

# Multiple Pianolas in Antheil's *Ballet mécanique*

Paul D. Lehrman  
Tufts University Department of Music  
20 Talbot Avenue  
Medford, MA 02155 USA  
paul.lehrman@tufts.edu

## ABSTRACT

George Antheil's notorious *Ballet mécanique* (1924-1925) was originally scored for percussion ensemble, sound effects, and 16 pianolas. He was never able to perform the piece with those forces, however, due to his inability to synchronize multiple pianolas. Thus all performances of the piece in his lifetime, and for decades after, were done with a single pianola or player piano.\*

The author traces the origin of the concept of synchronizing multiple pianolas, and explains the attendant technological issues. He examines attempts to synchronize mechanical pianos and other time-based devices at the time of *Ballet mécanique's* composition, and suggests that Antheil's vision for his piece was not as farfetched as has long been thought.

## Keywords

Antheil, Stravinsky, player piano, pianola, mechanical instruments, synchronization

## 1. INTRODUCTION

*Ballet mécanique*, by the New Jersey-born composer George Antheil (1900-1959), is one of the most famous, and infamous, compositions in 20th-century music. It was the first piece written for multiple automated instruments, and presaged the use of what are now called sequencers by over half a century.

The composer attempted to break new musical ground structurally, sonically, and technologically. At its premiere in Paris, where Antheil was living at the time, it was a huge success, despite the fact that it was performed by an ensemble considerably reduced from what Antheil originally proposed.

Antheil's score called for a percussion orchestra of xylophones, bass drums, tamtam, pianos, electric bells, siren, and airplane propellers, along with 16 synchronized pianolas performing four different parts. Although no one had ever before attempted to synchronize even two pianolas, Antheil insisted right up until the piece's premiere that it was possible.

Eventually, however, he realized the impracticality of his idea, and modified the piece so that a single pianola covered all four parts. It wasn't until the very end of the 20th century, using computer-controlled player pianos and MIDI sequencers, that *Ballet mécanique* could be realized in its original instrumentation.<sup>1</sup>

Antheil's vision of a huge ensemble of mechanical pianos was radical, but it was not entirely original, nor was it as farfetched as might be assumed. Recent research by the author shows that a system such as Antheil envisioned was in fact feasible using technology available at the time. It is possible, furthermore, that observations of instruments he saw in his youth inspired his vision. But his understanding of the technology was faulty, and this may have been the biggest contributor to his failure to realize his vision for the piece.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. *NIME'12*, May 21-23, 2012, University of Michigan, Ann Arbor. Copyright remains with the author(s).

## 2. STRAVINSKY'S PRECEDENT

Before *Ballet mécanique*, only one composer is known to have even considered the idea of combining multiple pianolas: Igor Stravinsky (1882-1971) had extensive experience with pianolas, transcribing several of his works onto rolls for both the Aeolian Company in England and Pleyel in Paris.

### 2.1 *Les Noces*

Beginning in 1914, Stravinsky started *Les Noces* four times, abandoning the first three efforts. In a later interview he recalled that while working on the third version, which he began in 1918, "...I decided to have the Finale accompanied mainly by four pianos. It seems to me that my thinking on that point will be clearer to you if I tell you that for a while I was minded to put four pianolas in their place."<sup>2</sup>

But the "great difficulty of synchronizing the parts executed by the instrumentalists and singers with those rendered by the mechanical players"<sup>3</sup> dissuaded him from including the idea in the fourth and final version of the piece, which he wrote between 1921 and 1922. The final version includes four conventional pianos.

### 2.2 Stravinsky and Antheil

Antheil idolized Stravinsky, and made no secret of the fact in his articles and letters. The two met for the first time in 1922 in Berlin, where Stravinsky was waiting for his mother to emigrate from the Soviet Union. Stravinsky was impressed with Antheil's music, especially a piece that Antheil had written which was highly imitative of Stravinsky's *Symphonies of Winds*. They spent significant time together over a two-week period, at the end of which Stravinsky returned to Paris. The Russian invited the American to join him there, which Antheil finally did a year later, the day of the premiere of *Les Noces*.<sup>4</sup>

Antheil made no mention in any later writings of discussing the use of multiple pianolas with Stravinsky, but it requires very little stretch of the imagination to suggest that they did so. Soon after Antheil arrived in Paris, he and Stravinsky had a serious falling-out, due in part, according to some reports, to Antheil accusing Stravinsky of stealing the idea of using four pianos *Les Noces* from him.<sup>5</sup>

## 3. SYNCHRONIZATION ISSUES

Synchronizing two or more mechanical pianos is not trivial. Most mechanical pianos have tempo controls, but they are not calibrated or referenced to any standard. Thus if two identical mechanical piano rolls are started at the same time, at the same nominal tempo, they will quickly drift away from each other. For pieces as heavily percussive and rhythmic as *Les Noces* or *Ballet mécanique*, this would be disastrous.

In filmmaking, multiple editing surfaces are synchronized using sprocket wheels on the film transports and chains to connect them. But piano rolls do not normally have sprockets. Thus even if the mechanisms were locked together, the players would still go out of sync—although perhaps not as quickly—due to differences in the thickness of the paper and to slippage of the rolls.

Using a single roll mechanism to drive the hammers and pedals in multiple instruments is not feasible, due to the

limitations of the pneumatic systems used in most of the mechanical instruments of the era. Should the tubing between the roll mechanism and the hammers exceed ten feet, the response of the system would be delayed due to the propagation speed of the change in air pressure, or it would not respond at all, due to the loss of pressure.<sup>6</sup> While “orchestrions”—player pianos that incorporate other instruments like percussion, violins, and organ pipes in a single cabinet, driven by a piano roll—could be squeezed into a case in such a way that none of the tubing would exceed ten feet, this was not practical when linking multiple instruments.

## 4. SYNCHRONIZATION SYSTEMS

Even while Stravinsky was still entertaining the idea of multiple mechanical pianos, there were a number of inventors working on methods of synchronizing pianos with other time-based mechanisms. Recognizing the limitations of all-pneumatic systems, the developers of synchronization systems proposed during the player-piano era all used a combination of electrical and pneumatic technology. Although none of them were specifically designed to synchronize multiple player pianos, in theory, they could have been adapted for such use. Some of them built operational prototypes.

### 4.1 Player Pianos + Phonographs

Between 1913 and 1916 three companies produced systems that combined a player piano with a phonograph. They were designed to allow a recording of a vocalist or instrumental soloist to be accompanied by a piano. Since phonograph recordings at the time tended to sound worse the more instruments one tried to record on them, these systems would separate the musical elements: the singer/soloist would be on record, while the accompaniment would be “live.”

#### 4.1.1 Gulbransen and Melville Clark

Systems built by Gulbransen and Melville Clark required the user to manually adjust the speed of the piano roll so as to remain in sync with the recording. Although a number of models were built, and Gulbransen’s marketing literature claimed that it was “quite simple” to get them to “synchronize perfectly,”<sup>7</sup> in fact the process of keeping the voice and the music together proved to be far too cumbersome for the intended market, and the idea was soon abandoned.<sup>8</sup>

#### 4.1.2 Welte

Heinrich Bockisch, an engineer with the Welte company, designed a system to do this task automatically. A combination of electrical contacts on the phonograph turntable and a dedicated duct on the piano roll regulated the piano mechanism’s speed through a series of vacuum chambers, valves, pressure sensors, and switches. An extremely complex system, it contained several hundred moving parts and was protected by seven United States patents, which together covered over 80 pages of text and 27 pages of detailed diagrams.<sup>9</sup> The company reportedly was able to build two prototypes (one for Edison discs and the other for Victor discs), and some rolls for the system are in the hands of present-day collectors, but the devices were never put into production, and none exist today.

### 4.2 Player Pianos + Film

The patent documents for the Welte system include mentions of its possible use to link player pianos with film projectors, but this was apparently never attempted. In the early 1920s two systems were proposed—both in France—that were more specifically designed for this purpose, although neither one of them was able to achieve their goal.

#### 4.2.1 Delacommune

A “Device For Synchronizing Various Apparatus With Motion Picture Projection,” was patented in 1922 by Charles Delacommune, an inventor and entrepreneur who was close to Fernand Léger, the artist whose *Ballet mécanique* film was originally designed to synchronize with Antheil’s score. In this system, a mechanical linkage connects the projector motor to a roller which drives a perforated paper tape, similar to a player-piano roll, but with only 12 “tracks” (as opposed to a player-piano’s 50 to 88). The tape is sprocketed to prevent slippage.<sup>10</sup>

As the tape travels, a series of sprung levers poke through the perforations and make contact with a metal plate below, activating solenoids, valves, lights, or other electro-mechanical devices. At the same time a second roller mounted on a wooden desk draws a paper roll on which is printed a script, a list of sound effects, or a musical score, to be interpreted by an actor, a technician, or a conductor, respectively.

The system, which the inventor called the “Ciné-pupitre,” was publicly demonstrated only once, in 1922, when it was used to cue the conductor of a score by Arthur Honegger accompanying a short film by Abel Gance.<sup>11</sup>

Although Delacommune’s patent claims that his system could operate “a mechanical piano whose keys are controlled by circuits each corresponding to a lever of the distributing device,” in reality the system would have had to have been much larger and more complex in order to cover even a reasonable fraction of the notes of a piano. It seems unlikely that the device would have lent itself to such scaling.

#### 4.2.2 Pleyel

In November, 1922 Pleyel, the Paris piano manufacturer above whose factory Stravinsky maintained a studio, and who was later to create the piano rolls for Antheil’s *Ballet mécanique*, filed a French patent (a British filing followed a year later) for a synchronizing system for “automatic musical instruments, kinematographs, [and] phonographs....” Similar to the Welte system described earlier, it claimed to use a series of vacuum chambers, bellows, and pneumatic speed controls to synchronize “the several apparatus being naturally in any number.”<sup>12</sup>

In contrast to the Welte system, however, the Pleyel patent was slim and vague, consisting of a mere four pages of text and a single page of simple graphics. A prototype was never built.

## 5. ANTHEIL’S CONCEPT

While some of these schemes were more feasible than others, George Antheil’s description of how he would perform *Ballet mécanique* bears little resemblance to any of them.

Antheil was convinced that some form of electrical switchboard would allow him to operate the multiple pianolas from a central control position. While the piece was in preparation he wrote a number of correspondents about the system he envisioned. In early 1924, as he was starting on the piece, he wrote to his friend and patron Natalie Clifford Barney, “We are going to give the first ALL MECHANICAL music in the world, and instead of a director or conductor, I will be at a switch-board. Pleyels [sic] are cutting all of the Ballet Mecanique upon one huge roll (the cutting is already in progress and will soon be finished) which will be the master roll for the electrical operation of 16 grand pianofortes...”<sup>13</sup>

In the same letter he indicates that other parts were to be played mechanically as well: “...The xilophones [sic], electric motors, etc. will be electrically controlled from another roll specially cut, and operated from a little switchboard before me, which can cheaply be arranged by an ordinary mechanician.”

He continued to believe for some time that his idea was possible. In May 1925 he wrote an article describing an opera

he was planning, based on a chapter in James Joyce's *Ulysses*, that would use a similar ensemble. (He never got past the third measure.)<sup>14</sup> And in December 1925 he inscribed a copy of the *Ballet mécanique* rolls that he sent to his friend Mary Louise Curtis Bok, "These are the master rolls which run the 16 pianos electrically from a common control (switching on 16 or 1 as might be necessary to the sonority)...."

He even managed to convince a reporter from the *New York Herald* that at the public premiere of the piece on June 19, 1926, "...there were sixteen pianolas connected with and synchronized with the instrument at which Mr. Antheil worked with such zeal at his feet. A loud-speaker was set at each side of the stage, however, to carry the conglomerate of sound from these hidden instruments to the listeners."<sup>15</sup> This was a complete falsehood—there were no hidden pianos.

## 6. ELECTRICAL CONTROL OF MECHANICAL PIANOS

The system that Antheil told his friends was going to perform *Ballet mécanique* was, of course, never built. The systems for synchronizing player pianos with other mechanisms that did exist—either in reality or on paper—had nothing in common with the system that Antheil envisioned.

But in fact some years prior to Antheil's starting work on *Ballet mécanique*, at least two automated instrument systems had been built using technology that bore a much closer resemblance to Antheil's description, and could conceivably have been improved and modified to accomplish Antheil's goal in the way he hoped.

### 6.1 Wurlitzer/Inhof & Mukle

From 1914 to 1918 the Wurlitzer company made an orchestrion called the Unit Orchestra for use in movie theaters. It was designed both for live keyboard performance and to play perforated rolls. The piano keys and roll mechanism, instead of opening pneumatic valves, closed electrical switches, which sent control signals through a series of relays to the pneumatic mechanisms, which could therefore be located some distance away. This gave far more freedom to theater designers and organ installers when it came to placement of the keyboard. According to mechanical instrument expert Arthur Reblitz, "The console in a Unit Orchestra could be located where the musician could see the screen, and the pipes could be located in chambers beside the screen, closer to the audience."<sup>16</sup>

Whether Antheil was aware of this system—or a similar one reportedly made in Germany by Inhof & Mukle—is unknown, but with some modification, and a "little switchboard," it might have been used to perform *Ballet mécanique*. But there is no evidence that such a device was ever conceived or built.

### 6.2 Tel-Electric

Even closer to Antheil's idea were player pianos and retrofittable player systems made by the Tel-Electric Company of Pittsfield, Massachusetts, from 1907 to 1917.<sup>17</sup>

The Tel-Electric system was unique in that it did not use pneumatics at all. The mechanism that drove the keys consisted of a set of simple 12-volt DC motors—rotary solenoids—one for each key, which turned 90° when current was applied to them. Mounted in a box directly under the keys, each solenoid was connected to a stiff wire which went up through a hole in the underside of the piano and attached to a key. As the motor turned, it pulled the key down, and when the current was removed, gravity and the piano's action pulled the key back up.

The control mechanism was located in a separate box, connected to the drive mechanism by a multi-conductor cable. Power was supplied from house current or (for powerless

homes) a car battery. The voltage going through the control cables could be varied with an "expression" knob on the control unit, so that the force of the motors, and thus the velocity of the keystrokes, could be controlled over a wide range.



**Figure 1. Solenoids from a Tel-Electric system installed under the keys of an Ivers & Pond upright piano**

The control unit used a motorized cylinder to read the piano rolls, but instead of paper, the rolls were made of .003-inch-thick brass. The roll passed between a comb-like rack of sensing fingers and the tracker bar, with each finger acting as a switch upon encountering a perforation in the roll. The brass was touted as being impervious to shrinkage, stretching, or other types of deformation or damage caused by variations in temperature and humidity.



**Figure 2. Tel-Electric Control unit**

The Tel-Electric company did not have a long life. While the brass rolls were more durable than competitors' paper rolls, they were far more expensive, not to mention completely incompatible with any other system. These were issues for player piano owners who wanted to collect a large repertoire of rolls from multiple manufacturers.

In 1917 the United States entered World War I, and the company was designated by the government as "having resources important to the war effort." It shut down its musical instrument operation and converted to producing war materiel. It went out of business completely in 1921.

Despite its brief history, the company was able to sell approximately 10,000 instruments and systems over a 12-year period. Its main sales office and recording facilities were in New York City, and most of its sales were in the Northeast.

In retrospect, modifying a Tel-Electric system to control multiple player pianos or other instruments in perfect synchronization would have been a simple task for a clever electrical engineer: it would essentially have involved creating cables that could run from a single control unit to multiple

solenoid banks, and perhaps building a larger power supply to accommodate the extra current. It would also have been simple to build an auxiliary “switchboard,” as Antheil described, to route the various switch closures to different instruments.

Tel-Electric’s unique technology was far ahead of its time. It is the direct ancestor of the technology used in modern computer-controlled solenoid-operated player pianos from manufacturers such as Yamaha, QRS, PianoDisc, and Bösendorfer. Had development of the system been able to continue, it could have led to even more intriguing possibilities than controlling multiple instruments, such as instruments that could transpose or, if every key were to have its own variable resistor, instruments with much greater and more subtle dynamics control.

## 7. WAS THIS IN ANTHEIL'S MIND?

There is no record of George Antheil ever having seen a Tel-Electric piano before embarking on *Ballet mécanique*. But given the instruments’ popularity in the Northeast U.S., it is quite possible that the young Antheil might have encountered one. As he was fascinated with machines, he surely would have given it more than a cursory look. He may have been particularly impressed with the external roll reader, and the relatively simple electrical connection between the reader and the player mechanism.

Thus it is not unreasonable to speculate that the Tel-Electric design may have been in the back of his mind a few years later when Antheil began to develop his ideas for *Ballet mécanique*. Indeed, it is difficult to consider any other technology that might have influenced the young composer.

## 8. WHY IT DIDN'T HAPPEN

Why Antheil was not able to use a modified Tel-Electric system or something similar to perform *Ballet mécanique* can be explained by three primary factors.

First, although Antheil was fascinated by machines, he had no training in engineering, and he may not have realized that Pleyel’s (and every other manufacturer’s) approach to player piano design was completely different from Tel-Electric’s. A potentially simple modification of a Tel-Electric system to control multiple pianos was in no way applicable to Pleyel’s pneumatically-driven instruments.

Second, Tel-Electric’s products were unknown in Europe. According to player-piano historian Bob Billings, there is today only one Tel-Electric system known to be in existence outside of the United States, and it is in England. In German player-piano expert Jürgen Hocker’s recent exhaustive history of the instrument, *Faszination Player Piano*, the Tel-Electric system does not even get a mention.<sup>18</sup>

Finally, by the time Antheil arrived in Paris, the Tel-Electric Company, and its technology, were long gone.

## 9. CONCLUSIONS

George Antheil’s ideas for using multiple synchronized automated player pianos to perform *Ballet mécanique* were very far out of the mainstream in 1920s Paris. But the technology for doing so did in fact exist, although not in a form that he could have used.

Several companies had synchronization technology that might have been customized to play Antheil’s piece, but Pleyel was unable or unwilling to work with those companies.

Antheil’s conception for the piece may have grown out of observation of a unique American player piano system, which could have been modified to achieve his goal. However, time, geopolitics, and market forces all conspired against this possibility. It would not be until 75 years later, using MIDI-controlled solenoid-driven player pianos, that *Ballet mécanique* would be performed according to Antheil’s wishes.

Had Antheil been able to achieve his goal, it is possible that 20th-century music would have developed very differently. The use of automation as a composition and performance tool might have had a significant role in the music of the first half of the century, instead of lying dormant until the 1980s.

## 10. ACKNOWLEDGMENTS

Thanks to Mauro Piccinini, Rex Lawson, the Automatic Musical Instrument Collectors’ Association, and Joe Lavacchia for access to his Tel-Electric-equipped player piano.

## 11. NOTE & REFERENCES

\* “Pianola” was originally the trademark for a piano-playing device made by the Aeolian Company which attached to a conventional piano. It used a perforated paper roll and a series of pneumatic valves to operate mechanical fingers to play the keys on the piano. A “player piano” uses the same principles, and can use the same paper rolls, but the player mechanism is inside the instrument, and operates the keys directly. The word “pianola” became a generic term for all such instruments. For purposes of this paper the two terms, as well as “mechanical piano,” can be considered synonymous.

- [1] Pfeiffer, E., Hearing the Din of History, *Boston Globe*, 20 Nov 1999
- [2] Lourie, A. Oedipus Rex. Opern-Oratorium nach Sophokles von Igor Strawinsky, *Blätter der Staatsoper*, VIII/19 (1928), 9-13
- [3] Stravinsky, I, *An Autobiography*, New York: Simon & Schuster, 1932, 104-5
- [4] Antheil, G. *Bad Boy of Music*, Garden City, NY: Doubleday, Doran & Company, 1945, 119-120
- [5] Anderson, M. *My Thirty Years’ War*, New York, Covici, Friede, 1943, 257
- [6] Reblitz, A.A. *The Golden Age of Automatic Musical Instruments*, Woodinville, NH: Mechanical Music Press, 2001, 273
- [7] quoted in Lobel, L. Player Rolls Accompany the Phonograph, *Mechanical Music Digest*, 26 Feb 1997
- [8] Wood, J.R. Player Piano Rolls Accompany the Phonograph, *Mechanical Music Digest*, 20 Feb 2008
- [9] Welte. C.M., Driving and Controlling Mechanism for Music-Rolls, United States Patent #1,211,799 (1913), et al
- [10] Device for Synchronizing Various Apparatus with Motion Picture Projection, Canadian Patent #247024 (1922)
- [11] Delacommune, C. Le Synchronisme de la parole, de la musique et des bruits au Cinéma, article accompanying the published script of Maurice Noverre, *Septumia: Legend-Mime*, Paris: Livre Octave Douin, 1923, XV-XXIII
- [12] “Improvements in Synchronizing System,” United Kingdom patent 207,798 (1924)
- [13] letter from Antheil to Natalie Clifford Barney, in the collection of the Jacques Doucet Library, Paris
- [14] Martin, P. ‘Mr. Bloom and the Cyclops:’ Joyce and Antheil’s Unfinished ‘Opéra Mécanique,’ in *Bronze By Gold: The Music of Joyce*, Sebastian D. G. Knowles, ed., New York: Garland Publishing, 1999, 95-105
- [15] Modern Composer Expects Riot Call When His Performance Opens To-day, New York *Herald*, 19 June 1926
- [16] Reblitz, *op cit*
- [17] Billings, G. and Billings, B. *The Tel-Electric Company from 1907 to 1917* (The Billings Rollography, volume 6, Early Player Piano Music), Reno, NV: Rock Soup, 2001
- [18] Hocker, J. *Faszination Player Piano*. Bergkirchen, Germany: Edition Bochinsky, 2009

