (fer to fer)	4.313	4.375	4.000	4.063	4.750	5.000		1.188		1.500	1.188	1.000	1.563	1.563
36	PTS diameter entrance		0.597	0.610	0.603	0.649	0.643				0.557	0.592	0.580	0.653	0.635
37	PTS diameter exit		0.635	0.631	0.643	0.693	0.686				0.613	0.619	0.608	0.692	0.687
38	PTS casing diameter ent		0.641	0.659	0.649	0.700	0.694	0.660		0.688	0.616	0.624	0.627	0.688	0.690
39	PTS casing diameter exit		0.677	0.697	0.684	0.723	0.731	0.688		0.740	0.656	0.660	0.663	0.740	0.747
40	2nd bow circumference 1	4.750	4.875	4.625	4.375	4.813	4.688	4.438	5.250	5.688	5.250	4.563	5.750	5.750	5.625
41	2nd bow circumference 2	8.500	8.500	8.563	8.250	8.688	8.313	8.438	9.500	11.125	9.563	8.250	8.375	11.000	11.000
42	Prime bow circumference 1	8.438	8.563	8.500	8.375	8.563	8.500	8.500	9.563	11.250	9.563	8.375	8.250	11.375	11.250
43	Prime bow circumference 2	10.563	10.813	10.813	10.250	10.250	10.250	10.250	12.188	14.938	12.125	10.313	10.125	14.938	14.938
44	Primary bow length	21.563	21.250	21.875	21.438	21.625	21.250	21.500	23.250	26.875	23.688	21.250	21.500	27.063	26.813
45	Bell circum at ferrule	11.125	11.000	11.125	10.625	10.750	10.625	10.625	12.750	15.500	12.625	10.625	10.625	15.375	15.563
46	Bell section length	23.188	22.875	23.250	24.750	25.125	24.875	25.375	27.250	29.000	27.375	25.500	26.000	29.250	28.875
47	Bell diameter	14.375	14.188	14.125	14.063	14.125	14.125	14.250	18.000	20.125	18.188	16.000	16.000	20.000	20.000

This spreadsheet represents the initial spreadsheet after collecting measurements at an accuracy of 0.001 inches. Blank cells represent an area that was inaccessible due to instrument damage.

FIGURE F-2

MEASUREMENTS AT 0.01 INCHES

Measurement Number	Serial Number	17793	18616	28941	31856	62905	70393	71782	161839	163855	173734	178831	183987	188071	204222
	Date	ca. 1890	1890	ca. 1894	ca. 1895	1901	ca. 1901	ca. 1902	1918	ca.1918	ca. 1920	ca. 1921	ca. 1921	1922	ca. 1923
	NMM Number	2565	254	4147	106	270	129	120	353	126	348	5965	2637	1344	10018
	Model	American Model Eb Bass	New American Model Eb Bass	The New American Model Eb Bass	New American Model Eb Bass	New Wonder Model Eb Bass	New Wonder Model Eb Bass		Professional Model Eb Bass	"Giant" Model Contra Eb Bass	"Professional" Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Monster Eb Bass	New Wonder Model Monster Eb Bass
	Action Type	Front	Front	Front	Front	Top	Top	Front	Top	Top	Top	Front	Top	Front	Front
1	Receiver Diameter Int	0.52	0.52	0.53	0.52	0.53	0.47	0.54	0.52	0.57	0.53	0.52	0.53	0.57	0.55
2	Receiver Diameter Ext	0.68	0.69	0.70	0.68	0.69	0.70	0.67	0.71	0.73	0.71	0.70	0.70	0.74	0.74
3	Lead-pipe Length	9.56	9.38	9.25	8.69	8.44	8.88		9.44	10.25	11.75	9.19	9.75	11.06	10.38
4	Piston Casing Height 1	4.11	4.01	4.04	4.19	4.76	4.69		4.13	4.69	3.98	4.10	4.18	4.52	4.60
5	Piston Casing Height 2	4.18	4.12	4.10	4.12	4.69	4.80		4.05	4.73	4.01	4.11	4.16	4.63	4.59
6	Piston Casing Height 3	4.18	4.12	4.07	4.06	4.54	4.79		4.10	4.70	4.14	4.11	4.16	4.63	4.60
7	Piston Diameter 1	0.88	0.89	0.89	0.89	0.89		0.90	0.88	1.05	0.88	0.89		1.05	1.04
8	Piston Diameter 2	0.88	0.89	0.89	0.89	0.89	0.89	0.90	0.88	1.04	0.88	0.89	0.88	1.05	1.04
9	Piston Diameter 3	0.88	0.89	0.89	0.89			0.90	0.88			0.88	0.88	1.05	1.04
10	Port Diameter 1	0.59	0.60	0.61	0.62	0.63		0.56	0.61	0.68	0.61	0.60		0.69	0.69
11	Port Diameter 2	0.61	0.60	0.59	0.62	0.62	0.61	0.59	0.62	0.67	0.61	0.61	0.61	0.68	0.68
12	Port Diameter 3	0.59	0.60	0.63	0.61			0.60	0.61			0.61	0.61	0.69	0.68
13	1 Valve length 1	2.54	1.96	2.07	2.08	6.22	6.25	6.88	7.69	6.63	7.69	2.50	7.25	6.23	6.20
14	1 Valve length 2	6.39	6.38	6.75	6.88	4.42	4.43	3.82	5.02	2.99	5.02	7.19	4.42	3.80	3.80
15	1 Valve length 3	3.31	3.30	3.68	3.82							3.76			
16	2 Valve length 1	2.91	2.89	2.89	2.88	0.74	0.78	2.91	2.00	2.29	1.99	3.00	2.18	3.19	3.11
17	2 Valve length 2	2.53	2.54	2.53	2.54	2.86	2.87	2.51	2.38	1.64	2.37	3.37	1.81	2.88	2.87
18	3 Valve length 1	3.16	3.15	3.14	3.27	9.94	9.94	3.29	10.75	9.06	10.63	3.89	13.00	3.69	3.00
19	3 Valve length 2	12.44	12.38	13.25	13.13	13.13	13.06	13.25	13.44	12.81	13.38	13.50	10.25	12.13	12.31
20	3 Valve length 3	8.31	8.25	8.88	8.94			8.94				8.31		7.63	7.63
21	Valve ferrule diameter 1	0.65	0.66	0.66	0.67	0.66	0.67	0.67	0.67	0.74	0.66	0.67	0.67	0.74	0.74
22	Valve ferrule diameter 2	0.65	0.65	0.67	0.67	0.67	0.67	0.67	0.67	0.73		0.68	0.67	0.75	0.74
23	Valve ferrule diameter 3	0.66	0.66	0.66	0.67	0.66	0.67	0.69	0.67	0.75	0.66	0.67	0.67	0.75	0.75
24	Valve slide length 1	9.25	9.56	10.38	10.38	11.44			11.38	2.81		9.38	9.06	11.88	9.88
25	Valve slide length 2		6.50	6.31	6.56	2.63			5.06	4.88		7.19	4.50	6.88	6.81
26	Valve slide length 3		8.75	21.13	11.38	11.69			12.13	11.31		10.81	11.25	10.38	11.44
27	Short V. slide length 1	1.06	1.38	1.06	1.25	0.94		1.06	1.19	1.31		1.25	1.25	1.25	1.25
28	Short V. slide length 2	0.69	0.75	0.50	0.88	0.25		0.50	0.44	0.56		0.81	0.44	0.56	0.50
29	Short V. slide length 3	1.38	2.25	1.19	1.50	1.81		1.19	2.19	1.94		1.31	2.06	2.25	2.19
30	1 Valve bore	0.59	0.64	0.65	0.65	0.66		0.64	0.66	0.74		0.66	0.66	0.74	0.74
31	2 Valve bore		0.61	0.64	0.65	0.66		0.64	0.66	0.73		0.67	0.65	0.74	0.75
32	3 Valve bore		0.64	0.66	0.65	0.66		0.66	0.66	0.73		0.66	0.66	0.74	0.74
33	PTS ferrule diameter 1		0.64	0.67	0.66	0.71	0.70		0.62		0.64	0.63	0.63	0.71	0.71
34	PTS ferrule diameter 2	0.68	0.69	0.69	0.70	0.73	0.73		0.68		0.67	0.66	0.67	0.74	0.74
35	PTS length (fer to fer)	4.31	4.38	4.00	4.06	4.75	5.00		1.19		1.50	1.19	1.00	1.56	1.56
36	PTS diameter entrance		0.60	0.61	0.60	0.65	0.64				0.56	0.59	0.58	0.65	0.64
37	PTS diameter exit		0.64	0.63	0.64	0.69	0.69				0.61	0.62	0.61	0.69	0.69
38	PTS casing diameter ent		0.64	0.66	0.65	0.70	0.69	0.66		0.69	0.62	0.62	0.63	0.69	0.69
39	PTS casing diameter exit		0.68	0.70	0.68	0.72	0.73	0.69		0.74	0.66	0.66	0.66	0.74	0.75
40	2nd bow circumference 1	4.75	4.88	4.63	4.38	4.81	4.69	4.44	5.25	5.69	5.25	4.56	5.75	5.75	5.63
41	2nd bow circumference 2	8.50	8.50	8.56	8.25	8.69	8.31	8.44	9.50	11.13	9.56	8.25	8.38	11.00	11.00
42	Prime bow circumference 1	8.44	8.56	8.50	8.38	8.56	8.50	8.50	9.56	11.25	9.56	8.38	8.25	11.38	11.25
43	Prime bow circumference 2	10.56	10.81	10.81	10.25	10.25	10.25	10.25	12.19	14.94	12.13	10.31	10.13	14.94	14.94
44	Primary bow length	21.56	21.25	21.88	21.44	21.63	21.25	21.50	23.25	26.88	23.69	21.25	21.50	27.06	26.81
45	Bell circum at ferrule	11.13	11.00	11.13	10.63	10.75	10.63	10.63	12.75	15.50	12.63	10.63	10.63	15.38	15.56
46	Bell section length	23.19	22.88	23.25	24.75	25.13	24.88	25.38	27.25	29.00	27.38	25.50	26.00	29.25	28.88
47	Bell diameter	14.38	14.19	14.13	14.06	14.13	14.13	14.25	18.00	20.13	18.19	16.00	16.00	20.00	20.00

This spreadsheet represents the initial spreadsheet after collecting measurements at an accuracy of 0.01 inches.

FIGURE F-3

EXACT MATCHES AT 0.001 INCHES

Measurement Number	Serial Number	17793	18616	28941	31856	62905	70393	71782	161839	163855	173734	178831	183987	2E+05	204222
	Date	ca. 1890	1890	ca. 1894	ca. 1895	1901	ca. 1901	ca. 1902	1918	ca.1918	ca. 1920	ca. 1921	ca. 1921	1922	ca. 1923
	NMM Number	2565	254	4147	106	270	129	120	353	126	348	5965	2637	1344	10018
	Model	American Model Eb Bass	New American Model Eb Bass	The New American Model Eb Bass	New American Model Eb Bass	New Wonder Model Eb Bass	New Wonder Model Eb Bass		Professional Model Eb Bass	"Giant" Model Contra Eb Bass	"Professional" Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Monster Eb Bass	New Wonder Model Monster Eb Bass
	Action Type	Front	Front	Front	Front	Top	Top	Front	Top	Top	Top	Front	Top	Front	Front
1	Receiver Diameter Int	0.515	0.516	0.531	0.517	0.534	0.468	0.537	0.522	0.565	0.525	0.519	0.526	0.569	0.549
2	Receiver Diameter Ext	0.681	0.685	0.701	0.680	0.686	0.699	0.672	0.705	0.732	0.708	0.704	0.702	0.736	0.740
3	Lead-pipe Length	9.563	9.375	9.250	8.688	8.438	8.875		9.438	10.250	11.750	9.188	9.750	11.063	10.375
4	Piston Casing Height 1	4.113	4.010	4.038	4.191	4.760	4.690		4.125	4.694	3.983	4.095	4.176	4.519	4.595
5	Piston Casing Height 2	4.177	4.123	4.103	4.122	4.687	4.802		4.049	4.727	4.007	4.113	4.161	4.628	4.594
6	Piston Casing Height 3	4.177	4.119	4.071	4.058	4.536	4.792		4.104	4.695	4.139	4.107	4.161	4.628	4.596
7	Piston Diameter 1	0.883	0.894	0.894	0.888	0.886		0.897	0.880	1.046	0.881	0.887		1.048	1.040
8	Piston Diameter 2	0.879	0.887	0.887	0.891	0.888	0.890	0.896	0.880	1.042	0.882	0.889	0.884	1.047	1.039
9	Piston Diameter 3	0.880	0.888	0.885	0.891			0.895	0.879			0.884	0.884	1.048	1.041
10	Port Diameter 1	0.592	0.598	0.613	0.618	0.631		0.563	0.611	0.683	0.605	0.599		0.687	0.688
11	Port Diameter 2	0.610	0.602	0.594	0.619	0.618	0.609	0.586	0.616	0.671	0.606	0.605	0.610	0.683	0.683
12	Port Diameter 3	0.593	0.600	0.632	0.614			0.600	0.611			0.607	0.608	0.688	0.681
13	1 Valve length 1	2.537	1.960	2.072	2.082	6.220	6.246	6.875	7.688	6.625	7.688	2.504	7.250	6.230	6.196
14	1 Valve length 2	6.386	6.378	6.750	6.875	4.420	4.426	3.815	5.015	2.994	5.022	7.188	4.419	3.804	3.798
15	1 Valve length 3	3.309	3.302	3.677	3.820							3.761			
16	2 Valve length 1	2.906	2.894	2.885	2.879	0.742	0.784	2.908	1.999	2.292	1.989	3.000	2.183	3.190	3.107
17	2 Valve length 2	2.533	2.539	2.533	2.543	2.864	2.869	2.512	2.380	1.636	2.372	3.373	1.811	2.882	2.874
18	3 Valve length 1	3.159	3.153	3.135	3.270	9.938	9.938	3.286	10.750	9.063	10.625	3.894	13.000	3.688	2.998
19	3 Valve length 2	12.438	12.375	13.250	13.125	13.125	13.063	13.250	13.438	12.813	13.375	13.500	10.250	12.125	12.313
20	3 Valve length 3	8.313	8.250	8.875	8.938			8.938				8.313		7.625	7.625
21	Valve ferrule diameter 1	0.647	0.657	0.659	0.670	0.662	0.669	0.667	0.666	0.742	0.662	0.666	0.668	0.741	0.744
22	Valve ferrule diameter 2	0.653	0.647	0.665	0.671	0.668	0.666	0.671	0.673	0.734		0.676	0.672	0.746	0.742
23	Valve ferrule diameter 3	0.664	0.657	0.662	0.669	0.663	0.666	0.685	0.668	0.747	0.656	0.665	0.670	0.747	0.746
24	Valve slide length 1	9.250	9.563	10.375	10.375	11.438			11.375	2.813		9.375	9.063	11.875	9.875
25	Valve slide length 2		6.500	6.313	6.563	2.625			5.063	4.875		7.188	4.500	6.875	6.813
26	Valve slide length 3		8.750	21.125	11.375	11.688			12.125	11.313		10.813	11.250	10.375	11.438
27	Short V. slide length 1	1.063	1.375	1.063	1.250	0.938		1.063	1.188	1.313		1.250	1.250	1.250	1.250
28	Short V. slide length 2	0.688	0.750	0.500	0.875	0.250		0.500	0.438	0.563		0.813	0.438	0.563	0.500
29	Short V. slide length 3	1.375	2.250	1.188	1.500	1.813		1.188	2.188	1.938		1.313	2.063	2.250	2.188
30	1 Valve bore	0.594	0.639	0.652	0.652	0.658		0.639	0.658	0.736		0.659	0.658	0.736	0.743
31	2 Valve bore		0.614	0.636	0.647	0.658		0.641	0.662	0.732		0.667	0.650	0.741	0.745
32	3 Valve bore		0.640	0.660	0.649	0.657		0.655	0.661	0.730		0.663	0.661	0.736	0.740
33	PTS ferrule diameter 1		0.641	0.665	0.655	0.706	0.701		0.618		0.639	0.629	0.625	0.708	0.705
34	PTS ferrule diameter 2	0.676	0.686	0.692	0.700	0.726	0.725		0.677		0.669	0.661	0.668	0.744	0.740
35	PTS length (fer to fer)	4.313	4.375	4.000	4.063	4.750	5.000		1.188		1.500	1.188	1.000	1.563	1.563
36	PTS diameter entrance		0.597	0.610	0.603	0.649	0.643				0.557	0.592	0.580	0.653	0.635
37	PTS diameter exit		0.635	0.631	0.643	0.693	0.686				0.613	0.619	0.608	0.692	0.687
38	PTS casing diameter ent		0.641	0.659	0.649	0.700	0.694	0.660		0.688	0.616	0.624	0.627	0.688	0.690
39	PTS casing diameter exit		0.677	0.697	0.684	0.723	0.731	0.688		0.740	0.656	0.660	0.663	0.740	0.747
40	2nd bow circumference 1	4.750	4.875	4.625	4.375	4.813	4.688	4.438	5.250	5.688	5.250	4.563	5.750	5.750	5.625
41	2nd bow circumference 2	8.500	8.500	8.563	8.250	8.688	8.313	8.438	9.500	11.125	9.563	8.250	8.375	11.000	11.000
42	Prime bow circumference 1	8.438	8.563	8.500	8.375	8.563	8.500	8.500	9.563	11.250	9.563	8.375	8.250	11.375	11.250
43	Prime bow circumference 2	10.563	10.813	10.813	10.250	10.250	10.250	10.250	12.188	14.938	12.125	10.313	10.125	14.938	14.938
44	Primary bow length	21.563	21.250	21.875	21.438	21.625	21.250	21.500	23.250	26.875	23.688	21.250	21.500	27.063	26.813
45	Bell circum at ferrule	11.125	11.000	11.125	10.625	10.750	10.625	10.625	12.750	15.500	12.625	10.625	10.625	15.375	15.563
46	Bell section length	23.188	22.875	23.250	24.750	25.125	24.875	25.375	27.250	29.000	27.375	25.500	26.000	29.250	28.875
47	Bell diameter	14.375	14.188	14.125	14.063	14.125	14.125	14.250	18.000	20.125	18.188	16.000	16.000	20.000	20.000

This spreadsheet represents the identical matches found at an accuracy of 0.001 inches. These matches are organized by row, and the different shades indicate which measurements match. The percentage of identical matches found at this level of accuracy is 19.55%.

FIGURE F-4

EXACT MATCHES AT 0.01 INCHES

Measurement Number	Serial Number	17793	18616	28941	31856	62905	70393	71782	161839	163855	173734	178831	183987	188071	204222
	Date	ca. 1890	1890	ca. 1894	ca. 1895	1901	ca. 1901	ca. 1902	1918	ca.1918	ca. 1920	ca. 1921	ca. 1921	1922	ca. 1923
	NMM Number	2565	254	4147	106	270	129	120	353	126	348	5965	2637	1344	10018
	Model	American Model Eb Bass	New America n Model Eb Bass	The New American Model Eb Bass	New American Model Eb Bass	New Wonder Model Eb Bass	New Wonder Model Eb Bass		"Professi onal" Model Eb Bass	"Giant" Model Contra Eb Bass	"Professio nal" Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Standard Eb Bass	New Wonder Model Monster Eb Bass	New Wonder Model Monster Eb Bass
	Action Type	Front	Front	Front	Front	Top	Top	Front	Top	Top	Top	Front	Top	Front	Front
1	Receiver Diameter Int	0.52	0.52	0.53	0.52	0.53	0.47	0.54	0.52	0.57	0.53	0.52	0.53	0.57	0.55
2	Receiver Diameter Ext	0.68	0.69	0.70	0.68	0.69	0.70	0.67	0.71	0.73	0.71	0.70	0.70	0.74	0.74
3	Lead-pipe Length	9.56	9.38	9.25	8.69	8.44	8.88		9.44	10.25	11.75	9.19	9.75	11.06	10.38
4	Piston Casing Height 1	4.11	4.01	4.04	4.19	4.76	4.69		4.13	4.69	3.98	4.10	4.18	4.52	4.60
5	Piston Casing Height 2	4.18	4.12	4.10	4.12	4.69	4.80		4.05	4.73	4.01	4.11	4.16	4.63	4.59
6	Piston Casing Height 3	4.18	4.12	4.07	4.06	4.54	4.79		4.10	4.70	4.14	4.11	4.16	4.63	4.60
7	Piston Diameter 1	0.88	0.89	0.89	0.89	0.89		0.90	0.88	1.05	0.88	0.89		1.05	1.04
8	Piston Diameter 2	0.88	0.89	0.89	0.89	0.89	0.89	0.90	0.88	1.04	0.88	0.89	0.88	1.05	1.04
9	Piston Diameter 3	0.88	0.89	0.89	0.89			0.90	0.88			0.88	0.88	1.05	1.04
10	Port Diameter 1	0.59	0.60	0.61	0.62	0.63		0.56	0.61	0.68	0.61	0.60		0.69	0.69
11	Port Diameter 2	0.61	0.60	0.59	0.62	0.62	0.61	0.59	0.62	0.67	0.61	0.61	0.61	0.68	0.68
12	Port Diameter 3	0.59	0.60	0.63	0.61			0.60	0.61			0.61	0.61	0.69	0.68
13	1 Valve length 1	2.54	1.96	2.07	2.08	6.22	6.25	6.88	7.69	6.63	7.69	2.50	7.25	6.23	6.20
14	1 Valve length 2	6.39	6.38	6.75	6.88	4.42	4.43	3.82	5.02	2.99	5.02	7.19	4.42	3.80	3.80
15	1 Valve length 3	3.31	3.30	3.68	3.82							3.76			
16	2 Valve length 1	2.91	2.89	2.89	2.88	0.74	0.78	2.91	2.00	2.29	1.99	3.00	2.18	3.19	3.11
17	2 Valve length 2	2.53	2.54	2.53	2.54	2.86	2.87	2.51	2.38	1.64	2.37	3.37	1.81	2.88	2.87
18	3 Valve length 1	3.16	3.15	3.14	3.27	9.94	9.94	3.29	10.75	9.06	10.63	3.89	13.00	3.69	3.00
19	3 Valve length 2	12.44	12.38	13.25	13.13	13.13	13.06	13.25	13.44	12.81	13.38	13.50	10.25	12.13	12.31
20	3 Valve length 3	8.31	8.25	8.88	8.94			8.94				8.31		7.63	7.63
21	Valve ferrule diameter 1	0.65	0.66	0.66	0.67	0.66	0.67	0.67	0.67	0.74	0.66	0.67	0.67	0.74	0.74
22	Valve ferrule diameter 2	0.65	0.65	0.67	0.67	0.67	0.67	0.67	0.67	0.73		0.68	0.67	0.75	0.74
23	Valve ferrule diameter 3	0.66	0.66	0.66	0.67	0.66	0.67	0.69	0.67	0.75	0.66	0.67	0.67	0.75	0.75
24	Valve slide length 1	9.25	9.56	10.38	10.38	11.44			11.38	2.81		9.38	9.06	11.88	9.88
25	Valve slide length 2		6.50	6.31	6.56	2.63			5.06	4.88		7.19	4.50	6.88	6.81
26	Valve slide length 3		8.75	21.13	11.38	11.69			12.13	11.31		10.81	11.25	10.38	11.44
27	Short V. slide length 1	1.06	1.38	1.06	1.25	0.94		1.06	1.19	1.31		1.25	1.25	1.25	1.25
28	Short V. slide length 2	0.69	0.75	0.50	0.88	0.25		0.50	0.44	0.56		0.81	0.44	0.56	0.50
29	Short V. slide length 3	1.38	2.25	1.19	1.50	1.81		1.19	2.19	1.94		1.31	2.06	2.25	2.19
30	1 Valve bore	0.59	0.64	0.65	0.65	0.66		0.64	0.66	0.74		0.66	0.66	0.74	0.74
31	2 Valve bore		0.61	0.64	0.65	0.66		0.64	0.66	0.73		0.67	0.65	0.74	0.75
32	3 Valve bore		0.64	0.66	0.65	0.66		0.66	0.66	0.73		0.66	0.66	0.74	0.74
33	PTS ferrule diameter 1		0.64	0.67	0.66	0.71	0.70		0.62		0.64	0.63	0.63	0.71	0.71
34	PTS ferrule diameter 2	0.68	0.69	0.69	0.70	0.73	0.73		0.68		0.67	0.66	0.67	0.74	0.74
35	PTS length (fer to fer)	4.31	4.38	4.00	4.06	4.75	5.00		1.19		1.50	1.19	1.00	1.56	1.56
36	PTS diameter entrance		0.60	0.61	0.60	0.65	0.64				0.56	0.59	0.58	0.65	0.64
37	PTS diameter exit		0.64	0.63	0.64	0.69	0.69				0.61	0.62	0.61	0.69	0.69
38	PTS casing diameter ent		0.64	0.66	0.65	0.70	0.69	0.66		0.69	0.62	0.62	0.63	0.69	0.69
39	PTS casing diameter exit		0.68	0.70	0.68	0.72	0.73	0.69		0.74	0.66	0.66	0.66	0.74	0.75
40	2nd bow circumference 1	4.75	4.88	4.63	4.38	4.81	4.69	4.44	5.25	5.69	5.25	4.56	5.75	5.75	5.63
41	2nd bow circumference 2	8.50	8.50	8.56	8.25	8.69	8.31	8.44	9.50	11.13	9.56	8.25	8.38	11.00	11.00
42	Prime bow circumference 1	8.44	8.56	8.50	8.38	8.56	8.50	8.50	9.56	11.25	9.56	8.38	8.25	11.38	11.25
43	Prime bow circumference 2	10.56	10.81	10.81	10.25	10.25	10.25	10.25	12.19	14.94	12.13	10.31	10.13	14.94	14.94
44	Primary bow length	21.56	21.25	21.88	21.44	21.63	21.25	21.50	23.25	26.88	23.69	21.25	21.50	27.06	26.81
45	Bell circum at ferrule	11.13	11.00	11.13	10.63	10.75	10.63	10.63	12.75	15.50	12.63	10.63	10.63	15.38	15.56
46	Bell section length	23.19	22.88	23.25	24.75	25.13	24.88	25.38	27.25	29.00	27.38	25.50	26.00	29.25	28.88
47	Bell diameter	14.38	14.19	14.13	14.06	14.13	14.13	14.25	18.00	20.13	18.19	16.00	16.00	20.00	20.00

This spreadsheet represents the identical matches found at an accuracy of 0.01 inches. These matches are organized by row, and the different shades indicate which measurements match. The percentage of identical matches found at this level of accuracy is 46.99%.

FIGURE F-5

DEFINITIONS OF ABBREVIATIONS

1. Receiver Diameter Int – Diameter of the interior of the mouthpiece receiver

2. Receiver Diameter Ext – Diameter of the exterior of the mouthpiece receiver

3. Lead-pipe Length - Length of lead-pipe from the termination of the mouthpiece receiver to either the valve entry or the primary tuning slide

4. Piston Casing Height 1 – Length/Height of the 1st valve casing

5. Piston Casing Height 2 – Length/Height of the 2nd valve casing

6. Piston Casing Height 3 – Length/Height of the 3rd valve casing

7. Piston Diameter 1 – Diameter of the 1st valve piston

8. Piston Diameter 2 – Diameter of the 2nd valve piston

9. Piston Diameter 3 – Diameter of the 3rd valve piston

10. Port Diameter 1 – Diameter of the 1st valve port

11. Port Diameter 2 – Diameter of the 2nd valve port

12. Port Diameter 3 – Diameter of the 3rd valve port

13. 1 Valve length 1 – Length of the 1st section of the 1st valve tubing

14. 1 Valve length 2 – Length of the 2nd section of the 1st valve tubing

15. 1 Valve length 3 – Length of the 3rd section of the 1st valve tubing

16. 2 Valve length 1 – Length of the 1st section of the 2nd valve tubing

17. 2 Valve length 2 – Length of the 2nd section of the 2nd valve tubing

18. 3 Valve length 1 – Length of the 1st section of the 3rd valve tubing

19. 3 Valve length 2 – Length of the 2nd section of the 3rd valve tubing

20. 3 Valve length 3 – Length of the 3rd section of the 3rd valve tubing (present on front-action Eb tubas but is not present on top-action Eb tubas)

21. Valve ferrule diameter 1 – External diameter of the 1st valve tuning slide between the ferrules

22. Valve ferrule diameter 2 – External diameter of the 2nd valve tuning slide between the ferrules

23. Valve ferrule diameter 3 – External diameter of the 3rd valve tuning slide between the ferrules

24. Valve slide length 1 – Length of the 1st valve tuning slide, taken along the innermost curve of the entire slide

25. Valve slide length 2 – Length of the 2nd valve tuning slide, taken along the innermost curve of the entire slide

26. Valve slide length 3 – Length of the 3rd valve tuning slide, taken along the innermost curve of the entire slide

27. Short V. slide length 1 – Length of the 1st valve tuning slide, from ferrule to ferrule along the innermost curve

28. Short V. slide length 2 – Length of the 2nd valve tuning slide, from ferrule to ferrule along the innermost curve

29. Short V. slide length 3 – Length of the 3rd valve tuning slide, from ferrule to ferrule along the innermost curve

30. 1 Valve bore – Internal diameter of the 1st valve tuning slide casing's bore

31. 2 Valve bore – Internal diameter of the 2nd valve tuning slide casing's bore

32. 3 Valve bore – Internal diameter of the 3rd valve tuning slide casing's bore

33. PTS ferrule diameter 1 – Exteral diameter of the 1st ferrule of the primary tuning slide

34. PTS ferrule diameter 2 – External diameter of the 2nd ferrule of the primary tuning slide

35. PTS length (fer to fer) – Length of the primary tuning slide from ferrule to ferrule

36. PTS diameter entrance – Interior diameter of the 1st section of the primary tuning slide

37. PTS diameter exit – Interior diameter of the 2nd section of the primary tuning slide

38. PTS casing diameter ent – Interior diameter of the 1st section of the primary tuning slide casing's bore

39. PTS casing diameter exit – Interior diameter of the 2nd section of the primary tuning slide casing's bore

40. 2nd bow cirumference 1 – Circumference of the 1st section of the 2nd bough at its ferrule

41. 2nd bow circumference 2 – Circumference of the 2nd section of the 2nd bough at its ferrule

42. Prime bow circumference 1 – Circumference of the 1st section of the primary bough at its ferrule

43. Prime bow circumference 2 – Circumference of the 2nd section of the primary bough at its ferrule

44. Primary bow length – Length of the primary bough taken along the bough plate from ferrule to ferrule

45. Bell circum at ferrule – Cirumference of the bell at its ferrule

46. Bell section length – Length of the bell section from ferrule to rim

47. Bell diameter – The bell diameter across the rim

APPENDIX G

SUPPLEMENTAL IMAGES

FIGURE G-1

AUTHOR'S CONCEPT SKETCH OF INTERCHANGEABLE STRUCTURES MIRRORED AT BELL

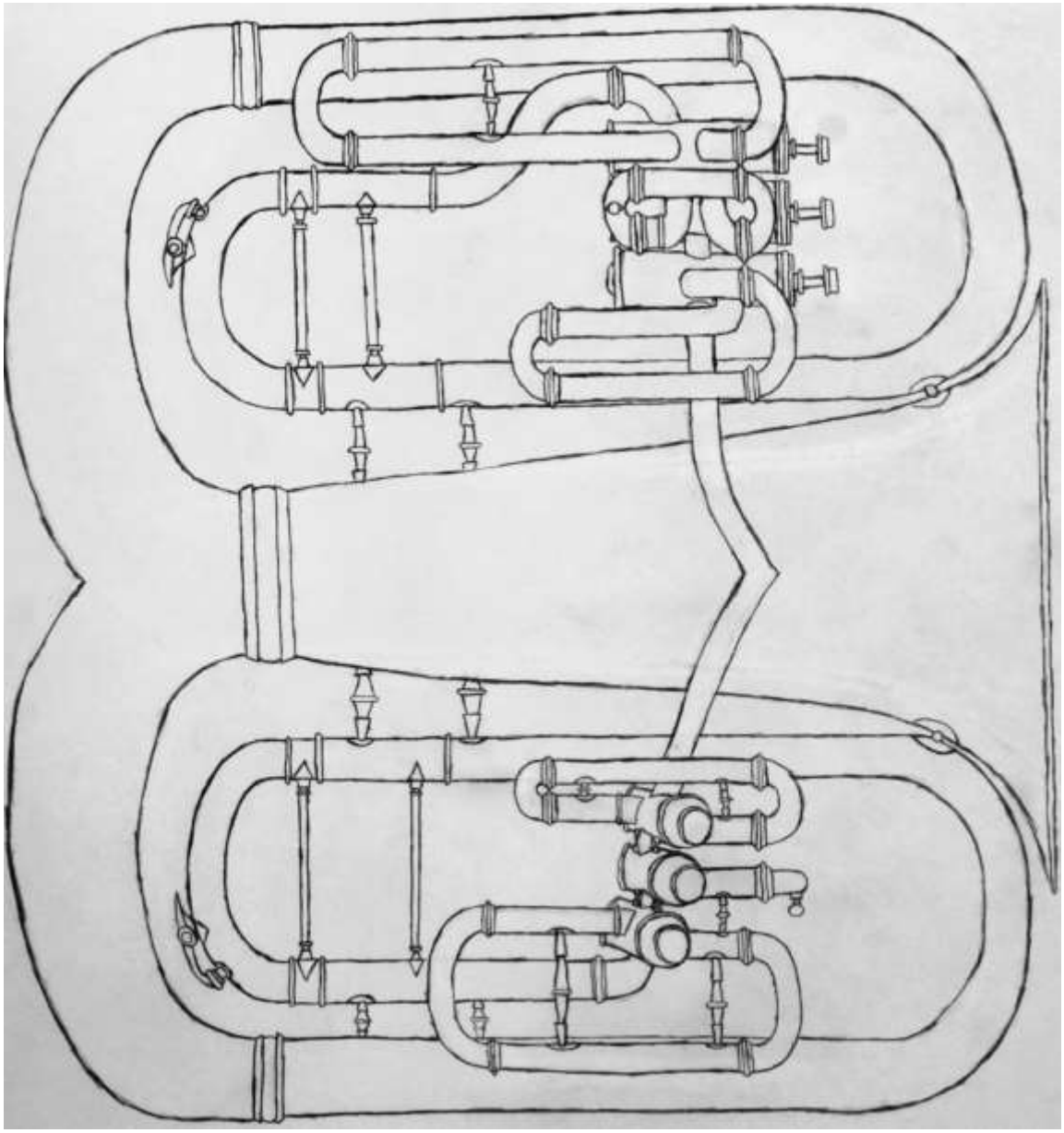
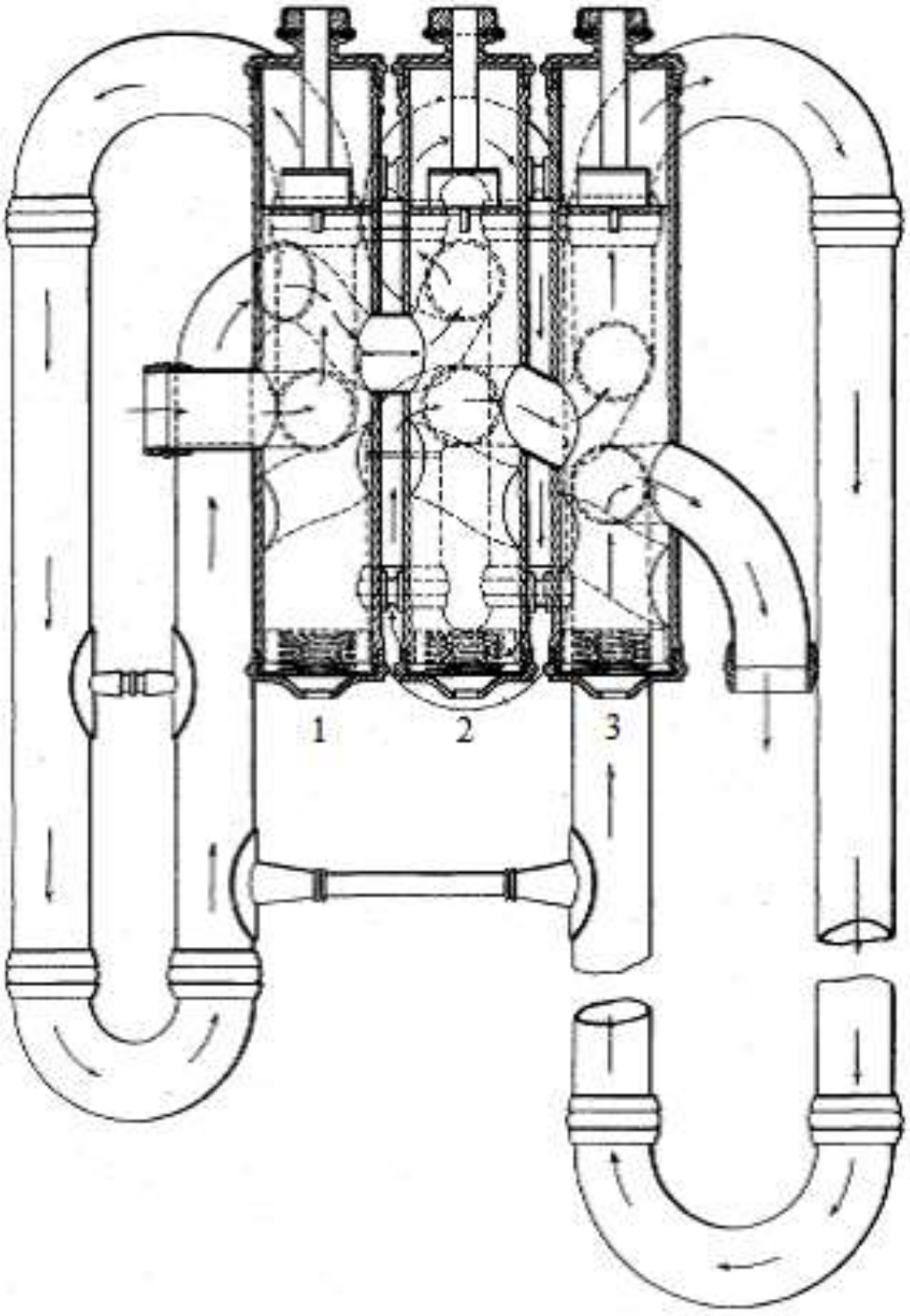


FIGURE G-2

INNER WORKINGS OF THE CONN WONDER MODEL VALVE APPARATUS AS SEEN FROM THE PLAYER'S PERSPECTIVE



APPENDIX H

PERMISSION LETTERS

FIGURE H-1
PERMISSION TO USE PHOTOGRAPHS OF INSTRUMENTS AND MEASUREMENTS

from: Clint Spell <orimister@gmail.com>
to: David Earll <dmearll@asu.edu>
date: Wed, Aug 20, 2014 at 6:56 PM

subject: Re: Use of Photographs from the National Music Museum Research in Doctoral Research Project

Dear Dave,
I do certainly grant you permission to use the photographs. Best of luck with your research! Let me know if there's anything else that I can do.
Sincerely,
Clint Spell

On Mon, Aug 18, 2014 at 1:54 PM, David Earll <dmearll@asu.edu> wrote:
Dear Clint Spell,
I am writing you in regards to our previous discussion about using several photographs from our time working together at the National Music Museum in my doctoral research project. In particular, I would like to include several photographs that you took of me taking measurements of C.G. Conn tubas using my digital camera while conducing my on-site research at the National Music Museum.

May I have your permission to use these photographs of my measurement procedures for my doctoral research project? I have included a copy of each of the images that will be used in my document.

Thank you for your time and consideration.
Sincerely,
David M. Earll

FIGURE H-2
PERMISSION TO USE IMAGES FROM THE KEN DROBNAK'S ARTICLE

from: Drobnak, Kenneth <kpdrobnak@nwosu.edu>
to: David M Earll <dmearll@asu.edu>
date: Mon, Aug 18, 2014 at 3:52 PM
subject: Re: Use of Images from ITEA Journal Article, 38:1 in Doctoral Research Project

YES

Ken Drobnak, D.M.A.
Director of Bands & Low Brass
Northwestern Oklahoma State University

office: 580-327-8191
mobile: 361-219-4567
Fax: 580-327-8514

NWOSU Ranger Bands<http://drobnakbrass.com/index.php/conducting/nwosu/band-information-fall-2014/>

On Aug 18, 2014, at 3:42 PM, David Earll <dmearll@asu.edu<mailto:dmearll@asu.edu>> wrote:

Hello Dr. Kenneth Drobnak,

I am writing you in regards to our previous discussion about using several images from your article in the ITEA Journal, issue 38:1, in my Doctoral Research Project. I would like to use two images from this article to demonstrate the difference between several Holton tuba designs and C.G. Conn tuba designs in this research project.

May I have permission to use the following images for comparison in my doctoral research project?
-NMM 11754 Front 2, found on page 94 of the ITEA Journal, issue 38:1
-NMM 134 Holton Tuba Front, found on page 92 of the ITEA Journal, issue 38:1

Thank you again for your time and consideration!

Sincerely,
David M. Earll