



The Piano

Although there were earlier attempts to make stringed keyboard instruments with struck strings, the invention of the modern piano is credited to Bartolomeo Cristofori of Padua, Italy, who was employed by Prince Ferdinand de Medici as the Keeper of the Instruments. It is not known exactly when Cristofori first built a piano. An inventory made by his employers, the Medici family, indicates the existence of a piano by the year 1700; another document of doubtful authenticity indicates a date of 1698.

Like many other inventions, the piano was founded on earlier technological innovations. The mechanisms of keyboard instruments such as the clavichord and the harpsichord were well known. In a clavichord the strings are struck by tangents, while in a harpsichord they are plucked by quills. Centuries of work on the mechanism of the harpsichord in particular had shown the most effective ways to construct the case, soundboard, bridge, and keyboard. Cristofori, himself an expert harpsichord maker, was well acquainted with this body of knowledge.

Cristofori's great success was in solving, without any prior example, the fundamental mechanical problem of piano design: the hammers must strike the string, but not remain in contact with the string (as a tangent remains in contact with a clavichord string) because this would damp the sound. Moreover, the hammers must return to their rest position without bouncing violently, and it must be possible to repeat a note rapidly. Cristofori's piano action served as a model for the many different approaches to piano actions that followed. While Cristofori's early instruments were made with thin strings and were much quieter than the modern piano, compared to the clavichord (the only previous keyboard instrument capable of minutely controlled dynamic nuance through the keyboard) they were considerably louder and had more sustaining power.

Piano-making flourished during the late 18th century. Viennese-style pianos were built with wood frames, two strings per note, and had leather-covered hammers. Some of these Viennese pianos had the opposite coloring of modern-day pianos; the natural keys were black and the accidental keys white.^[4] It was for such instruments that Wolfgang Amadeus Mozart composed his concertos and sonatas, and replicas of them are built today for use in authentic-instrument performance of his music. The pianos of Mozart's day had a softer, clearer tone than today's pianos or English pianos, with less sustaining power. The term *fortepiano* is nowadays often used to distinguish the 18th-century instrument from later pianos.

Development of the modern piano

In the period lasting from about 1790 to 1860, the Mozart-era piano underwent tremendous changes that led to the modern form of the instrument. This revolution was in response to a consistent preference by composers and pianists for a more powerful, sustained piano sound, and made possible by the ongoing Industrial Revolution with technological resources such as high-quality steel, called piano wire, for strings, and precision casting for the production of iron frames. Over time, the tonal range of the piano was also increased from the five octaves of Mozart's day to the 7 $\frac{1}{3}$ or more octaves found on modern pianos.

Broadwood grand square action

Early technological progress owed much to the English firm of Broadwood, who already had a reputation for the splendour and powerful tone of its harpsichords. Broadwood constructed instruments that were progressively larger, louder, and more robustly constructed. They sent

pianos to both Joseph Haydn and Ludwig van Beethoven, and were the first firm to build pianos with a range of more than five octaves: five octaves and a fifth during the 1790s, six octaves by 1810 (Beethoven used the extra notes in his later works), and seven octaves by 1820. The Viennese makers similarly followed these trends, however the two schools used different piano actions: Broadwoods were more robust, Viennese instruments were more sensitive.

Erard double pilot action

By the 1820s, the center of innovation had shifted to Paris, where the Érard firm manufactured pianos used by Frédéric Chopin and Franz Liszt. In 1821, Sébastien Érard invented the double escapement action, which permitted a note to be repeated even if the key had not yet risen to its maximum vertical position. This facilitated rapid playing. When the invention became public, as revised by Henri Herz, the double escapement action gradually became standard in grand pianos, and is still incorporated into all grand pianos currently produced.

The iron frame

One of the major technical innovations that helped to create the sound of the modern piano was the use of a strong iron frame. Also called the "plate", the iron frame sits atop the soundboard, and serves as the primary bulwark against the force of string tension. The increased structural integrity of the iron frame allowed thicker, tenser, and more numerous strings to be used. In a modern grand the total string tension can approach 20 tons.

Hammers

Other innovations for the mechanism included the use of felt hammer coverings instead of layered leather hammers. Felt hammers, which were first introduced by Henri Pape in 1826, were a more consistent material, permitting wider dynamic ranges as hammer weights and string tension increased. The sostenuto pedal, invented in 1844 by Jean Louis Boisselot and improved by the Steinway firm in 1874, allowed a wider range of effects.

Strings

Other important technical innovations of this era included changes to the way the piano was strung, such as the use of a "choir" of three strings rather than two for all but the lower notes, and the use of different stringing methods. With the over strung scale, also called "cross-stringing", the strings are placed in a vertically overlapping slanted arrangement, with two heights of bridges on the soundboard instead of just one. This permits larger, but not necessarily longer, strings to fit within the case of the piano. Over stringing was invented by Jean-Henri Pape during the 1820s, and first patented for use in grand pianos in the United States by Henry Steinway Jr. in 1859.

Duplex scaling: Treble strings of a 182 cm. grand piano. From lower left to upper right: dampers, main sounding length of strings, treble bridge, duplex string length, duplex bridge (long bar perpendicular to strings), hitchpins.

Much of the most widely admired piano repertoire, for example, that of Haydn, Mozart, and Beethoven, was composed for a type of instrument that is rather different from the modern instruments on which this music is normally performed today. Even the music of the Romantics, including Liszt, Chopin, Robert Schumann, Felix Mendelssohn and Johannes Brahms, was written for pianos substantially different from ours.

Types

Modern pianos come in two basic configurations (with subcategories): the grand piano and the upright piano.

Grand piano

Grand pianos have the frame and strings placed horizontally, with the strings extending away from the keyboard. This makes the grand piano a large instrument, for which the ideal setting is a spacious room with high ceilings for proper resonance. There are several sizes of grand piano. Manufacturers and models vary, but a rough generalization distinguishes the "concert grand", (between about 2.2 m to 3 m long) from the "parlor grand" (about 1.7 m to 2.2 m) and the smaller "baby grand" (which may be shorter than it is wide).

All else being equal, longer pianos with longer strings have better sound and lower inharmonicity of the strings. Inharmonicity is the degree to which the frequencies of overtones (known as partials, partial tones, or harmonics) depart from whole multiples of the fundamental frequency. Pianos with shorter, thicker, and stiffer strings (e.g., baby grands) have more inharmonicity. The longer strings on a concert grand can vibrate more freely than the shorter, thicker strings on a baby grand, which means that a concert grand's strings will have truer overtones. This is partly because the strings will be tuned closer to equal temperament in relation to the standard pitch with less "stretching" in the piano tuning. Full-size grands are usually used for public concerts, whereas smaller grands, introduced by Sohmer & Co. in 1884, are often chosen for domestic use where space and cost are considerations.

Upright piano

Upright pianos, also called vertical pianos, are more compact because the frame and strings are placed vertically, extending in both directions from the keyboard and hammers. It is considered harder to produce a sensitive piano action when the hammers move horizontally, as the vertical hammer return is dependent on springs which are prone to wear and tear. The grand piano hammers return by gravity, hence their return will always remain more consistent than the vertical hammers, thus giving pianists better control of their playing. However, a well-regulated vertical piano will probably play smoother than a grand piano that has not been regulated for years, and the very best upright pianos now approach the level of some grand pianos of the same size in tone quality and responsiveness.