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Inventions for random voices: Acoustically Informed Experimental Musical Instruments

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Resumo

Um instrumento musical pode ser definido de maneira ampla como um dispositivo sonoro usado para fazer música. Há uma enorme comunidade mundial de inventores de instrumentos e um grande número de patentes de instrumentos é depositado a cada ano. Alguns instrumentos podem ser fruto de pura intuição, enquanto a maioria deles é resultado de aprimoramento e implementação de recursos tecnológicos. No entanto, a maioria dos instrumentos recém-desenvolvidos dificilmente se torna disponível e útil para intérpretes e compositores. Este artigo descreve a origem criativa das invenções acusticamente informadas, referindo-se a uma série de inventores e grupos musicais que as utilizam, e considerando sua possível designação como uma composição musical, além de sua característica de propriedade industrial. Dois casos selecionados são analisados, um de um instrumento aperfeiçoado desde o século XVI e outro de um instrumento feito a partir de uma garrafa de plástico, que consiste num Ready Made, dentro da conceituação de Marcel Duchamp. Um determinado exemplar de instrumento é efetivamente registrado como composição no Brasil, e o resultado é avaliado em termos de aplicação musical, direitos autorais e reconhecimento de autoria.

Palavras-chave: acústica, musical, instrumentos, invenção, experimental, alternativo, composição

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Abstract

A musical instrument can be broadly defined as a sound-producing device used to make music. There is a huge worldwide community of instrument inventors and a large number of instrument patents being filed every year. Some instruments may be the result of pure intuition, while most of them are the result of improvement and implementation of technological resources. However, most of the newly developed instruments hardly become available and useful for performers and composers. This article describes the creative origin of acoustically informed inventions, referring to a series of inventors and musical groups that produce and employ them, considering their possible designation as a musical composition, besides their characteristic of industrial property. Two selected cases are analyzed, one of an instrument that has evolved since the 16th century, and the other of an instrument made from an ordinary plastic bottle, consisting of a Ready Made, within the conceptualization of Marcel Duchamp. A particular instrument is effectively registered as a composition in Brazil, and the result is evaluated in terms of musical application, copyright and authorship recognition.

Keywords: acoustics, musical, instruments, invention, experimental, alternative, composition

1. INTRODUCTION

Intelligence is the faculty of making artificial objects, especially tools to make tools.

Henri Bergson



Music needs sound waves, needs ideas on how to use them, and tools to implement those ideas. Our voice, our body movements and the instruments we employ are such tools. The instruments of music belong to the history of technology and art (Sachs, 1940; Shaeffner, 1960).

Instruments can be generally defined as devices that serve as tools for the performance of music. This is certainly vague because any object may somehow produce sound - mechanically, electrically or electronically - and its recorded sound, or the object itself, be employed in some kind of musical composition. Regarding the more conventional, mainstream instruments, they are usually a result of a long-term trajectory, comprising subsequent improvements, changes and the dedication of a whole community of users (Montagu, 2017; Henrique, 2002; Zecher, 2007).

In our times, invention is usually associated with machines and processes, while creation and composing normally refer to works of art. However, since the 16th century, invention as a category of musical piece is used by several composers, such as J.S. Bach, John Dowland, Antonio Vivaldi, Alban Berg, Alexander Tcherepnin, and many others. There is a contemporary understanding that music is not only an invention, but rather a collective invention, not confined to individual geniuses (McAndrew and Everett, 2015).

Interestingly, the term composition originally applies to any work in music, fine art and literature, but its use tends to be more and more confined to music, particularly in some languages, such as in Portuguese. Therefore, musical pieces may be invented or composed, while instruments are hardly described as being a result of compositional activities.

This paper describes some processes and agents of instrumental invention, proposing the idea that the design and construction of experimental instruments are a product of musical composition. Our discussion will

concentrate on exclusively acoustical instruments.

2. MUSICAL INSTRUMENT DEVELOPMENT: HOBBY AND MÉTIER

Our first interest refers to the reasons why people are still inventing instruments; after all, there are already so many efficient instruments (Johnson, 1995). This creative process may be understood as a multiple source of pleasure and rewarding: it is something that pleases the inventor just by delivering a device that functions in an autonomous way, rather than a practical solution for day-life problems. There is a perspective of making meaningful music and having the instrument adopted by other performers. The instrument may be used as a tool for education. There is even a slight possibility of becoming a financially profitable product. An alternative instrument, being an unknown object to the audience, provides entertainment just by its demonstration, even if with a limited degree of artistry in the performance. Much probably, with further exploration and use of the instrument, new techniques and resources will be developed for it.

Newly invented instruments are not necessarily devices requested for a certain purpose or application, as ordinary working tools generally are. Otherwise, if no clear function is defined, they might even be regarded as “pointless inventions” (Brandreth, 1984). In fact, there is an established Japanese art of ‘unuseless inventions’, called *chindogu*, which challenges common sense, stimulates a deeper insight on our consumer culture, and defines a style of humor (Kawakami, 1996). Since experimental musical instruments are not necessarily specific tools, they can be assumed as being an artwork in its own right, entailing a comic and/or provocative content (Fischer, 1963). A branch of experimental instrument making, mostly electronic, is called *gambiarra* (Obici, 2014). The concept of *gambiarra* combines several techniques and approaches to build instruments, such as bricolage, Ready Made, circuit bending, recycling, hardware

hacking, among others. The advent of electronic music and the development of digital systems brought a new force to the ideas of instrument making in general.

Instrument inventors are numerous all over the world. Anecdotal stories refer to the existence of instrument inventors in every country, town, and village; there are international programs designed to establish courses and collaborations between such artists (e.g. <https://instrumentinventors.org/>).

Many websites and social media groups are dedicated to exotic and alternative instruments. A traditional quarterly journal, *The Experimental Musical Instruments*, was effective between 1985 and 1999, with 70 issues (Hopkin, 1996). There is a good demand for experimental instruments in education and in contemporary music. Some associated terms are particularly attractive, when instrument making is considered, such as “recycled materials”, “everyday objects” and “hands-on activities”.

3. ACOUSTICALLY INFORMED INSTRUMENTS

We adopt this broad term to refer to instruments that have been developed with the help of the available knowledge provided by music acoustics, organology, psychoacoustics, and other disciplines, such as audio technology and ethnomusicology. Instrument inventors, in case they want to share their invention, might be required to explain how their instrument works, at least to their best understanding. Also, in order to justify the “acoustically informed” label, it would be expected that the makers and dealers should provide all the available information about the instrument to the public, whenever it is exhibited, published, demonstrated or traded. This refers to ethical aspects of instrument making: as an artistic and material activity, it involves copyrights, industrial property and cultural heritage (Droth, 2004).

This author has been working in a project that aims at gathering, classifying and developing instruments based on the pioneer work of Hermann von Helmholtz, whose bicentennial

was celebrated in 2021. Several new acoustically informed instruments were produced in collaboration with Malte Kob, professor of music acoustics at the Detmold University of Music, Erich Thienhaus Institute. A family of “Helmholtzian” instruments was designed, analyzed and prototyped using 3-D printing, to make the models available and sharable online (Fuks et. al., 2021; Goldenbaum and Fuks, 2021; Almeida and Fuks, 2021).

Unfortunately, many instruments are exposed and offered to the market without proper information about their origin, ethnic context, historical use and additional data that might connect them to other existing instruments and cultures. Furthermore, some reputed instrument makers, that employ highly specialized acousticians, tend to publish some groundless information on their websites and manuals, such as “The 500 and 600 series combine the brilliance of nickel silver with the characteristic mellow timbres of sterling silver, while the 700 series delivers warmth and expressive color that only the finest silver flutes can provide.” There is no available published data in the acoustics domain to support these statements, that are probably provided by a marketing division of the company (Yamaha Corporation, 2022).

Some invented products are not complete instruments, but accessories or replacement components for the instruments that may bring some improvement to them. One well known example among wind players is a recent product, commercially known as LaFreque Sound Bridges (<https://www.lefreque.com/>). Their website contains information about a network of users and endorsers, with several assertions about the product's acoustical properties and even supposed acoustical principles that have absolutely no scientific support. A rigorous technical paper in acoustics couldn't confirm their claims (Petiot, 2019).



4. INSTRUMENT INVENTORS AND INNOVATIVE GROUPS

The Old Testament (Genesis 4:21) mentions Jubal, a descendant of Cain, as “the father of all who play the lyre and the flute”. This also seem to imply, at least symbolically, that Jubal was the inventor of such instruments. According to the Greek mythology, some particular instruments are deeply associated to their creating deities: Hermes and the Lyre, Pan and the Syrinx (panpipes), Athena and the Aulos - the last corresponding to the flute and to other wind instruments (Kotsanas, 2013).

We don't intend to make an exhaustive list of inventors, but rather to select some of them, drawing a panorama of different approaches and features across history.

Leonardo da Vinci (1452-1519) is credited with the invention and improvement of several instruments (da Vinci, 1478-1519).

<https://www.recorderhomepage.net/leonardo-da-vincis-recorders/>

Benjamin Franklin (1706-1790), the great American polymath, created the glass harmonica, a mechanical rotary instrument, based on the sounds generated by the friction of the edge of wine glasses and crystal bowls, which W.A. Mozart especially composed music for. Franklin had a deep background in physics, played several instruments and used to compose/arrange music.

Theobald Boehm (1794-1881) was a virtuoso flutist, with technical training as a goldsmith and as mechanic, a deep interest in acoustics, who promoted great advancements to the flute, being the main creator of this modern instrument. Böhm took lessons with professor Carl von Schafhäütl, from Munich and probably discussed with him several scientific problems related to the flute and other winds (Boehm, 1922).

Adolphe Sax (1814-1894) was one of the most prolific instrument inventors in history. He played several instruments, designed various improvements for existing ones and created

different families of wind instruments (Braasch, 2019). In spite of his spirit of entrepreneurship and connections with governments and composers, Sax was bankrupt by the end of his life, being involved in several lawsuits against other instrument makers.

Richard Wagner (1813-1883) was not properly an instrument inventor, but he requested and even commissioned instrument makers to introduce some modifications on traditional ones, to better respond and perform in his compositions. He influenced the creation of the heckelphone and the Wagner tubas, for instance.

Harry Partch (1901-1974) was an American composer, music theorist, and inventor of musical instruments. He employed several uncommon scales which required custom-made instruments. Several projects of new instruments, particularly those proposing alternative temperaments, were stimulated and based on Partch's work (Low, 1998).

The Argentinian musical group Les Luthiers, famous in Spanish-speaking countries, was founded in 1967 and is still active; the ensemble developed a large number of original and humorous instruments, almost exclusively employed in their own sophisticated comedies and parodies. Their instruments invariably hold funny and historically-elaborated names.

<https://www.youtube.com/lesluthiers/videos>

Bart Hopkin (b. 1952) is a North American instrument maker, inventor and educator who provides a thorough amount of detailed information in his influential book (Hopkin, 1996). Hopkin was the editor of the popular publication The Experimental Musical Instruments Journal.

Linsey Pollak (b. 1952) is a multi-instrumentalist, composer and instrument inventor, dedicated to traditional and new wind instruments, most of them using alternative, ingenious and curious materials and solutions. His videos are usually short and tend to focus on the attractive and exotic aspects of his

instruments and sound effects, rather than on the musical structure of his compositions.

Walter Smetak (1913-1984) was a Swiss-Brazilian composer, sculpturer and instrument inventor, who created a large number of instruments from the different families, and was very influential in Brazilian music, particularly the Tropicalist movement, having inspired several artists, in special the group UAKTI. Smetak regarded his instruments as sound sculptures and fine arts compositions (Scarassatti, 2015).

Uakti was a group from Belo Horizonte, Brazil, active between 1978 and 2015, that almost exclusively played their own-invented instruments, mostly by Marco Antonio Guimarães, a disciple of Smetak (Ribeiro, 2004).

Blue Man Group, founded in 1987, is probably the most successful and popular music group that uses their own instruments, most of them are percussions made in PVC and other common materials, some of them strikingly similar to those employed by Uakti (Moss and Blue Man Group, 1990; Hutchings, 1990; Bacon and Torok, 2011).

Stomp, founded in 1991, is originally a British percussion and physical theatre group, from Brighton. It uses predominantly body percussion, conventional percussion and everyday objects. Some of their instruments are specially customized, such as buckets and other objects with rivets and rings, that make rattling sounds. Their website doesn't inform about their instruments.

Hermeto Pascoal (1936) is one of the most important Brazilian composers of all times and is also known for using uncommon instruments, objects and methods for sound production. He masters as a virtuoso multi-instrumentalist the piano, the accordion, the flute, the saxophone, the trumpet, several percussive and stringed instruments. Examples of his alternative instruments are the teapot (chaleira) - played as a trumpet with the mouthpiece attached to the spout, singing and

bubbling inside a glass of water, whistling through a folded piece of paper, making percussive sounds out of his whole body, using noisy children's toys, making sounds from the friction of his long beard, and so. In the 70's, Pascoal used a pig on stage and interacted with it, sometimes patting and gently squeezing the animal to make different sounds. Instead of building new instruments, most of Hermeto's innovations consist of making sounds with virtuoso technique from Ready Made (Stévanço et al. 2007) objects and beings.

Nicolas Bras is a young and prolific instrument inventor, maker and pop/world music composer, who has dozens of videos on Youtube. The main features of his work are the visual and sound appeals of his inventive and entertaining instruments and performances, some of them taking only some seconds for each instrument.

The Wikipedia article elaborated on inventors, "Category:Inventors_of_musical_instruments" lists 77 inventors, many of them still unknown to most readers. Among the inventors' names, the only ones widely recognized are Bartolomeo Christofori (inventor of the piano), Adolphe Sax (inventor of the saxophone and saxhorn families), along with Theremin, Cahill, Hammond, Moog, Les Paul, Oberheim, and Rhodes, all of them creators of successful electronic or electroacoustical instruments.

5. WHAT IS THE NAME OF THE INSTRUMENT?

A relevant part of the creation of an instrument seems to be the creation of its name.

Not only the instrument maker but also the audience is often eager to know what it is called, usually expecting an ingenuous and even humorous word, probably reflecting the instrument's main features. It is admissible that the naming of instruments is, in itself, a modality of art (Radermecker, 2019; Leder et al., 2006). In organology, there is a systematic way of classifying them, bringing other similar and ancestral ones, what may be helpful in the naming of the instruments. The five categories



from organology are an effort to include all possible instruments, but some of them belong to more than one category. The organological categories widely accepted are: idiophones, membranophones, chordophones, aerophones, and eletrophones (Hornbostel and Sachs, 1914; Montagu, 2017; Wachsmann, 1984; Kartomi, 1990; Knight, 2015; Magnusson, 2017)

On the other hand, some instruments are given completely arbitrary names or, sometimes, a name that only distantly refers to their organological and acoustical features. For instance, the popular percussive aerophone usually made of PVC pipes, is called by several names: tubulum, thongophone (thong being a type of flip-flop), PVC pipe xylophone, chinelofone (flip flop-phone in Portuguese), etc. The latter a name that doesn't refer to the instrument itself, but to the method for exciting the tube, sometimes with an actual flip flop. Interestingly, the website from the well-known Blue Man Group, that notoriously uses it, doesn't inform how they call their instruments. Their previous online links on the instruments are not available at the moment.

The various instruments with names ending in "phone" are in part eponymous, referring to the maker or inventor, such as saxophone, sarrusophone, sousaphone, and heckelphone. Besides, there are some additional ones, that refer to the material, the principle of operation (wind), pyrophone (fire), photophone (light), vibraphone (a tremolo, or vibrato-like effect), among a few others or some sound feature, like xylophone (wood), lamellophone (blade or tongue), aeliphone (wind), pyrophone (fire), photophone (light), vibraphone (a tremolo, or vibrato-like effect), among a few others.

6. WHAT ARE THE DESTINATIONS OF INVENTED INSTRUMENTS?

Most of books of the type "inventions that changed the world" rarely include musical instruments but, mainly, sound recording and playback equipment (Challoner, 2009; Philbin, 2005; Fakrudeen, 2021). Usually, most of the newly invented instruments are discontinued in

terms of not being adopted by performers, not receiving dedicated compositions, and not being further recorded in original or transposed pieces. When an instrument is developed by a musical group, is prone to be associated to it; with the decay of activities or the end of the group, the instrument tends not to be used anymore (Ribeiro, 2004). Invented instruments are kept by their makers, who proudly demonstrate them to interested listeners, but are hardly able to share them among players, educators and students. The huge production of Walter Smetak, for example, the mentioned composer and inventor, is available online and in books that mostly display their sculptural and constructive features; his instruments' sounds and music, however, are hard to find (Scarassatti, 2015). This behavior would indicate that newly-invented musical instruments often follow the path of artistic creations, rather than that of commercially competitive technological products and tools (Lamarque, 2010).

7. MINIMALIST MUSIC AND INSTRUMENTS

"Obviously, new instruments make new music" (Reich, 2004)

Steve Reich is one of the main founders and composers of the minimalist movement, with Philip Glass. He wrote compositions for simple instruments, such as clapping hands and wooden claves. His important work from 1973 is *Music for Pieces of Wood*, requires five pairs of tuned claves, supposedly to be adapted or built by the performers. The instruments are carefully described and depicted on the introductory part of the score (Reich, 1973). In spite of being unconventional instruments, the composer doesn't mention any instrument brand or offers an address for the performers to buy or rent the claves. Some years ago, the present author made a complete set of these tuned claves, for a university ensemble.

8. INSTRUMENT COMPETITIONS AND CROWDFUNDING

One of the only competitions of its kind is The Guthman Musical Instrument Competition, with financial rewards and the goal of identifying the newest and best musical instruments developed by independent musical inventors, equally for acoustic and electronic instruments - <https://guthman.gatech.edu/>

Crowdfunding sites are a rather recent and fruitful way to promote the newly invented instruments, to make them visible/audible and to bring users and customers, sometimes with a success of thousands of sales of the products. They are regarded as helpful in the funding of projects, in particular of musical instruments, without the need of bank loans or venture capital. The most popular sites are [kickstarter.com](https://www.kickstarter.com/) and [indiegogo.com](https://www.indiegogo.com/). The instrument inventor sets a financial goal and a time period to have it completed. A video must be provided demonstrating the instrument, with additional text information, and the supporters will deposit an established amount, that should correspond to the instrument to be shipped. Some projects achieve a number of thousands of customers, providing an unprecedented way of popularizing a given instrument.

9. THE BULA, A BRAZILIAN TERM FOR PLAYING INSTRUCTIONS

Classical music from the so-called contemporary period, flourishing between the 1960's to the 1990's, often includes in the score instructions for the preparation and performance, sometimes using extended techniques and modifications on the instruments. In some particular cases, they provide directions for building the instruments.

In Brazil, these instructions received the nickname “bula”, certainly referring to the verbose content of the drug labels, i.e., medicament package inserts, containing information about the medicines. In many works, the bula provides instructions and even suggested fingering for some notes or multiphones which are beyond the conventional methods and fingering charts; The above mentioned Music for Pieces of

Wood (Reich, 1972) incorporates a careful description of the five pairs of instruments to be used.

10. TO PATENT OR NOT TO PATENT

The first obvious requirement for a new instrument is to be original, what must be initially verified through a careful search in patents databases, such as the following:

- <https://patents.justia.com/patents-by-us-classification/84/1>
- <https://ipportal.wipo.int/>
- <https://patents.google.com/>

An examination on the patents websites, show that musical instruments is a subject placed among the largest number of patents in the world (USPO). There are three types of patents: (1) Utility patents, that may be granted to anyone who invents or discovers any new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof; (2) Design patents, may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture; and (3) Plant patents - do not apply to instruments.

The costs in obtaining an international patent for a single invention vary considerably; a minimal value for its application would be ca. U\$ 5,000 (Gassman et al., 2021). To maintain a final patent for ten years, the additional international costs are above U\$ 15,000, sometimes achieving much higher values. Therefore, there is no reason for the patenting of every instrument, what would incur high expenses to the inventor and a non-promising market.

Instruments may be also registered, as mentioned above, as designs. This refers to existing instruments, protected or not by invention patents. This type of patent is sometimes as expensive as in the case above to be registered and maintained.

Another possibility, when the instrument offers an original visual, constructive and functional display, is the registration as an artistic work, such as the musical sculptures conceived by



Smetak. The advantage of such documentation are the low costs and the short time for its implementation. If this register ensures the authorship of the instrument, consisting of a copyright document, it does not fully protect the creator in the case of some instrument maker that decides to produce a similar version of it. At least, if properly done, no one will have the exclusive rights to reproduce it through a patent.

11. TWO CASE STUDIES

11.1 The Glissotar, a Tarogato without Keys

This fascinating instrument called glissotar, a contraction of the terms glissando and tárogató - a Hungarian woodwind, reflect some of its sounding characteristics and origin. The tárogató was developed in the 1890's, many years after the saxophone, which was patented in the 1850's. The name of the modern tárogató was taken from an ancient Hungarian double reed wind instrument, similar to a shawm (Radford, 2005). The adoption of such name is influenced by a nationalistic attitude, as an effort to reinforce the Hungarian cultural heritage. The glissotar was developed by Dániel Váczi and Tóbiás Terebessy <https://glissonic.com/>

It consists of a body similar to a tárogató or a soprano sax, and a longitudinal slit covered by a magnetic ribbon, stretched by an elastic device. The player is able to define the acoustical length of the instrument by pressing the ribbon at the desired spots, without the need of tone-holes or keyworks. It is important to mention that Leonardo da Vinci, by the end of the 16th century, sketched recorders with longitudinal slits (Codex Atlanticus Folio 1106r). Also, two makers - Swanee and Reifel & Husted- produced the so-called slide saxophones in the 1920's and 1930's (Rycroft, 1999; Cohen, 1994). The glissotar deservedly won first place in the 2022 edition of the Guthman Musical Instrument Competition. It would be elucidative if the information about this instrument contained references about the mentioned and other sources that preceded the contemporary creation.

11.2 The BaroBottle

A well-known instrument made from pressurized PET bottles is the so-called bottlephone. <https://youtu.be/eHoHqHK2UVU> Usually, a bicycle valve is installed across the bottle cap and the internal pressure is increased by a hand pump. A set of such bottles may be arranged, held and tuned as the player wishes. The maintenance of the intonation is hard, due to temperature changes, as well as small air leaks and the distension of the material. If an accurate tuning is needed, a frequent work must be done to keep them under control. The sound produced usually contains a noticeable inharmonic character, what seems to be also dependent on the shape of the bottle. We could not find an article about the acoustics of such bottlephone. One could try to model its behavior from some references related to the oscillation modes of large thin shell vessels (Gao et al., 2022). Departing from this instrument, the present author examined several bottles, trying to find models, sizes and ways that allowed suitable sound levels and good controlling conditions at comparatively lower pressures, connecting the bottles directly to the player's mouth. Among several bottles between 1.5 and 3.0 liters, the selected one seemed to have the best acoustical response: a 2.25 liters Guaraná Antarctica (a typical Brazilian soda) bottle. This is a Ready Made instrument, since it doesn't need any change or interference to become a musical instrument (Stévance et al., 2007). By attaching the mouth to the bottle neck and varying the internal pressure, a range of more than an octave is achieved, usually excited by finger tapping. A suitable mallet may obviously be used.

The following video documents the interaction between the author and composer Hermeto Pascoal, during the demonstration of this instrument.

- <https://youtu.be/QuKsyVkgIYg>



Figure 1. Author demonstrating the BaroBottle to Hermeto Pascoal. At this moment, Pascoal is tapping the bottle, while Fuks is varying the internal pressure.



Figure 2. Hermeto Pascoal is exploring the bottle in a different way, squeezing it and producing a breathy sound.

The following video was done in duo with colleague Babilak Bah in 2012, when the instrument was “discovered” or invented by the author <https://youtu.be/ZAZXtR43XPM>.



Figure 3. Author and colleague are playing BaroBottles. One of the bottles remains with the plastic label, while the other was removed. The vibrations are considerably freer and more durable without the damping of the label.

12. REGISTERING AN INSTRUMENT AS A MUSICAL COMPOSITION

The BaroBottle is a Ready Made instrument. It doesn't need any modification to be used as a musical instrument. In case one would like to obtain a patent for it, it might be carefully described as a vibrating vessel with a thin shell (Gao et al., 2022), made in plastic or other similar material, with a shape that resembles that of a soft drink bottle, trying to encompass the dimensions and features of that one on the pictures, but also including other volumes, thicknesses, materials and shapes. It would cost at least US\$ 15,000 to have this property protected in the whole world.

This author's decision, in a completely different direction, was to register a musical work, called BaroBottle 1, at the Brazilian office for musical copyright registration, located at the Rio de Janeiro School of Music. This musical piece contains an introduction (called “bula”), with illustrations and texts explaining how to select a plastic PET bottle, giving recommendations about different brands and volumes. It also instructs on how to use the instrument and contains YouTube links with sound and video examples. The score consists of several phrases, with a thorough exploration of the instrument, in terms of attacks, glissandi, scales, and several other musical and sound resources of the instrument. By means of this copyright document and the videos, the authorship of the piece and the instrument are believed to be associated to the composition and invention described. The costs for this registration are very inexpensive, only about US\$ 4.00. This means that the instrument can be used by anyone under the condition of acknowledging the author/inventor rights. However, in case the instrument is marketed or produced especially for musical purposes, with the same dimensions and characteristics, the author could not claim any industrial property. On the other hand, it will suffice, for anyone wanting to employ the instrument, to declare this authorship. In case of a live performance



or a recording, the author still has the copyrights.

These are the links for the copyrights office in Brazil.

- <https://musica.ufrj.br/registro-autoral/sobre-o-direito-autoral>
- <https://cartadeservicos.ufrj.br/servico/414#!>

13. CONCLUSIONS

Musical instruments invention is a very dynamic activity all over the world, attracting new practitioners, composers, performers, educators and the general audience. It seems to be very rewarding and stimulating, involving principles and knowledge from several fields of science, technology and arts.

Many of the successful instrument inventors mentioned had deep backgrounds in art, science and technology. It seems that their musical training, in terms of composition, perception and performance skills are essential for the quality and originality of the instruments.

Musical instrument invention can be considerably helped by systematic studies in historical musicology, ethnomusicology, music acoustics, organology, design, and other disciplines.

As an invention, musical instruments have clear features of ordinary tools, but also of artistic creations.

There is a huge market for instrument invention and innovation, comprising products for music education, performance and entertainment.

Instrument invention should be stimulated as an activity at school, university and among communities of craftsmen. Composers are important idea givers and partners in the promotion and incorporation of the instruments in musical practice.

Instruments can be registered as patents (both as utility invention and design), as musical compositions, and also as sculptures; the two last modalities ensuring copyrights, but not industrial property.

By means of registering a new instrument, in the case of a Ready Made instrument exemplified, it was possible to quickly and with low expenses obtain a document that asserts about its authorship.

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