Adolphe Sax: Visionary or Plagiarist?

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This article presents an overview of Sax's brasswind inventions, identifying some of the influences on Sax and examining how he in turn influenced brasswind design.[1] A major factor affecting nineteenth-century brasswind development was intellectual property legislation. In France no preliminary examination was necessary before a patent could be granted; in Germany examination was obligatory; and in Britain the situation was intermediate. Sax's developments influenced makers in Britain more than in Germany: one reason for this could have been British patent laws, which allowed makers to register designs or apply for patents for developments that had been copied from abroad (imported inventions), as long as they had not been published in Britain. Intellectual property legislation in Britain, especially before the middle of nineteenth century, was, as Sherman and Bently state, "not organised in a consistent or coherent manner."[2]

Sax was granted seven French brasswind patents and several certificates of addition to these patents.[3] Many of his inventions are included in certificates of addition, which are not always directly related to the main patents. The reason is that the cost of a certificate of addition was much lower than that of a main patent.

The 1843 patent

In 1843 and 1845 Sax took out two patents regarding brass instruments. The 1843 patent was granted for the invention and improvement of a new system of chromatic instruments (see Figure 1). His claims concerned:

i) adaptation of spring slides,
ii) adaptation of valve slides,
iii) modifications to the Berlin valve.

A page with drawings of seven instruments carrying these modifications accompanies the short text. There are three bugles, similar to the later high saxhorns; a chromatic trumpet and a tenor trumpet; and bigger instruments described as *contrebasses d'harmonie*. Only the chromatic trumpet is equipped with the spring slide (later known as the compensator), which will be discussed below. The valve slides were not a new invention as they had already been patented by Meifred and Deshays in 1834: this part of the patent was later annulled.[4]

Sax's modifications to the Berlin valve

It is often stated that from 1843 Sax merely copied the Berlin valve and applied it to his instruments, a misunderstanding arising from the inventor's failure to clarify the nature

DOI: 10.2153/0120080011005

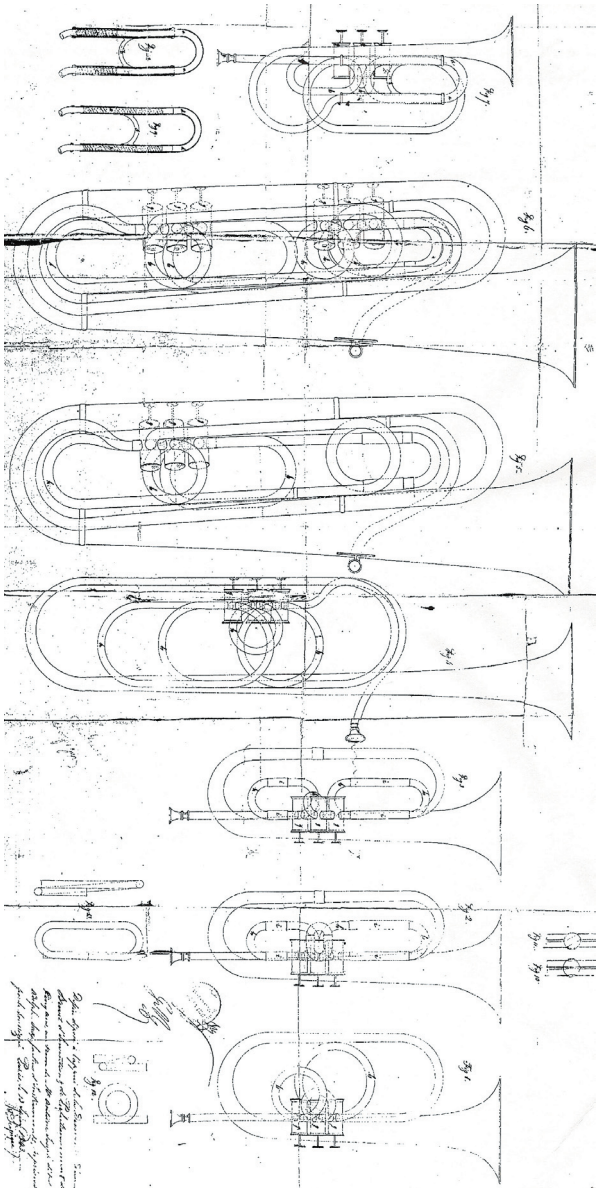


Figure 1: The drawing section from Sax's 1843 patent. Nos. 1-3, bugles. No. 4, tenor trumpet. Nos. 5-6, *Contrebasses d'harmonie* in E♭ and F. No. 7, chromatic trumpet with spring slide. Nos. 8-9, details of the spring slide. Nos. 10-11, detail of the valves. Nos. 12 -13, trumpet crooks.

of his invention in his 1843 patent. In this patent Sax mentioned that his improvement "suppresses the angles in the tubing added to the *cylindres* or *pistons*, so as to preserve in the wind instruments their initial sonority"[5] and later in the patent he referred to the "suppression of the angles or too irregular curves that distort the sounds."[6] Sax here emphasized that his "improvements" to the valves concerned the additional valve tubing, which was less angular than that of other makers; his valve loops were made in the form of a perfect circle or in an oval shape. He neither acknowledged the preexistence of the Berlin valves in Germany, nor did he claim to have invented them.

In his 1862 patent, which discusses valve design almost exclusively, Sax provided a short history of various valve systems. He referred briefly to his 1843 modifications to the Berlin valves, saying that "in 1843 I patented the disposition of the additional valve tubing," and provided drawings of the various shapes of the tubing that are more explicit than his vague 1843 patent drawings. He mentioned that with his 1843 system he had not been able to give to the valve tubing of the second valve the correct shape because

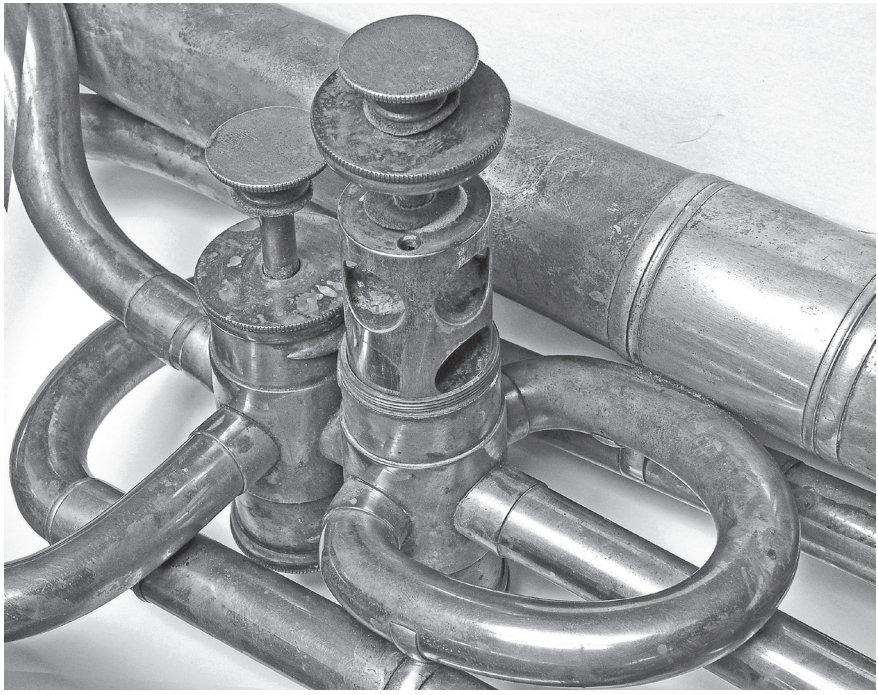


Figure 2: *Basstuba* in F, C.F. Zetsche Söhne, Berlin, probably third quarter nineteenth century. This instrument's Berlin valves are made according to the German tradition whereby valve ports are placed at right angles and the valve loops pass around the valves. Edinburgh University Collection of Historic Musical Instruments, 4091. Photograph by Raymond Parks.

of its short length. Thus even in his system, sharp angles are created in the valve tubing of the middle valve.

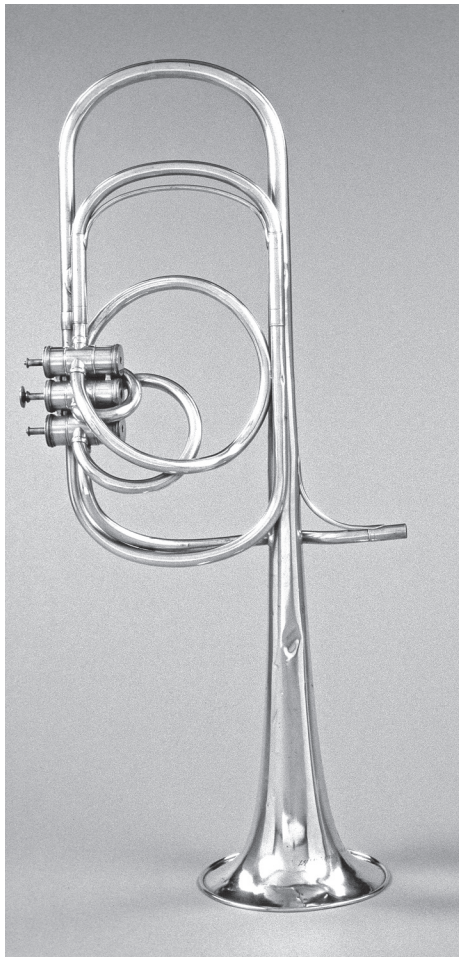
Herbert Heyde suggested that Sax's modification to the Berlin valve design concerned the valve ports, which deviated from the right angle of the German instruments and were placed at angles of 75° and 105°.[7] This was based on measurements taken from an alto saxhorn at the National Music Museum, University of South Dakota. He suggested that Sax model instruments made in other factories would have a disposition of the valve ports at slightly different angles and that this would help identify their makers. The authors' own measurements, based on a larger sample of instruments, show that there is definitely a tendency to deviate from right angles, but reveal no specific pattern, so Heyde's hypothesis cannot be confirmed. Both German and British valve pistons were measured. The measurements showed clearly that in instruments following the German tradition the valve ports are indeed placed at right angles (see Figure 2). In Sax's instruments and a few other French and British instruments, different patterns are followed. It has recently been discovered that Sax and other makers commonly purchased valves from specialist valve makers rather than make their own,[8] a practice that also precludes definite identification of instrument makers on the basis of valve details.

Examining Sax's instruments and patent drawings, one can observe the following on instruments of the early period:

- Instruments from the 1843 patent whose valve loops are made in the form of a perfect circle are not fitted with valve tuning-slides and have the valve loops passing under the valves and not around them as in most German instruments. The valves in these instruments are placed perpendicular to the bell axis in a manner similar to that of the German tradition.
- The loops are inclined in the same direction (in instruments with no tuning-slides).
- In instruments of the bell-front type that are not fitted with valve tuning-slides, the loops pass under and around the valves but are inclined (with the exception of the middle valve) in different directions (see Figures 3 and 4).

In later instruments by Sax and later drawings either published in Sax's patents or in handbills of his workshop, it can be observed that

- The perfect circle has been abandoned.
- After the introduction of the saxotromba form, the valves were placed parallel to the bell axis in a way that became strongly associated with Sax; the first and third valve loops in the higher instruments are inclined in different directions to leave space for the middle valve loop, whose inlet and outlet are on the same side of the valve (see Figure 5), whereas in the lower instruments all valve loops are inclined in the same direction.



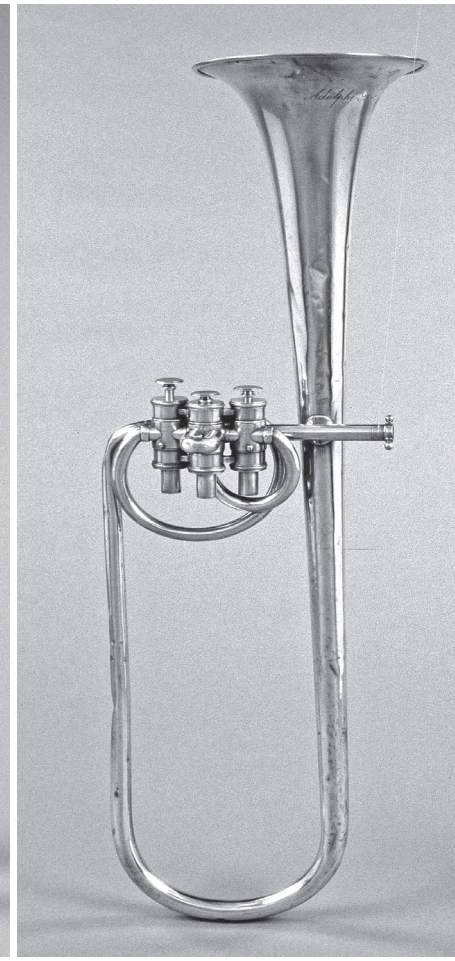


Figure 3 (left): Valve trombone, Adolphe Sax, Paris, 1847. This instrument formerly was in the private collection of Adolphe Sax. The valves loops are constructed according to the specifications of the 1843 patent. Inscribed with monogram trademark *AS* and *A ˡ S*. Serial number 4747. Musée de la musique, Paris, E.729. Photograph by Thierry Ollivier.

Figure 4 (right): Contralto saxhorn in B♭, Adolphe Sax, Paris, 1846. Made in saxotromba form for musicians of the cavalry, patented in 1845. Its valve loops are made according to the specifications of the 1843 patent. It was formerly in Sax's private collection. In the collection sale catalogue it is described as *premier modèle*. Serial number 3151. Musée de la musique, Paris, E.740. Photograph by Thierry Ollivier

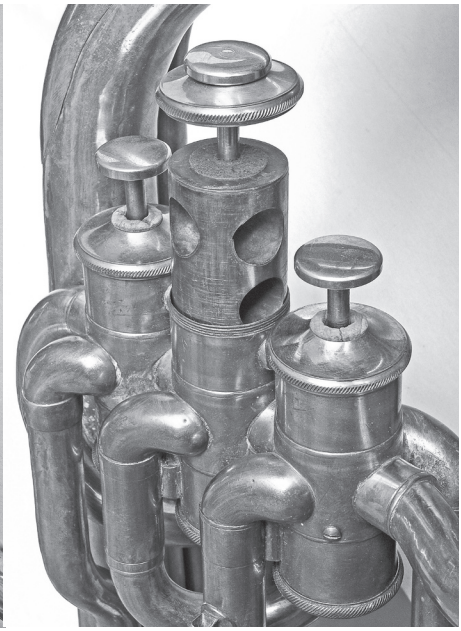


Figure 5a (left): Tenor saxotromba in E♭, 1855. This instrument has three Berlin valves; the valve loops of the first and third are inclined towards different directions so as to leave space for the second valve loops. Inscribed on bell: *No. 13247 / Adolphe Sax Breveté à Paris / F^teur de la M^son Mil^re de l'Empereur.* and monogram trademark *AS* with *PARIS* on stem of the letter S. Edinburgh University Collection of Historic Musical Instruments, 4543. Photograph by Raymond Parks.

Figure 5b (right): Contrabass saxhorn in E♭, 1846. The valve loops of all three Berlin valves are inclined towards the same direction. Inscribed on bell: *Adolphe Sax et Cie à Paris ,, 250 ,,* and monogram trademark *AS* with *Paris* on stem of the letter S. Edinburgh University Collection of Historic Musical Instruments, 4544. Photograph by Raymond Parks.

The inclination of the valve loops is something that Sax failed to mention, although it appears to be one of the major differences between his version of the Berlin valve and Berlin valves in the German tradition. He emphasized that the shape of the valve loops was that of the perfect circle; it should be noted, though, that in Wieprecht's Berlin valves the loops are also made in a round form, but their position in relation to the piston differs.

In the minutes of the lawsuits that were brought against him by rival makers, Sax on several occasions expressed the opinion that he had done better than Périnet, because he arranged the valve tubing with loops that were less angular. In his view the Berlin valves made by Wieprecht did not achieve the goal of the elimination of sharp angles since

the additional tubing of each valve "returns completely to itself," by which he probably meant the right angle.[9] He defended himself against accusations that his instruments were impractical because they lacked valve tuning-slides by saying that slides become necessary only when the player wanted to change the pitch of an instrument by using a crook.[10] However, he confessed that later he had to abandon the perfect circle, but even so, the additional valve tubing in his pistons was not as angular as in those by Périnet. One of the major advantages of his version of the valve was therefore lost, but the inclination of the valve loops was retained for some time.

Some of the later small saxhorns with Berlin valves present a peculiar feature: their second valve is of the Périnet type. However, the piston diameter, external appearance, height, and other features are identical to those of the first and third (Berlin) valves. The only difference is detected in the valve ports and tubing, which are constructed in a manner similar to those of Périnet valves; this is the case for many surviving contralto

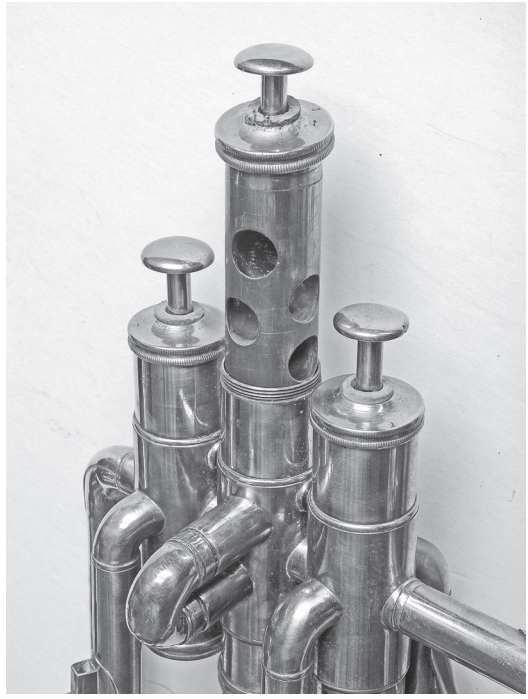


Figure 6: Contralto saxhorn in B♭, 1867. First and third valves are of the Berlin type; second valve of the Périnet type. Inscribed on bell: *N^o^ 30365 / Saxhorn C^tre^ alto Si♭ Cavalerie / Adolphe Sax F^teur^ Breveté / de la M^son^ Mil^re^ de l'Empereur / 50, rue St Georges a Paris* / monogram trademark *AS* with *PARIS* on the stem of the letter S. Edinburgh University Collection of Historic Musical Instruments, 4253. Photograph by Raymond Parks.

saxhorns. Sax never revealed why he started making the second valve with vertical additional tubing, as in Périnet valves, but it is probable that he considered the Périnet-type valve more efficient for the middle valve, which he always regarded as problematic in the smaller instruments (see Figure 6).

Another deviation from the regular Berlin valve in Sax's instruments is found in later contrabass saxhorns. At first glance the valves appear to be regular Berlin valves, but close examination shows the influence of Périnet. Again the width, height, and external appearance are identical to that of the Berlin valves, but in this case the valve ports deviate from the regular Berlin type in all three valves: the inlets and outlets of the

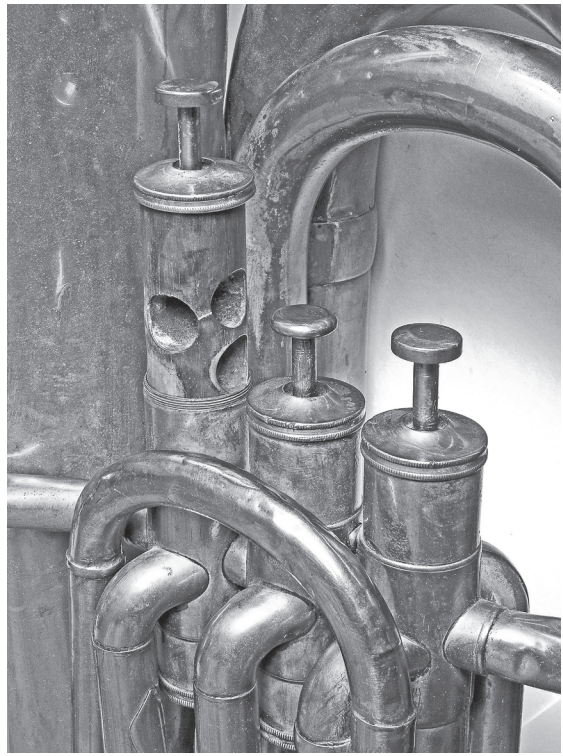


Figure 7: Contrabass saxhorn in B♭, 1869. All three valves of the Berlin type, influenced by Périnet. Inscribed on bell: *No 33112* / *Saxhorn Ctre Basse en si♭* / *Adolphe Sax Fteur Breveté* / *de la Mson. Milre. de l'Empereur* / *50, rue St. Georges a Paris* / *SEUL* / *GRAND PRIX* / *1867* / *1560* / imperfect lettering, possibly *L.M/24* upside down in ellipse / monogram trademark trademark *AS* containing *PARIS*. Edinburgh University Collection of Historic Musical Instruments, 3229. Lent by The National War Museum of Scotland (1987–65). Photograph by Raymond Parks.

additional valve tubing are placed on different levels. The difference in height, however, is less pronounced than in the majority of Périnet valves: it is about half the diameter of the valve port (see Figure 7).

The lack of standardization in the valve designs used by Sax could be attributed to the fact that he probably relied on different suppliers over the years. Although Comettant, Sax's biographer, states that every single instrument part was manufactured in the Sax workshop, elsewhere in the same work he discusses the story of an independent piston maker[11] who produced the Sax version of the Berlin valve in the early days. Although Sax and this *pistonnier* discontinued their collaboration, Sax probably found a different valve maker among the others active in Paris.

British-registered designs of the time may indicate what makers considered to be a Sax valve. In 1845 and 1846 "Messrs. Distin of London"[12] and Thomas Key, respectively, registered instrument designs influenced by Sax's valves (see Figures 8 and 9). The objective of Key's "Sax valve French Horn" and of the Distins' four-valve contralto saxhorn is the same as that of Sax: the free passage of air. In both cases valve ports in the piston are placed at right angles, although the Distins' valve loops (apart from second valve) are made with the inclination observed in Sax's instruments. Key's valve loops are placed at right angles, although, contrary to the German tradition, they pass under the valves as in Sax's valves. The firm's connection with the *pistonniers* of Paris is confirmed in a

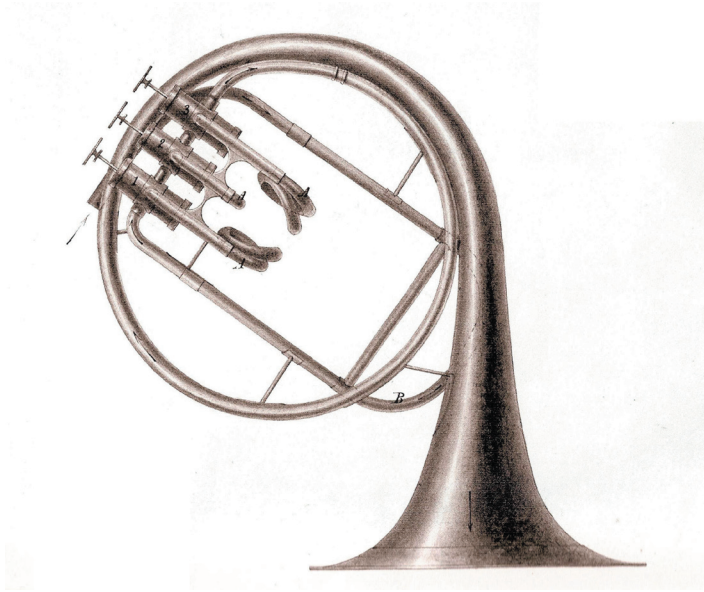


Figure 8: Thomas Key's registered design of 1845 for a Sax valve French horn (BT45/4/699). Reproduced with the permission of the National Archives, UK.

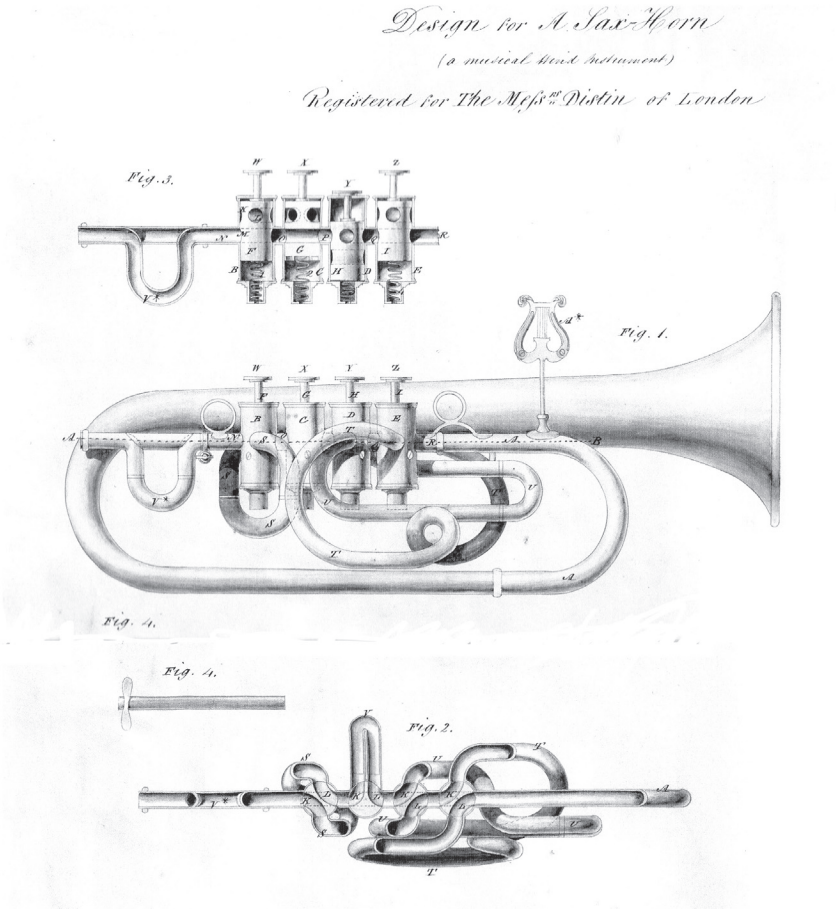


Figure 9: Messrs. Distins' registered design of 1845 for a sax-horn (BT45/2/345). Reproduced with the permission of the National Archives, UK.

later document when the later Key & Co. appear as clients of the French valve maker Drouelle.[13] It is apparent that even among makers themselves it was not clear what a constituted a "Sax valve."

The 1845 patent

The patent Sax was granted in 1845 concerned the invention of the saxotromba, whose form with small modifications could be applied to saxhorns, cornets, trumpets, and trombones (see Figure 10). The novelties of this patent, according to Sax, were:

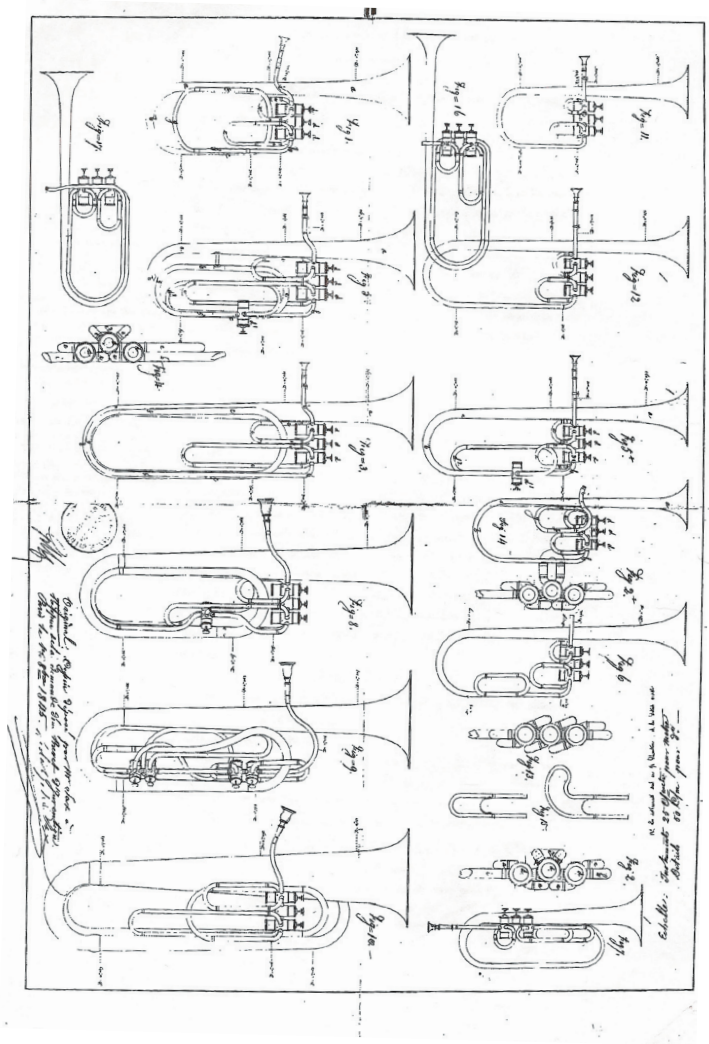


Figure 10: Sax's 1845 patent drawings. No. 1, saxotromba in E♭.
No. 2, detail of the valve section of no 1. No. 2+, the same as the previous with the slide for the semitone made in a different way. No. 3, saxotromba in B♭.
No. 4, detail of the valves adapted to saxotromba of no. 3. Nos. 5 and 5+, saxhorns with four valves. Nos. 6, 8, 9, 10, 11, 12 and 14, saxhorns. No. 7, saxhorn in A♭ made according to the specifications of the 1843 patent. No. 13, valves for being adapted to the instruments of nos. 3, 8, 9 and 10. No.15, crooks.
No. 16, trumpet in form saxotromba. No. 17, trombone in form saxotromba.

- The invention of the saxotromba, an instrument made for cavalry musicians in upright form which can be held between the player's left arm and left side, with the bell slightly tilted from left to right so that the instrument does not risk being hit by the horse's head.
- The application of the form of the saxotromba to saxhorns, trumpets, cornets and trombones.
- All the instruments of this new system can be fitted with crooks and shanks for changing the pitch, something that was not possible on any of the instruments of the 1843 patent.
- The addition of a fourth valve to the instruments that need an extension of their range in the lower register.

Only two of the instruments presented in the patent drawings are saxotrombas. Nine of the instruments are saxhorns in various pitches. Three other instruments in saxotromba form are shown: a cornet, a trumpet, and a trombone. Important features of this extensive patent are that the name "saxhorn" appears officially and that Sax provided measurements of the bore width at various points in the instruments presented in the drawings. Was the fact that more saxhorns than saxotrombas are shown in the drawings an attempt by Sax to display the wider range of the saxhorn family by illustrating publicly so many different models? Likewise, is the frequent presence in the text of the term "saxhorn" an attempt to establish it officially? There has been a schism in the academic community regarding the "saxhorn patent," with some scholars regarding the 1843 patent[14] as the saxhorn patent and others, the 1845 patent.[15] The facts are:

- the term "saxhorn" does not appear in the 1843 patent;
- hardly any of the models presented in 1843 appear intact in 1845;
- no extant instruments correspond to the 1843 drawings;
- both the term "saxhorn" and the instruments—more or less as we know them today—appear in the 1845 patent; and
- none of the models presented in the 1843 patent were new—they were modified versions of existing instruments. Bugles and *contrabasses d'harmonie* were present before 1843 and they were definitely not invented by Sax.

These considerations might explain why some scholars have considered the 1845 patent to be the saxhorn patent.

On the other hand:

- by 1845 saxhorns were already in use and had been established as a distinct species of instrument;
- they are mentioned in the 1845 patent together with other existing instruments—a cornet, trombone, and trumpet—and with no definition;
- no reference is made to saxhorns in the introductory section, in which Sax

describes the new inventions; and
- the principal focus of this patent is the saxotromba.

These considerations would explain why other scholars have considered the 1843 patent to be the saxhorn patent. The present authors believe that neither of the two patents can be accepted as a saxhorn patent. It seems probable that Sax's idea of creating a complete family of brass instruments carrying his modifications came shortly after the 1843 patent, but that by 1845 saxhorns had already been established and could not be claimed to be new.[16] However, Sax needed a way of protecting his ideas; this might explain their abundant presence in the drawings of the second patent. Sax's adversaries disputed the novelty of the saxotromba as an instrument and as a form.

The influence of saxhorns was far-reaching and rapid. Through the Distins, saxhorns became well known in Britain and they provided the basis of the British brass band instrumentation. The concerts of the Distin family were very well attended and they became famous for their performances on saxhorns. Distin became Sax's agent for the sale of saxhorns in Britain, but from 1850 he started making his own instruments, for which he adopted new names that did not include the "Sax" prefix. The agency came to an end and was eventually transferred to Rudall, Rose, Carte & Co. Saxhorns became popular in Britain and penetrated the British market rapidly. Many instrument makers and suppliers of the time advertised them at low prices.

Instruments from a parallel tradition also became known as saxhorns. These were the American bell-to-the-rear instruments that were widely used during the American Civil War and were known as over-the-shoulder saxhorns, although no evidence suggests that Sax ever made over-the-shoulder instruments. It is possible that the Distins were the first to introduce the saxhorns in the United States during their tour of 1849. According to a *Musical World* article, the Distins appeared at a concert in May or June 1849 at which the famous Dodworth band also performed, along with other bands.[17] Later in the century, in 1880, Harvey Dodworth claimed that his father, Thomas, had invented an instrument similar to the saxhorns, the *ebor corno* in 1838, long before Sax's instruments appeared.[18] No patent for the *ebor corno* exists and no extant instruments, or other evidence, support this claim.

The compensator

One of the developments of the 1843 patent was the use of spring slides which could, according to Sax, be adapted to all valved brass instruments. These spring slides had two functions: the execution of glissandi and the correction of the instrument's intonation when valves were used in combination. In the supporting patent drawings the only instrument equipped with such slide is a valve trumpet (Figure 1, no. 7).

A few years later, in his *Méthode complète pour saxhorn et saxotromba* (1847),[19] Sax depicts a *cornet compensateur* with a spring slide.[20] He gives instructions for the performance

of glissandi and provides examples for the use of the slide in trills; certain trills become easier to perform because operating the slide allows a simpler alternative fingering.

This feature, ingenious as it may seem, was never generally adopted, and even Sax incorporated it rarely and only in cornets. A report by three experts, Fromental Halévy, Nicolas Savart, and N. Boquillon, appointed to study the case during the lawsuits, addresses the validity of Sax's patents.[21] Sax's rivals questioned both the novelty of the spring slide and its practicality. The report noted that Sax was the first to try to use such a slide in non-cylindrical instruments. An instrument with a spring slide was played during the court case and the experts greatly appreciated the results. As for its practicality, they reported that special studies were required that might explain the reluctance of performers to use it. However, they admitted that its use was not completely impossible, as was asserted by Sax's opponents. According to court minutes Sax even admitted that he had manufactured only a limited number of such instruments in the years following the 1843 patent.[22]

Although the spring slide was not widely adopted, some makers tried to employ it. A surviving handbill from the Distin workshop (not dated but probably published in the early 1850s), advertises a *cornet-à-piston* with patent slide.[23] James Balthazar Ziegler, an obscure maker, registered in the United Kingdom as early as 1847 a design for a cornet with double-piston valves and a spring slide (see Figure 11).[24] As described by Ziegler in his registered design, the object of this spring slide was

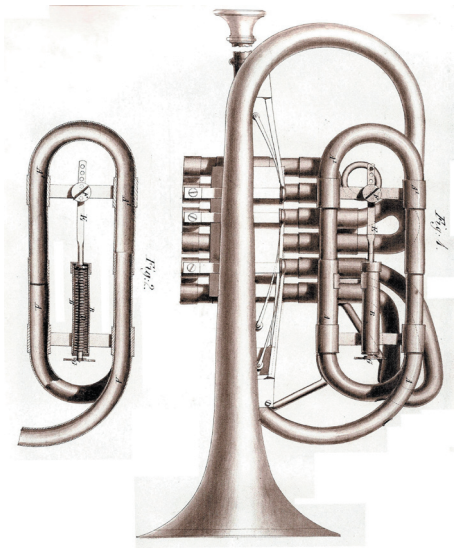


Figure 11: James Balthazar Ziegler's registered design of 1847 for a valve-perfecting spring slide (BT45/6/1059). Reproduced with the permission of the National Archives, UK.

> to give to the performer on Cornets or other valve instruments the power to sharpen or flatten any one or a given number of notes in the scale with facility.... [A]ny note in the piece of music may be flattened or shortened as required; and if from continuous exertion, the performer finds it an increased difficulty to play in perfect tune, he may by this improvement be considerably assisted.

No mention is made of the possibility of performing glissandi, as in the case of Sax's spring slide. A later trumpet of ca. 1885, by Mahillon, in the Edinburgh University Collection of Historic Musical Instruments (inventory number 2321) and a trombone by D. & P. Le Brun (inventory number 3219) incorporate spring slides (see Figure 12).

Figure 12: Detail of a spring slide from a bass cavalry trombone in B♭ + F, système Eugène Detiège, D. & P. Le Brun, Brussels, ca. 1919. Edinburgh University Collection of Historic Musical Instruments (3219). Photograph by Raymond Parks.

Bugle with valve attachment

In 1849 Sax took out a patent for improved bugles (Fr. *clairon*) for the infantry. His innovation was to make the instrument in such way that certain parts could be detached; it would allow the addition of crooks and a valve section, so as to transform the natural instrument into a chromatic one. It would allow players both to give signals and, adding valves, to perform in small groups such as duos and trios. Sax provided drawings of his bugles *système Sax* (see Figure 13) that formed a complete family whose members were made in alternating pitches, B♭ and E♭.

All these valve attachments use Berlin valves, and the absence of any tuning-slides allowed Sax to give the valve loops the oval shape or the shape of the perfect circle patented in 1843. These instruments were exhibited at the International Exhibitions of 1851 and 1855, held in London and Paris respectively. According to the latter exhibition jury's report, the primary impetus for Sax's invention was an official prohibition against any change that would affect the instrument's overall shape: with the removable valve attachment the shape of the instrument would be kept intact. Sax claimed that even the lowest instrument was no larger than an ordinary bugle.[25]

According to the 1855 exhibition jury's report, about a year before the exhibition, these instruments were tested by the Sixth Battalion of the French infantry with success, and according to the sale catalogue of Sax's personal instrument collection, which was sold in 1877, they had been adopted by ministerial decision in 1854.

In the British domain, an advertisement of Boosey and Sons in the *Musical World* in 1854 offered bugles with a similar valve attachment.[26] A year later, in 1855, Distin took out a patent for what appears to be the same instrument.[27] A valve section could be added to both the single- and double-coiled bugles. The configuration is only slightly different from that of Sax, with the Périnet-type valve section protruding from the instrument. The instrument—after Distin's design—is also included in later catalogues of instrument makers in both France and Britain, such as Gautrot ainé et Cie.,[28] Hawkes & Son,[29] and Besson.[30] According to Baines the instrument was used for some time in "Chromatic bugle bands," but apart from that it was not a success.[31] This could be ascribed to the strong similarity of the valved bugle's bore profile to that of a flugelhorn or a contralto saxhorn. It is also probable that the inconvenience of carrying extra instrument parts, and the vulnerability of an assembled instrument, militated against the instrument.

Modifications to the trombone

In 1845 Sax applied the Berlin valve to the trombone and made it in the form of the saxotromba. This *trombone à cylindres* is depicted not only in the 1845 patent, but also in Kastner's *Manuel général de musique militaire*[32] and various handbills from the Sax workshop (see Figure 14).[33] In the 1850 handbill Sax also included bass and contrabass valve trombones in saxotromba form. Distin imported the tenor model into Britain

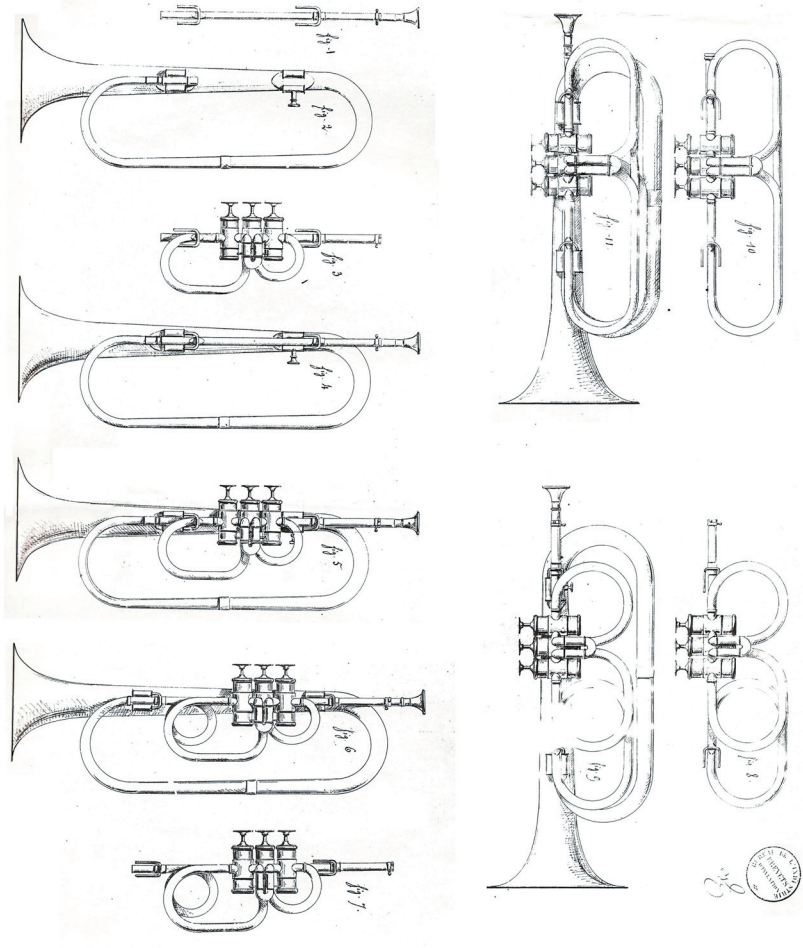


Figure 13: Bugles with detachable valve sections in various pitches from Sax's 1849 patent.

as "valve tenor trombone in C and B♭." A similar instrument is also included in later catalogues from the firm of Pelitti.[34]

In 1852 Sax was granted another certificate of addition for modifications to the slide trombone and slide trumpet. There he enumerated the problems that performers had with bass and contrabass trombones in F or E♭. Using a handle to reach the lower slide positions, he said, was inconvenient, especially for musicians in marching bands.

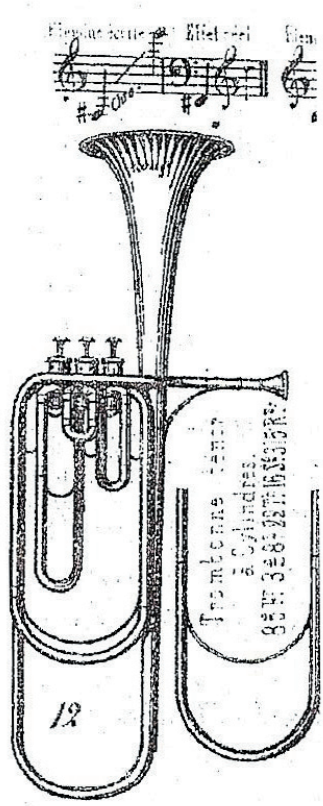


Figure 14: *Trombone à cylindres* in saxotromba form from Sax's 1850 handbill.

Additionally, the execution of legato was not always easy. The valve trombone could definitely not be a substitute for it. Sax claimed to combine the advantages of both instruments in his own version, in which an ordinary tenor trombone is equipped with a larger bell and a valve is placed close to the joint between the bell and slide sections; this extends the instrument's range in the lower register. The slide section is also equipped with another two or three valves that could be used to facilitate the execution of certain musical passages, especially in the higher register of the instrument. These "new" features could be used either separately or in combination. Sax was certainly not the first to apply the thumb valve to the trombone: Sattler employed a rotary valve for that purpose as early as 1839.[35] Sax's modification was the use of a Berlin rather than a rotary valve.

It is probable that Sax applied the thumb valve to a narrow-bore tenor, a typical French model, rather than a wide-bore trombone as in Sattler's case. However, this cannot be said with certainty since it is an observation based only on drawings. This model appeared in handbills distributed by the Sax workshop in 1850, two years before the certificate of addition. It was advertised in Britain by Distin in the early 1850s. Exactly the same model was exhibited by Sax in 1862 in the London International Exhibition and continued to be advertised until later in the century as *trombone Sax ténor et basse* (see Figure 15). As early as December 1849 Thomas Key, who was closely following Sax's inventions registered in Britain a design for what appears to be a similar model of a trombone with a thumb valve.[36] The only difference was the use of a valve, a modified Sax version of the Berlin type, that was shorter than that of the Sax trombone.

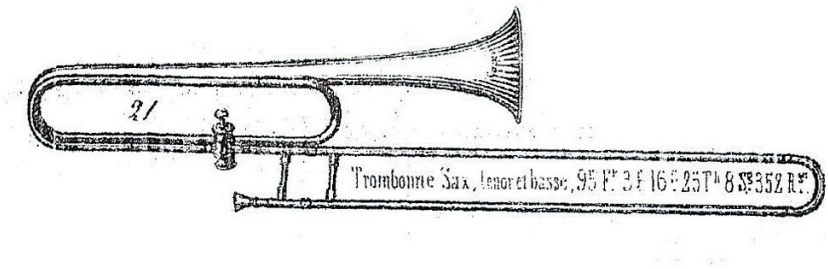


Figure 15: Trombone Sax *ténor et basse*.

The slide trombone with three valves was later offered by Besson.[37] The concept of a duplex trombone was reinvented ca. 1970 as the "Superbone" by Ashley Alexander and/or Maynard Ferguson with the Holton Company in the U.S.A.

A better-known model of trombone by Sax is the cavalry valve trombone, equipped first with three Berlin valves, and later with four and five,[38] which he developed in 1859. It combines the advantages of the form of the saxotromba with those of the bell-front models; the instrument is supported under the left arm, but the bell faces to the front as in the bell-front model, directing the sound to the marching soldiers. The model with four valves was adopted by the French cavalry bands in a ministerial decision of 26 May 1860.[39] There are a few surviving specimens (see Figure 16). The cavalry valve trombone was made in considerable numbers by Henry Distin and his successor, Boosey & Co.[40] Another version incorporated six independent valves: this was a more influential model.

Figure 16: Tenor/bass cavalry model valve trombone in C and G, 1871. Inscribed on bell: *A.S. PARIS* monogram trademark / *SEUL / GRAND PRIX / 1867 / ADOLPHE SAX / Facteur Breveté / DE LA M^ON M^RE DE L'EMPEREUR / 50.Rue S^t Georges / A PARIS / N^o 34539*. Edinburgh University Collection of Historic Musical Instruments (3199). Photograph by Antonia Reeve.

Sax and the trumpet

The earliest depiction of a trumpet designed by Sax is in the 1843 patent, where a deep-bodied trumpet equipped with three Berlin valves and a spring slide appears. The same patent also shows a *trompette-ténor* in B♭ in upright form (Figure 1, no. 4). Even at this early date Sax was already producing the trumpet advertised in his later sales catalogues as *trompette système Sax*. This is the only model of bell-front trumpet equipped with Berlin valves illustrated in Sax's various advertisements; it has a more elongated form than the trumpet of the 1843 patent. It was equipped with three Berlin valves and a complete set of crooks and shanks, and in the 1848 and 1850 advertisements it is called *trompette à cylindres avec les tons Infanterie*. An example which was once part of

the collection of Adolphe Sax survives in the Musée de la Musique in Paris (inventory number E.727; see Figure 17). In the collection's sale catalogue it is called *trompette longue à pistons*. The identical drawing was used by Kastner in his *Manuel général de musique militaire* (in plate XXIV) and is described as *nouvelle trompette à cylindres en sol, forme infanterie* ("new rotary-valve trumpet in G, infantry form"). Next to it is an instrument in bell-up form, described as "the same instrument in the form of a cavalry saxotromba."[41] This model also reached Britain; it is included in Distin's handbill of the mid-1850s, where it is described as a *Sax-valve trumpet,* but it was not mentioned in Distin's catalogue of 1857.[42]

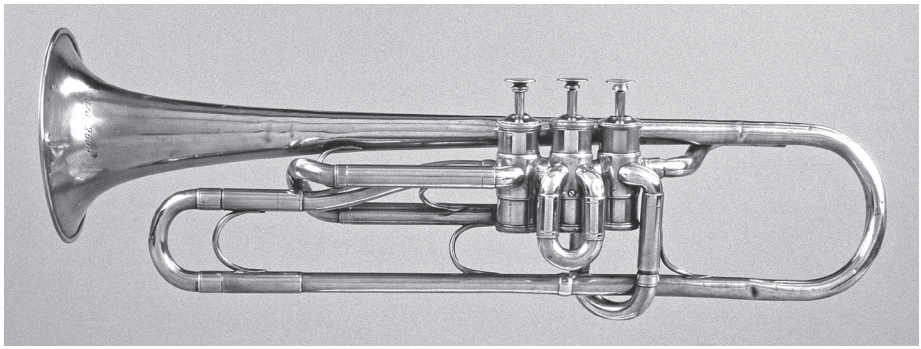


Figure 17: *Trompette système Sax*, 1846. Part of the collection of Adolphe Sax, this instrument was described in the collection's sale catalogue as *trompette longue, à pistons*. Inscribed on bell: *Adolphe Sax & Cie à Paris 2599*. Musée de la musique, Paris, E.727. Photograph by Thierry Ollivier.

Kastner, in the *Supplement* to his instrumentation treatise, devoted a separate section to the *trompette à cylindres*;[43] the *trompette à pistons* had already been discussed in the treatise.[44] Again here the instrument is presented as a complete family. Sax was certainly not the first to apply the Berlin valve to the trumpet; this had been done in Germany long before. However, Kastner praises the quality of those made by Sax in Paris. The instrument in E♭ was used extensively by the composers of the time in works for *fanfares* or wind bands, where it is denoted as *trompette à cylindres*.

In 1852 Sax added a valve to the slide trumpet, which he also calls *Trompette Anglaise,* that lowered the instrument's pitch by a tone and a half. The collection of the Musée de la musique includes such an instrument from Sax's collection (inventory number E.725; see Figure 18).

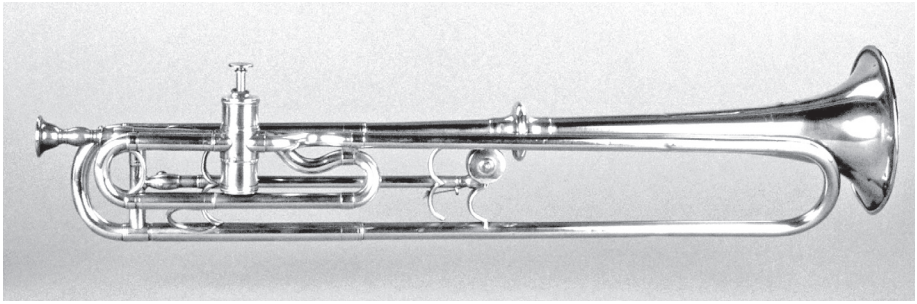


Figure 18: Slide trumpet with one Berlin valve, probably 1854. Trumpet according to the specifications of Sax's 1852 certificate of addition. Inscribed *A I S / 103*.
Musée de la musique, Paris, E.725. Photograph by Thierry Ollivier.

The Saxtuba

Saxtubas were patented in 1852, in a certificate of addition to the 1849 patent.[45] The most distinctive feature of these instruments was claimed to be the equality they allowed between the sounds of the various military band and orchestral instruments. Because instruments had different shapes, Sax considered the direction of their sound to be different and also that listeners perceived their sounds differently depending on position. His first aim was to correct this imbalance by changing the direction of the bell: it was directed to the front of the player, and was parallel to the ground. Thus the listener perceived the sound both directly from the instrument and from its reflection off the ground.

The second distinctive feature of these instruments is their overall shape: they were designed to resemble instruments from Greek or Roman antiquity so as to add importance to public ceremonies. To reinforce the instruments' historical character the valves are placed so that, concealed by the player's hand, they cannot be seen by the spectator. Moreover, in the higher-pitched instruments of the trumpet family the various loops of the tubing are brought as close together as possible, so that they can be more easily gripped by the performer's hand. Sax was inspired by the representation of a Roman instrument on Trajan's column in Rome.[46] This also expresses the nineteenth-century preoccupation with and idealization of Greek and Roman antiquity.[47]

Four instruments appear in the drawings of this certificate of addition: a straight trumpet; a saxtuba probably of baritone size; a saxtuba in the contrabass register with a circular shape, bearing a close resemblance to that of the helicon; and a parade trumpet (see Figures 19, 20, 21).

Comparing the circular saxtuba with Stowasser's drawing in the 1848 helicon patent,[48] it can be observed that although both instruments are based on the same idea, there are some differences, mostly those that would distinguish a German tuba from a French one. The saxtuba has a more compact shape with its bell directed to the front,

and is equipped with Berlin valves rather than the four rotary valves of the helicon. A late advertisement from the Sax workshop, published in 1886–87, includes saxtubas, and for the contrabass instruments in E♭ and B♭ the name *helicon* is noted in brackets. The explanatory text notes that this model of saxtuba was later imitated in Germany under the name helicon![49]

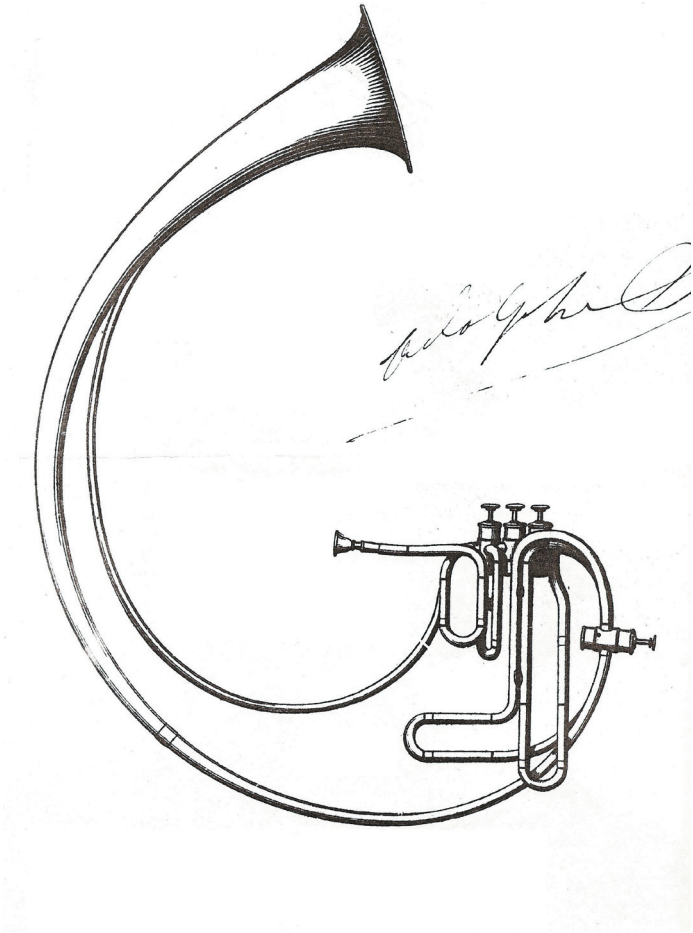


Figure 19: Contrabass saxtuba from Sax's 1852 certificate of addition to the main patent of 1849.

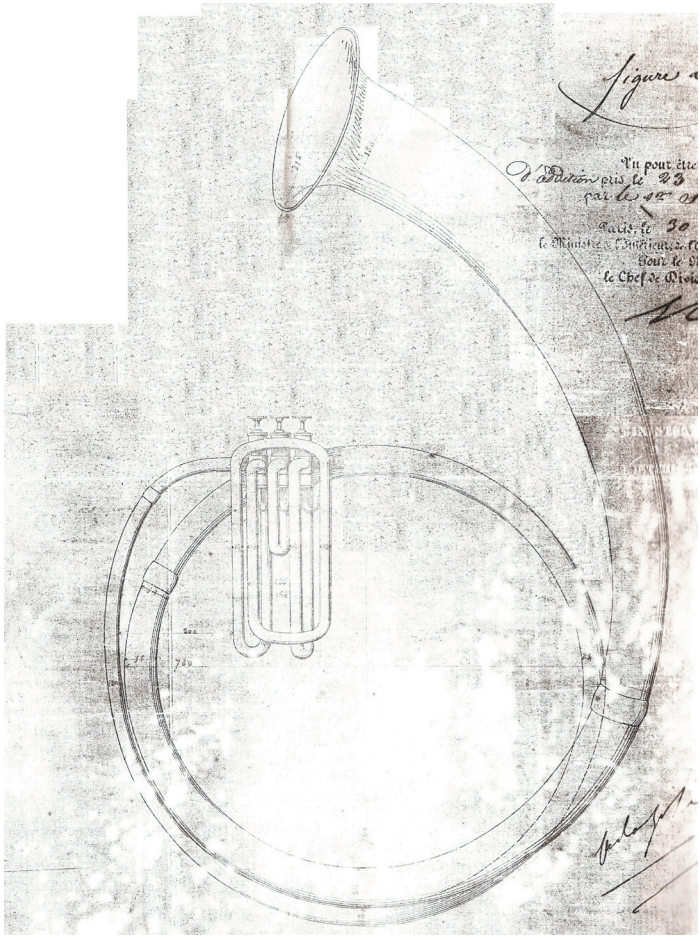


Figure 20: Contrabass saxtuba from Sax's 1852 certificate of addition to the main patent of 1849.

Almost thirty years after the introduction of the system of six dependent piston valves, Sax applied it to the saxtuba in his 1881 patent. Also shown is a paraboloid that can be added at the bell (see Figure 22).

The name saxtuba is not mentioned in the 1852 certificate of addition. There is evidence, though, that the word was used some time before the issuance of the patent, even though it was associated with different instruments. In Britain, Distin mentioned "sax-tubas" in his *Musical World* advertisements of 1847, and concert announcements in the same journal stated that the famous Distin family quintet also played an instrument

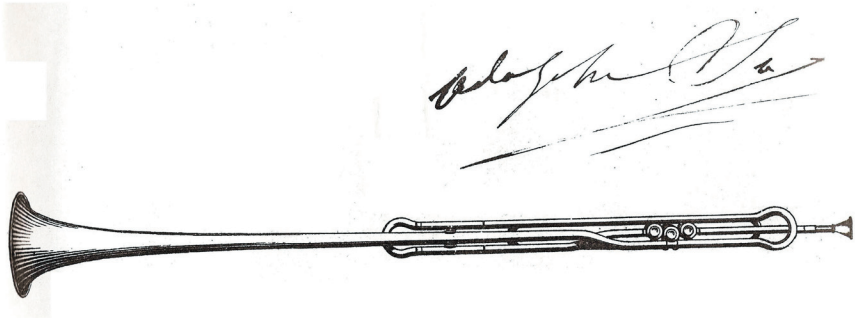


Figure 21: Parade trumpet from Sax's 1852 certificate of addition to the main patent of 1849.

they called a "sax-tuba." Here the term was used for the tenor instrument of the saxhorn family. Later, the term "tuba" was used in Distin's sale catalogues for the majority of the upright brass instruments. The same term was also used by other, less well-known, British makers of the time.

Only two saxtubas made by Sax have been located. The first, made in 1855, is in the Metropolitan Museum of Art, New York (inventory number 1109); it has three Berlin

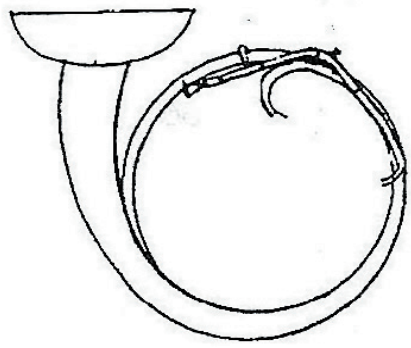


Figure 22: Saxtuba with parabolic bell from Sax's 1881 patent.

valves and is pitched in 13-ft. E♭.[50] Compared with saxhorns of the same pitch made by Sax, there are striking differences, notably the saxtuba's greater diameter at mid-length. The saxtuba's bore expands more over the proximal half of its tube, but has a less abrupt expansion at the distal part of its tube, making the instrument quite different from saxhorns of the same pitch. The second saxtuba, in contralto size, is in the Trompetenmuseum in Bad Säckingen (inventory number 14602),[51] and was also made in 1855. Unlike the contrabass saxtuba, it is remarkably similar in bore profile to saxhorns of the same pitch (see Figure 23).

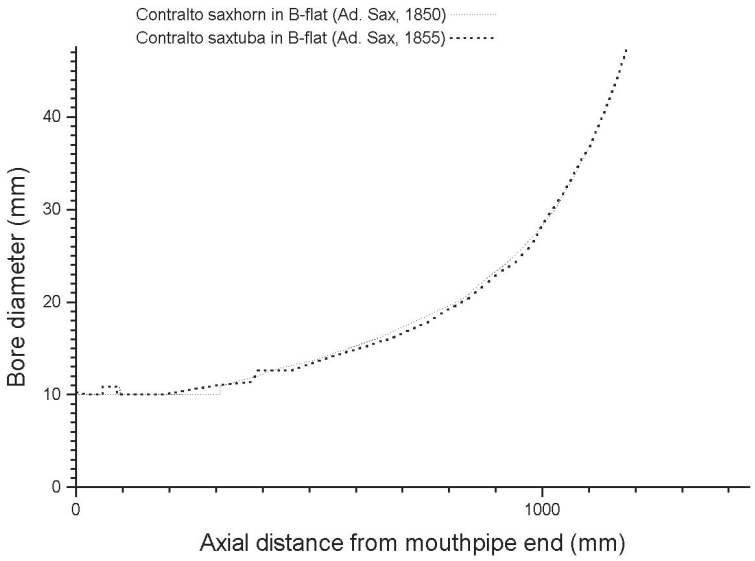


Figure 23: Comparison of bore profiles of the Bad Säckingen contralto saxtuba (collection number 14602) and a contralto saxhorn (Musée de la musique, Paris, E.745).

At the end of the nineteenth century, Adolphe-Edouard Sax (Adolphe Sax's son), following his father built saxtubas in a similar shape, with the addition of the movable bell discussed below. A few of these instruments have survived in the collection of the Musée de la musique in Paris (see Figure 24).

Figure 24: Baritone saxtuba, Adolphe-Edouard Sax, Paris, ca.1895–1907. Inscribed *AS / Fournisseur de l'Académie N^le^ de Musique/ 51. Rue Blanche.51 / PARIS*. Musée de la musique, Paris, E.0709. Photograph by Thierry Ollivier.

Brass instruments with valves and keys

The first mention of the application of keys to valved brass instruments by Sax was made in 1852: in his patent introducing the independent system piston valve he included the provision of a key close to the mouthpiece to facilitate the production of sounds in the higher register. In his 1859 patent he refers again to this provision and explains that he was inspired by the application of a similar key to his bass clarinet in 1838. In 1859 Sax revisited the application of keys to valved brass instruments.

Sax explained that valved instruments obviously offer more advantages than keyed brass instruments. However, one of the advantages of keys is in performing trills, which with valves are in many cases very difficult or impossible because of the awkward fingerings. Moreover, the instrument's bore profile is not affected by the activation of keys, as happens in the case of valved instruments. The portamento is also achieved with more facility. The same notes can be played in two or three different ways, offering considerable musical advantages. He suggested that when the performer plays the lower notes with the keys open, the sound of the instrument will be improved in sonority and will have a different timbre, similar to *le son bouché* in horn playing; this characteristic timbre was also described as *voix sombrée* ("dark-voiced") by Sax in his last surviving sale catalogue.[52]

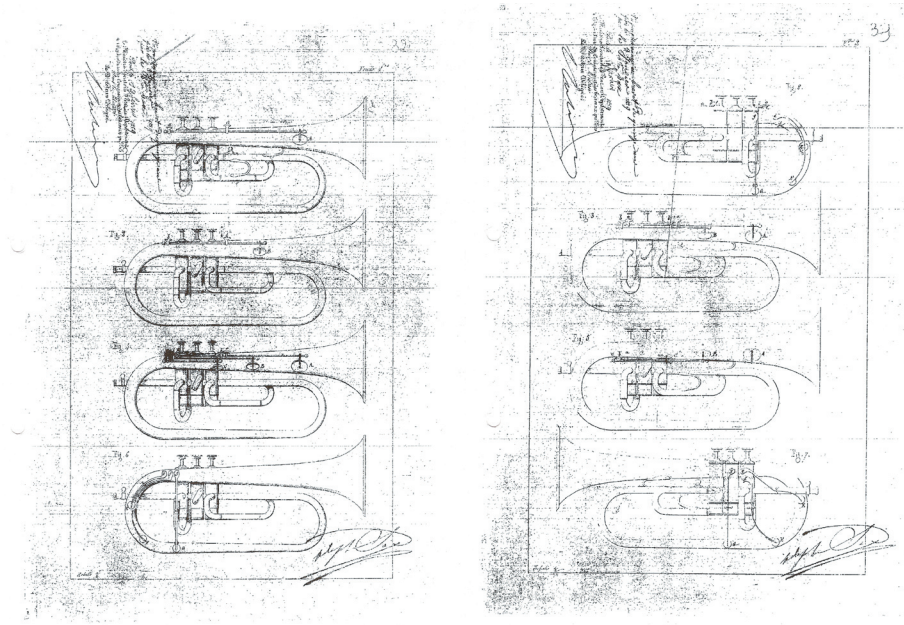


Figure 25 : Two plates with drawings of instruments with valves and keys from the Sax's 1859 patent.

The 1859 patent includes eight different drawings of what appear to be contralto saxhorns or valved bugles with added keys. There is considerable variety in the number of keys and the position of the keys or holes. All the saxhorns have first and third valves of the Berlin type, and the second valve of the Périnet type. However, most surviving instruments have all Périnet-type rather than Berlin-type valves (see Figure 25). In the second certificate of addition to this patent,[53] Sax presents a French horn with both valves and keys, but no surviving specimens with this configuration are known to the authors.

Instruments with valves and keys were exhibited for the first time in the 1862 London International Exhibition. The military decree of 1860[54] allowed valved-brasswind soloists in military bands to employ instruments, such as trumpets, cornets, saxhorns, and saxotrombas, equipped with keys for the production of certain effects. These instruments were also in use at the Paris Conservatoire for a short time.

Saxhorns, cornets, trumpets, and trombones with valves and keys were advertised by Sax as late as the 1880s. Very few instruments made with both valves and keys in his workshop have survived; those that have are mainly high saxhorns.[55] Musicians apparently did not share his views concerning the usefulness of keys on valved instruments.

Turning bell (*pavillon tournant*)

Among the innovations announced by Sax in 1859 was the *pavillon tournant*, or turning bell. Detachable bells had already been used by other makers; what Sax presented, however, was a bell that could be turned in different directions. In surviving instruments the flange where the bell attaches to the instrument has three screws, allowing the bell to be turned in three possible positions. To permit the direction of the bell to be altered, it was built at an angle, with its shape, as described by Sax, being similar to that of the bell of the saxophone.[56] This shape is reminiscent of the bell with "parabolic curve" of 1855, described by Halary in his patent specification and mentioned below—which, however, was not movable.

Although the turning bell was introduced in 1859, the earliest surviving numbered instrument equipped with a *pavillon tournant* is a trombone dating from 1864 in Bruno Kampman's collection (inventory number 201). The feature was used mostly in saxhorns of various sizes and was usually, but not exclusively, combined with the system of six independent valves. An even more extravagant development, especially for the larger instruments of the saxhorn family, was introduced in 1867—a combination of turning bell with a more cumbersome overall shape, intended for orchestral use in which the instrument's tubing rests on the floor (Figure 26). A bell of a similar kind, a *pavillon renversée,* was advertised in the Sax workshop's last catalogue and could be ordered for an additional fee.

Instruments with a similar feature seem to have been patented by Besson in 1856, three years before Sax's patent.[57] Here the bell could be rotated in two different directions. These were probably the Besson instruments that later became known as the *neoform horns*. An instrument of this type was apparently exhibited in the 1890 Royal Military

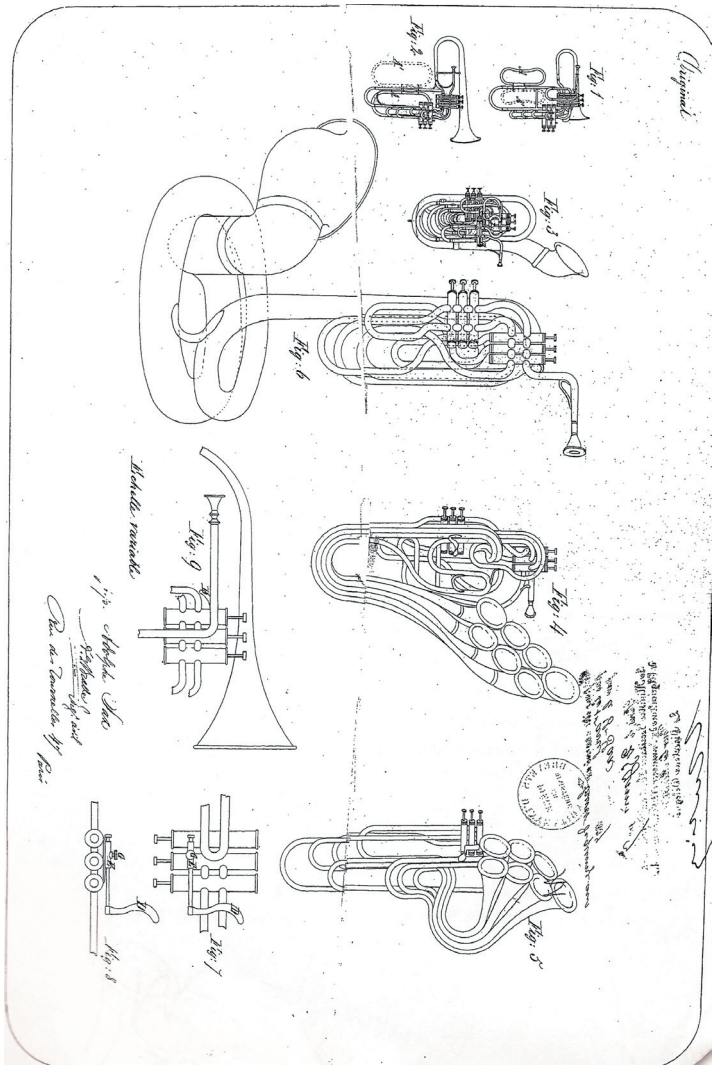


Figure 26: The drawing section of Sax's 1867 patent. Nos. 1 and 2, instrument with six independent valves with removable section to improve the instrument's ergonomics. No. 3, instrument with six independent valves and an added seventh valve that has a similar role to that of the fourth valve of saxhorns with ordinary valves. Nos. 4 and 5, instruments with multiple bells made in saxotromba form. No. 6, instrument with bell resting on the floor, intended for orchestral use. Nos. 7, 8, 9, adjustable support added to instruments with independent valves to facilitate the fingering.

Exhibition (item 445).[58] *Neoform horns* were the instruments used by the Musical Shapcotts in a series of concerts in 1863.[59]

Very soon after Sax's 1859 patent, a rotating bell was patented in Britain by George MacFarlane, William Edward Newton, and Richard Carte.[60] Their 1860 patent shows the direct influence of Sax, and includes a claim for the means to throw the sound in any desired direction.[61] The bell here is bent over; the bent part is moveable, and can be secured in any desired direction by a collar, a spring clip, and a thumbscrew. It thus differs from Sax's *pavillon tournant,* where the bell can face only a limited number of directions.

The practicality of this development is debatable, especially when talking about larger instruments, such as the contrabass saxhorns. Nevertheless, it is an indication of nineteenth-century makers' obsession with the direction of the sound. The feature was later re-introduced by Sax's son, Adolphe-Edouard, in his saxhorns and saxtubas, as mentioned above. It has also been reported that Adolphe-Edouard collaborated with Eric Sarnette and used instruments with this type of bell for early studio recordings.[62]

The independent system valve

In 1852 Sax took out a patent in which he addressed once again the problems resulting from the use of valves in combination. Initially he suggested joining together seven instruments with the same mouthpiece. Six valves would have been employed, each of which when operated would have engaged the instrument with which it was connected. A similar result was achieved in a less cumbersome way in the system Sax introduced that later became known as the independent valve system. Six of the instruments were each replaced by an additional tube that could be engaged by a valve. Supposing the instrument's pitch to be B♭, when the first valve is operated it would give B♭, the second would give A, the third A♭, the fourth G, the fifth F♯, and the sixth F. With no valves it would give E. The instrument's nominal pitch thus is given by the operation of the first valve. The valves are ascending since they do not add extra tubing, but rather each of them isolates different amounts of the total tubing of the instrument. Moreover, if the player needed to change the pitch of the instrument, additional tubes could be supplied with tuning-slides (see Figure 27).

Sax was definitely not the one who led the way in this field. The first recorded attempt, to our knowledge, came from an Englishman, John Shaw, who in 1824 was granted a patent for a similar system, twenty-eight years before Sax.[63] Shaw's patent was for "transverse spring slides" that could be applied to all brass instruments. What Shaw described as a slide is not actually a slide but an early form of double-piston valve.[64] In the example given, a trumpet, Shaw used four independent valves, without any tuning-slides, three ascending and one descending; the ascending valves raise the instrument's pitch by a semitone each by cutting off corresponding tubing, and the descending valve lowers it by a semitone by adding corresponding length. An example of a trombone was also presented, equipped with six valves. Although no instruments with this type of

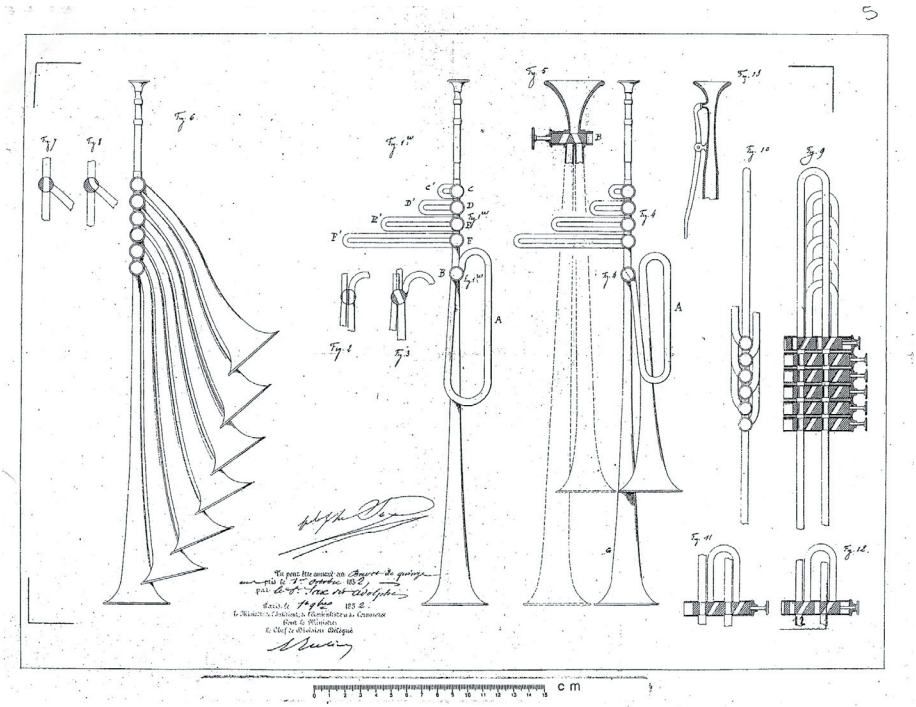


Figure 27: The drawing section of Sax's 1852 patent.

valve survive, Sax might have known of the existence of the patent since he occasionally travelled to Britain, especially during the 1851 exhibition.

Although Sax took out the first patent on the independent valve in 1852, the earliest surviving numbered instrument dates only from 1864. It was not until 1859 that he announced in a new patent the application of the system to his brass instruments in saxotromba form (see Figure 28). The usual number of such valves in surviving instruments is six, which are normally divided in two groups, three for each hand, although instruments with fewer than six exist and the French horns have six valves in a row (one hand being occupied with the bell).

Further provisions in the 1859 patent[65] concerned the use of independent valves as well as those in "the public domain," and the employment in combination of both descending and ascending independent valves.[66]

In his 1867 patent Sax introduced improvements to the ergonomic aspects of instruments with independent valves, including a detachable device for holding the instrument more firmly and a handle attached to the valve casings. His last (1881) patent concerning brass instruments announced further improvements to this system. He dispensed with

Figure 28: *Nouveau saxhorn basse* in C/B♭, Adolphe Sax, Paris, 1871. Instrument equipped with six independent valves and *pavillon tournant*. Inscribed on bell : *N^o^ 35012 / Nouveau Saxorn* [*sic*] *Basse a 6 pistons / en Ut & Si B / Adolphe Sax F^teur^ Brevete / de la M^son^ Mil^re^ de l'Empereur / 50 rue S^t^ Georges a Paris / SEUL / GRAND PRIX / 1867*, with monogram trademark *AS PARIS*. Edinburgh University Collection of Historic Musical Instruments, 3115. Photograph by Antonia Reeve.

tuning-slides, which constituted the only disadvantage of the system in his view. This "new" arrangement, however, is identical with that of a cornet made by Richardson in Boston about twenty years earlier, now in Edinburgh University Collection of Historic Musical Instruments (inventory number 4466), though Sax may not have known about this American model (see Figures 29 and 30).a.

Figure 29: Cornet in C, Richardson, Boston, ca. 1860. Inscribed *Bayley's American Cornet*. Equipped with six independent valves without valve tuning slides. Edinburgh University Collection of Historic Musical Instruments, 4466. Photograph by Raymond Parks.

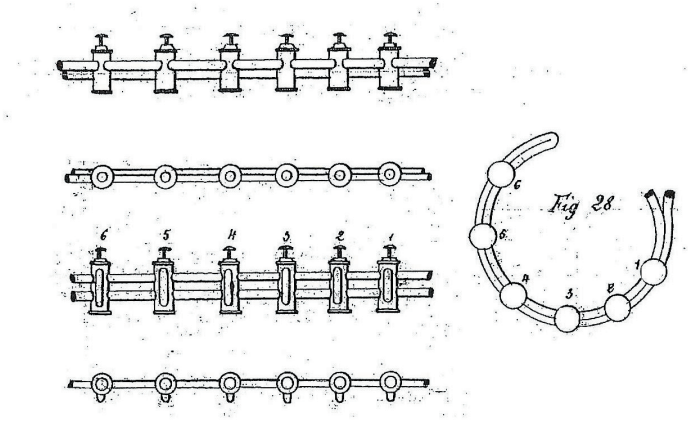


Figure 30: Independent valves without tuning slides from Sax's 1881 patent.

Technique

The independent valve system requires a completely different fingering technique, and this made performers reluctant to adopt it. The player needs to press only one valve at a time, but if more than one valve is operated, only one, that giving the shortest tube length, will determine the sounding length. Forestier's method for instruments with six independent valves refers to what he calls "the preparation of the fingers."[67] Although the valves can only take effect one at a time, they can be operated "in combination" at will to simplify the fingering of subsequent notes and reduce overall finger movement. There are many alternative fingering combinations, and Forestier wrote that a performer with practice should find the most suitable. The Paris Conservatoire offered instruction for the trombone and the lower saxhorns with this system, and Sax himself apparently endorsed the "preparation" technique. Three surviving tablatures prepared by Sax for teaching this valve system confirm the above technique (see Figure 31). Some string players also use a similar technique, in which the fingers continue to press the strings that do not sound, in order to be in position when needed.

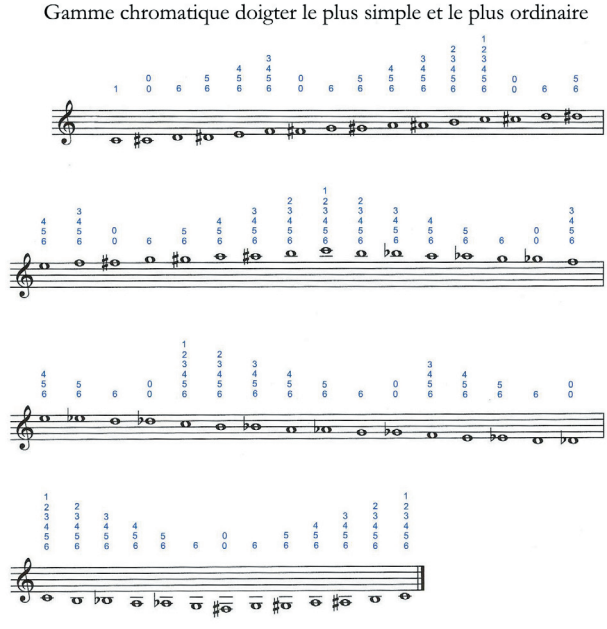


Figure 31: Exercise showing Sax's suggested fingerings for instruments with six independent valves. Drawn from *Tablature des nouveaux Instruments à six pistons et à tubes correspondants*.

Influence

The independent valve system was used by Sax extensively, more often for saxhorns and trombones than for other brasswinds; it was also used by Adolphe-Edouard Sax. It was not a lasting success, probably because of the difficulties of a different fingering system and because instruments of this kind are also considerably heavier than the equivalent instruments with regular valves. Makers outside France also manufactured independent valves following Sax's system; it survived for a long time in Belgium, where it was used on trombones and was taught at the Brussels Conservatoire. Two examples, both made by Le Brun in Belgium, are part of the Edinburgh University Collection of Historic Musical Instruments (inventory numbers 3219 and 4111). Even Besson manufactured instruments with this valve system.[68]

The patent by MacFarlane, Newton, and Carte mentioned above specified among other things an ascending valve that could be applied to all known brass instruments.[69] The valve is not independent, since it is used in combination with the ordinary Périnet valves, and it is made in a different way from Sax's ascending valves, being of rotary type ("cylindrical," as termed in the patent). The patentees stated that the addition of this valve would not require the performer to alter the known fingering. It could be used at the performer's "discretion" and employed progressively as the performer became more familiar with it.

Adolphe Sax and his brother Alphonse disputed the "ownership" of the invention of the ascending valves. In the late 1840s Alphonse patented a system of valves called *perce conique*, which preserved a conical bore through the pistons and the valve loops. The initial patent was for three descending pistons, but in the mid-1850s he applied the conical bore principle to ascending pistons. However, Adolphe had already patented the ascending valves in 1852, and there is no evidence to support Alphonse's claim of being the inventor of the ascending valve.

Other means of compensation

The first provision of the 1859 patent deals with means of compensating for the use of the fourth valve in bass saxhorns. Earlier, in 1845, bass saxhorns had been equipped with a fourth Berlin valve that would lower the pitch by a fourth. This valve could be used either as a regular valve or as a transposing valve, but caused intonation problems when used in combination. By adding a fifth valve parallel to the fourth and perpendicular to the first three, extra valve tubing can be engaged when the transposing valve is in use. Sax also added the possibility of giving to the fifth valve the functions of the fourth by making it cross the valve tubing that lowers the pitch by a fourth, since the fourth valve and the fifth should always work simultaneously. Distin copied this system, and an instrument by Distin at the Horniman Museum has this type of *registre* valve.[70] Five-valve euphoniums without a *registre* were made by Besson, and the five-valve tuba in F was used professionally in Britain, where it was known as the "Barlow tuba."[71] Sax's

fifth valve, though, is similar in concept to Besson's *registre,* patented three years earlier, in 1856, and improved in 1857 (see Figure 32).

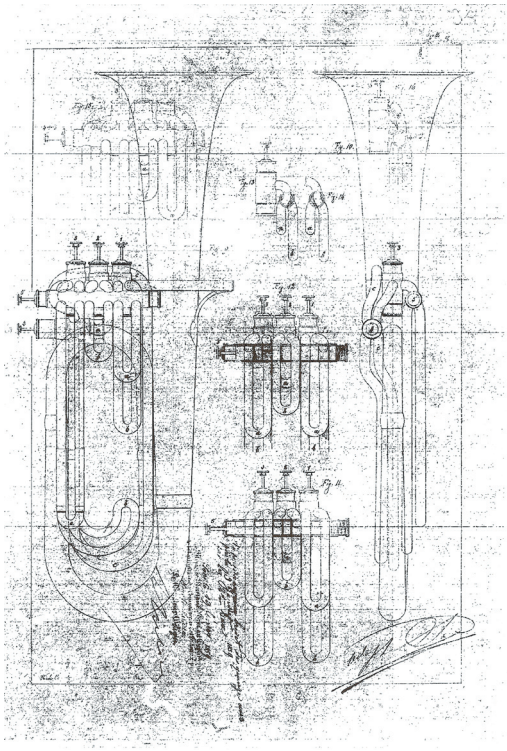


Figure 32: Sax's version of the *registre* from his 1859 patent.

Parabola

Many nineteenth-century instrument makers appear to have tried to exploit the reflective properties of a parabola. Sax viewed the saxophone as having the shape of a "parabolic cone," though this is contested today. Boehm described the head of his 1847 model flute as parabolic in a patent. In 1866 Sax took out a patent for a concert hall in parabolic shape. It is surprising that Sax tried to apply the parabola to brass instruments so late in his career. In his 1881 patent Sax, among other claims, suggested the application of a parabolic bell to existing instruments in addition to their usual bell. Depending on the point where this parabola is applied, the timbre would be affected accordingly.

The "Aida trumpet" was specially made for the production of Verdi's opera *Aïda*. Some Aida trumpets made by Sax appear to be the realization of the application of parabola to brass instruments. The only such instruments with this added feature known to the present writers are Aida trumpets with one or two valves. The surviving Aida trumpets with the extra bell (in Edinburgh, Bad Säckingen, and the Musée de la musique, Paris) are made in two ways: either with the addition of the parabolic bell a few centimeters before the end of the normal bell, or with the extra bell added at the very end of the regular bell. According to Sax, the two designs produce different sounds. Sax also made Aida trumpets without the extra bell. The trumpets with the parabolic bell are made with an internal bell that has little flare compared with that of a regular trumpet bell, rather resembling that of a sackbut or a *Swedish kornett*. The parabolic extra bell is made of thin metal sheet and is very flexible (see Figure 33).

Figure 33: Aida trumpet in B♮, Adolphe Sax, Paris, 1879. Equipped with one Berlin valve and an extra parabolic bell. Inscribed on bell with monogram trademark *A S PARIS / SEUL / GRAND PRIX / 1867 / SAX & CIE / Facteur Breveté / 39. Rue De DunKerque / A PARIS / N 41206* (the serial number was originally stamped *40206* and the first zero subsequently overstamped with *1*). Edinburgh University Collection of Historic Musical Instruments, 3344. Photograph by Antonia Reeve.

Verdi opposed the idea of having Sax make the trumpets for the premiere of *Aida* in Cairo in 1871, offering the commission to Pelitti of Milan instead. In November 1879 in a letter to Verdi regarding the production in Paris, August Emmanuel Vaucorbeil, director of the Opéra, asked the composer if he was certain he wanted the trumpets to be sent from Italy;[72] he mentioned that their number should be increased due to the size of the Opéra and suggested that Sax could make new ones of excellent quality. Verdi replied that Sax could make the trumpets, but that if so his "refinements" would be useless, since valves or keys added to these trumpets would result in the loss of their antique character. An impressive photograph in the archives of the Bibliotheque de l'Opéra in Paris shows six Aida trumpets made by Sax, three of them with the additional parabolic bell, two of them with additional material in other shapes around the original bell, and one of them

with no additions, but simply fitted with a narrow bell. Sax probably intended each of them to create different effects.

However, was Sax the pioneer in the application of parabola to brass instruments? As early as 1845 Alexandre (Théodor Lambert Prosper) filed a patent for the application of parabola to two instruments, the trumpet and the bugle (Fr. *clairon*).[73] A later patent of 1855, taken out by Halary, is based on a similar idea.[74] Here the parabola is applied in two ways. In the first case the instrument, instead of being made with the bell up, has a bell directed to the front, and includes a parabolic section. In the second case an instrument with a parabolic bell is further equipped with a "paraboloid" that is inserted into the bell. Both designs are thought to facilitate the reflection of sound. These models were never produced commercially, which is hardly surprising, considering the great difficulties that the manufacturing processes would have involved (see Figure 34).

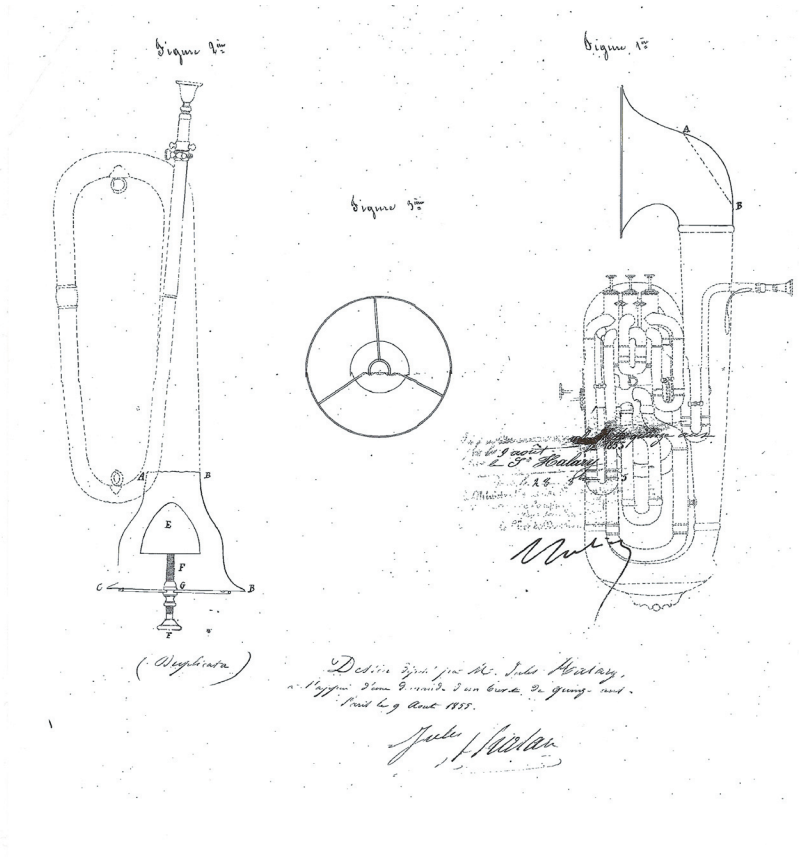


Figure 34: The drawing section from Halary's 1855 patent.

Although not leading the way in the application of the parabola to brasswinds, Sax's external parabolic bells seem to have been of an innovative nature. It is probable, though, that his extra bells contribute little acoustically. It could be expected that the internal, narrow bell (typical of ancient Egyptian trumpets) would affect the quality of the sound more; it would be interesting to test this theory.[75]

Double/multiple bell instruments

In the 1852 patent discussed previously, Sax also dealt with ways to extend an instrument's range. Here for the first time he proposed joining together two instruments that share the same bell and also the first half of their tubing.[76] Later, in 1859, he presented a double instrument whose bell is partitioned, based on a more or less similar idea. He joined two instruments of the same type but of different pitches to give the player a wider range of sounds. Sax made a distinction between his development and duplex instruments in the public domain; he joined together instruments of the same family, in different pitches and not two distinct instruments, such as a flugelhorn and a trumpet; the latter combination of instruments at the same pitch, but with different overall proportions, results in the instruments having the same range, but different timbres (see Figure 35).

It appears that as early as 1851 a British maker, James Gisborne of Birmingham, had exhibited double instruments in the London exhibition.[77] Pelitti of Milan had also been making duplex instruments since the late 1840s.[78] Sax's principle of two instruments sharing part of the same bell was ingenious but it seems that it was never realized. The more usual combinations in duplex instruments were those of a bugle with a trumpet and double-bell euphoniums. There is also a surviving specimen in Leipzig by Sax, combining a bugle in B♭ and trumpet in E♭, made in 1857.[79]

Another area where Sax seems to have been a pioneer, and with which his name has been associated, is that of instruments with multiple bells. This principle was patented in 1852. A small number of surviving instruments with multiple bells, the majority in Brussels, are equipped with six independent valves and seven bells.[80] Each valve is connected to a bell, and with the valves at rest the longest tube is employed.

An unsigned instrument of an even more ingenious design, in the Henri Selmer collection in Paris, is a trumpet in 4-ft. C with thirteen bells, giving pitches at each note of the chromatic scale down to 8-ft. C. There are six independent valves and two of Sax's version of the *registre,* mentioned above, which double the function of the six independent valves so that they can control the twelve bells; the longest tube (8-ft. C) sounds when no valves are operated.

An instrument with multiple bells, made by Distin, was also exhibited in the Royal Military Exhibition of 1890 (item 446). It was described by Day as a tenor saxhorn with seven bells and an extra echo bell, and six independent valves;[81] with the exception of the "echo bell" this appears to be a direct copy of Sax's instruments.

The multiple-bell principle deals well with acoustical problems, since each sounding length can end in a proportionally scaled flaring section. However, both the fingering

difficulties and the instruments' considerable weight and bulk (not to mention expense) prevented their general adoption.

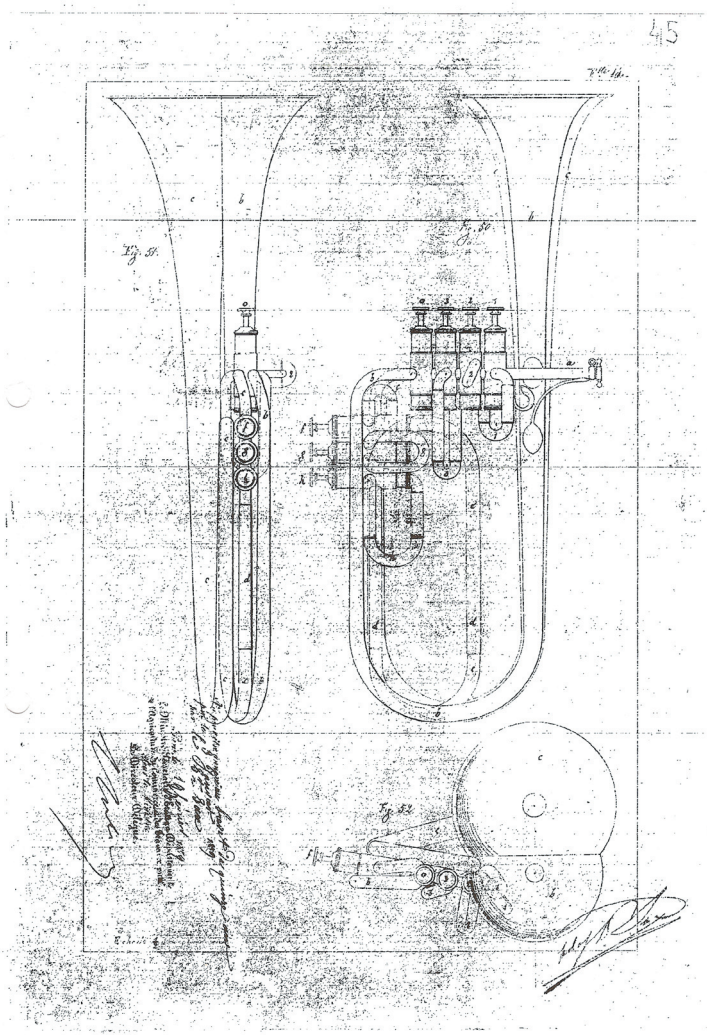


Figure 35: Double saxhorn from Sax's 1859 patent.
The two instruments share part of the same bell.

Adolphe Sax and the double-piston valve

The earliest evidence of Adolphe Sax equipping his instruments with double-piston valves comes from the famous 1845 Baugniet lithograph of the Distin family with the instruments Sax made for them.[82] One of the family members, William Distin, holds what Adam Carse called a German or Austrian flugelhorn.[83] Carse considered it possible that Sax had made that instrument, but never presented evidence for his theory. Since instruments of a similar or identical design were exhibited at the London 1851 exhibition, it appears that Sax was indeed the maker of this instrument. The exhibition included at least four instruments with double-piston valves. The sale catalogue of the Sax collection listed a trombone with double-piston valves described as a *premier* trombone of the kind made by Sax. It is not known to survive.

The patent of 1862 dealt almost exclusively with the development of various valve systems.[84] Sax gave a brief overview of the development of the valve and presented his views on the existing valve systems. In a short paragraph he mentioned that he had imagined a system that would improve facility and offer better sonority: this was the system of double-piston valves with spiral springs in boxes. The drawing provided shows the type of double-piston valve now known as the *système belge*. He asserted that this was the system modified in Germany for increased rapidity with the use of touch keys, but added that this type of valve is too complicated to make, very fragile and too expensive, and has all the disadvantages caused by the angles of the windways of the early version of the double-piston valve.

It is not clear who was the inventor of the *système belge*. According to Robert Eliason[85] it might have been Isaac Fiske; this type of valve was made in the 1840s by American makers.[86] In the account by Cools[87] of Belgian patents for improvements to the system, the earliest is one taken out by Ferdinand van Cauwelaert in 1847 for its application to the horn. Cools considered that the system originated in Germany. Heyde illustrates another early instrument equipped with a similar type of valve,[88] which he calls the "Hanoverian model."[89] This model of trumpet had been made from 1835 by J.H. Zetsche in Hanover. While the question of who was the inventor of this particular type of valve is still open, there is no evidence that it was Sax.

Rotary Valves in Sax's production

This is perhaps the only commonly used valve system to which Sax never claimed to have made any modifications. In his 1862 patent he reported all the drawbacks of the rotary valve. In his view this system, although it removed the sharp angles of the early versions of the double-piston valve, was noisy and very fragile. However, a small number of instruments with rotary valves were made in Sax's workshop. Very few are extant.

The rotary valve was not popular in France at the time, so Sax may have been aiming at the foreign market. His sale catalogue of ca. 1850 gives instrument prices in

three different currencies, francs, English pounds and Prussian thalers, which were the most stable currencies of the time; this indicates his aspirations for sales abroad.

Conclusions

From the early years of his career Adolphe Sax displayed evidence of a serious, methodical approach to instrument design and made significant efforts to resolve the imperfections of instruments through imaginative innovations and with the employment of principles of the science of acoustics. His ideas through the years showed development, and he held views that have been endorsed by present-day acousticians. The instruments made in his workshop display high standards of workmanship. A number of his brasswind inventions can be seen not to have been completely original, but Sax demonstrated a resourceful mind which, taking existing designs as a starting point, could develop and refine them to the limits of practicality. His most successful models, the saxhorns, were immediately copied by many other makers and their influence continues to this day. The uniformity and regularity of the saxhorn group and the pedagogical advantages in their use, such as the same treble-clef notation and the same fingering, should definitely be ascribed to him. Some of his developments, such as the independent valve, the compensator, and the instruments with multiple bells, seem superior from an acoustical point of view; however performers' reluctance to adopt new fingering systems and their ergonomical difficulties have prevented their general adoption. His brasswind production in general had a great impact upon makers both within the borders of France and outside, especially in Britain where Sax was much copied, since the British law of the time allowed "imported inventions."

Visionary or plagiarist? The authors are unable to give a simple verdict. Sax was incontestably a visionary; as for the plagiarism, borrowing in music and musical instrument making has been as old as music itself and appears to be inherent in most developments and advances in art and science. The fact that Sax claimed originality for some borrowed ideas seems in retrospect less important than the true vision shown in his inventions.

ACKNOWLEDGEMENTS

The authors wish to thank the museum staff of various public collections: Thierry Maniguet and Patrice Verrier (Musée de la musique, Paris), Géry Dumoulin (Musée des Instruments de Musique, Brussels), Bradley Strauchen (Horniman Museum, London). Also, thanks go to private collectors Bruno Kampmann (Paris) and John Webb (Swindon). They are also indebted to Raymond Parks (University of Edinburgh) for help with measurements and for taking photographs of instruments of the Edinburgh University Collection of Historic Musical Instruments.

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Arnold Myers read physics at St. Andrews University and completed his doctorate at the University of Edinburgh with research into the application of acoustical techniques for the study of brass instrument history. He is the Director of the Edinburgh University Collection of Historic Musical Instruments, and was appointed in 2006 to a Personal Chair in Organology in the University of Edinburgh.

APPENDIX
Summary of Adolphe Sax's French patents

Date	Patent number	Short description
13 June 1843	15364	Pour un système d'instruments chromatiques.
13 October 1845	2306	Pour un instrument de musique dit Saxotromba, dont la construction, au moyen de légères modifications, peut être appliqué aux Sax-horns, cornets, trompettes et trombonnes [*sic*].
5 May 1849	8351	Pour dispositions applicables aux instruments à vent, se rattachant particulièrement aux clairons, des chasseurs d'infanterie.
20 August 1849	1st certificate of addition to main patent 8351	Addition se rattachant particulièrement aux trombones & aux trompettes à coulisses.
23 Avril 1852	2nd certificate of addition to main patent 8351	Pour dispositions applicables aux instruments à vent, se rattachant particulièrement aux clairons, des chasseurs d'infanterie.
1 October 1852	14608	Pour des dispositions applicables aux instruments de musique à vent, notamment en cuivre.
3 January 1859	39371	Pour dispositions applicables aux instruments de musique, en cuivre.

30 April 1859	1st certificate of addition to main patent 39371	Pour dispositions applicables aux instruments de musique, en cuivre.
31 December 1859	2nd certificate of addition to main patent 39371	Pour dispositions applicables aux instruments de musique, en cuivre.
19 May 1862	54212	Pour des modifications apportées aux instruments de musique à pistons.
1 April 1867	75861	Pour divers perfectionnements apportés aux instruments de musique en cuivre.
8 May 1881	141575	Pour des perfectionnements dans les instruments de musique.

NOTES

[1] For a list of known Adolphe Sax instruments, see Eugenia Mitroulia and Arnold Myers, *List of Adolphe Sax Instruments,* <http://www.music.ed.ac.uk/euchmi/galpin/gdsl.html>
[2] Brad Sherman and Lionel Bentley, *The Making of Modern Intellectual Property Law* (Cambridge: Cambridge University Press, 1999), 96.
[3] See Appendix for a table containing information on Sax's brasswind patents.
[4] According to French law one or more parts of a patent could be annulled, leaving the rest of it valid. When a patent or part of it was annulled, those parts became invalid both for the past and present. When a patent was forfeited, the patent became invalid for the future only. See Benjamin Vaughan Abbott, *The Patent Laws of All Nations* (Washington: Charles R. Brodix, Law Publisher, 1886), 188.
[5] "Il supprime aussi les angles dans les tons ajoutés aux cylindres ou pistons, de manière à conserver aux instruments à vent leur sonorité première."
[6] "suppression des angles ou des courbes trop heurtées qui dénaturent les sons."
[7] Herbert Heyde, "The Early Berlin Valve and an Unsigned Tuba at the Shrine to Music Museum," *Journal of the American Musical Instrument Society* 20 (1994): 54–64.
[8] Eugenia Mitroulia, Gery Dumoulin, and Niles Eldredge, "On the Early History of the Périnet Valve," *Galpin Society Journal* 61 (April 2008): 217–29, 255.
[9] Adolphe Sax, *Note pour Messieurs les conseillers* (Paris: H. Simon Dautreville, 1850), 4.
[10] This was particularly usual in Germany. To support his view he presented at court four instruments from his private collection: a bass tuba by Moritz and a tenor horn, a trumpet, and a bass tuba by Heiser.
[11] Probably Sassaigne. See Mitroulia et al, "Early History."
[12] It is strange that the Distins registered the design as early as 1845, since it is known that at the time they did not manufacture instruments of their own and that they were importing instruments

from Paris only as Sax's agents. It is possible that they registered the design in Britain on behalf of Sax, even though this is not mentioned in the design's supporting text and cannot be confirmed.
[13] See *Affaire Drouelle contre Sax. Renvoi devant la Cour impériale de Rouen après cassation* (Paris: Renou et Maulde, 1866), 5.
[14] See for example Malou Haine, *Adolphe Sax. Sa vie, son œuvre et ses instruments de musique* (Brusselles: Éditions de l'université de Bruxelles, 1980), 62.
[15] See for example Adam Carse, *Musical Wind Instruments* (London: Macmillan, 1939), 298.
[16] According to article 31 of the law of 5 July 1844, "Any discovery, invention or application, which in France or abroad, and previously to the date of the deposit of the demand, has received sufficient publicity to enable it to be worked, shall not be reputed to be new." See Vaughan Abbott, *Patent Laws,* 189.
[17] "The Distins in America," *The Musical World* 24, no.27 (Saturday, 7 July 1849): 430.
[18] H. Dodworth, "Band Music Then and Now," *American Art Journal* (17 July 1880), cited in Robert Garofalo and Mark Elrod, *A Pictorial History of Civil War Era Musical Instruments & Military Bands* (Charleston, WV: Pictorial Histories Publishing Company, 1985), 9.
[19] There is confusion regarding the exact year Sax's method was published. 1847 is the date mentioned in the latest surviving handbill from Sax's workshop.
[20] For an illustration see Gery Dumoulin, "The Cornet and Other Brass Instruments in French Patents of the First Half of the Nineteenth Century," *Galpin Society Journal* 59 (May 2006): 88.
[21] See *Affaire Sax. Rapport d'expertise dans le procès de déchéance intenté contre les brevets Sax, par MM. Raoux, Halary, Gautrot, Gambaro, Buffet, etc., délégués des facteurs français* (Paris: Imprimerie Édouard Proux, 1848), 47.
[22] See *Nullité de brevet. Instruments et brevets Sax. Tribunal correctionnel de la Seine, 6me Chambre. Affaire Rivet contre Sax. Documents* (Paris: Impr. Dodney-Dupré, 1855), 57.
[23] Adam Carse archive, the Horniman Museum, London; reproduced in Anthony Baines, *Brass Instruments Their History and Development* (London: Faber, 1976 / New York: Dover, 1993), 256–57.
[24] Design registered to James Balthazar Ziegler for a "Valve perfecting spring slide for cornets &c," 1847 (BT45/06/1059).
[25] XXVII CLASSE. FABRICATION DES INSTRUMENTS DE MUSIQUE, 1335, <http://cnum.cnam.fr/CGI:fpage.cgi?8XAE53/1423/100/1664/0/0> Accessed 19 January 2008.
[26] The appearance of bugles with a valved attachment in this advertisement before the issue of Distin's patent of 1855 suggests that Distin might have been the maker of the instruments offered for sale by Boosey & Sons at this time.
[27] British patent number 1465.
[28] *Catalogue des instruments de musique de la manufacture générale de Gautrot ainé et Cie* (Paris: Typographie Ch. Oberthur & Fils, 1867), 81.
[29] *Illustrated Price List of the Hawkes Military Band Instruments* (London: Hawkes & Son, [n.d.]), 57.
[30] *Besson & Co, Ltd. 196–198 Euston Road, London* (London: Langley & Sons, Euston Press, [n.d.]), 35.
[31] See Baines, *Brass Instruments*, 176.
[32] See plate XXIV in Georges Kastner, *Manuel général de musique militaire* (Paris: Didot Frères, 1848).
[33] See Haine, *Adolphe Sax*; Malou Haine and Ignace De Keyser, *Catalogue des instruments Sax au Musée Instrumental de Bruxelles* (Brussels: Musée instrumental, 1980); and Wally Horwood, *Adolphe Sax 1814–1894. His Life and Legacy* (Hertfordshire: Egon Publishers, 1983).

[34] See *Giuseppe Pelitti. Fabbrica nazionale fondata 1720* (n.p., [ca.1870]).
[35] Herbert Heyde, *Das Ventilblasinstrument* (Leipzig: Deutscher Verlag für Musik, 1987), 63.
[36] For an illustration see John Webb, "Designs for Brass in the Public Record Office" *The Galpin Society Journal* 38, (1985): 48–54, 50.
[37] See Arnold Myers, and Niles Eldredge, "The Brasswind Production of Marthe Besson's London Factory," *Galpin Society Journal* 59 (2006): 43–75.
[38] These valves could also be used as transposing valves.
[39] For an illustration see Jacques Cools, "Adolphe Sax, la réorganisation des Musiques militaires sous Napoléon III," *Larigot* no. 25 (March 2000): 31–36.
[40] See Arnold Myers, "Brasswind Innovation and Output of Boosey & Co in the Blaikley Era," *Historic Brass Society Journal* 14 (2002): 391–423.
[41] "même instrument forme Saxotromba de cavalerie."
[42] *Complete Catalogue of Military Musical Instruments Manufactured by Henry Distin* (London: Henry Distin, 1857).
[43] Georges Kastner, *Supplément au traité général d'instrumentation* (Paris, 1844), 31–32.
[44] Idem, *Traité général d'instrumentation* (Paris, [1837]), 50–52.
[45] The addition, though, has very little in common with the main patent.
[46] Trajan's column was the model for the Vendôme Column built by Napoleon in Paris.
[47] Clifford Bevan, in "The Saxtuba and Organological Vituperation," *Galpin Society Journal* 43 (1990): 135–46, gives an account of the introduction of the saxtubas.
[48] For a reproduction of the drawing of Stowasser's patent, see Heyde, *Das Ventiblasinstrument,* 301.
[49] *Manufacture d'instruments de musique en cuivre* [et] *en bois ... Adolphe Sax* (Paris: Joseph Kugelmann, [1886–87]).
[50] For an illustration see Clifford Bevan, *The Tuba Family* (England: Piccolo Press, 2000), 472.
[51] For an illustration see Edward Tarr, "Eine Checkliste der Instrumente im Trompetenmuseum Bad Säckingen," *Musica instrumentalis* 3 (2001): 121.
[52] *Manufacture d'instruments de musique en cuivre en bois*. Bibliothèque Nationale de France, Site Louvois.
[53] The second certificate of addition was taken out on 31 December 1859.
[54] See Cools, "Adolphe Sax."
[55] For example the contralto saxhorn in B♭ with three Périnet valves and three keys at the Musée de la musique in Paris (inventory number E.1689).
[56] Several instruments with a bell of this kind were exhibited in the 1890 Royal Military Exhibition. One in particular is described as "parabolic funnel-shaped."
[57] Certificate of addition of 30 April 1856 to the main patent (FR 22072) of 18 January 1855.
[58] Charles Russell Day, *A Descriptive Catalogue of the Musical Instruments Recently Exhibited at the Royal Military Exhibition, London, 1890* (London: Eyre & Spottiswoode, 1891), 223.
[59] The Musical Shapcotts were an English brass ensemble formed in the late 1840s by John Shapcott. His seven sons were the members of the group. Advertisements of their concerts appear from 1849 and onwards in the English press; the Shapcotts, closely linked to the Temperance movement, appeared as a "Sax horn band." In 1852 they even offered for sale saxhorns at very low rates. In the early 1860s the band was re-established by four of John Shapcott's sons and renamed The Brothers Shapcott. This time they seem to have had a preference for Besson's *neoform horns,* which were advertised as "expressly made for them by F. Besson."
[60] British patent no. 2967, 3 December 1860 for "Improvements in Wind Musical Instruments."

[61] Other specifications included in the British patent influenced by Sax are the addition of an ascending valve to brass instruments mentioned in a following section, and the "movable cap or hood," a direct copy of Sax's *reflecteur sonore* of the 1859 patent.
[62] *Grove Music Online,* ed. Laura Macy (accessed 19 January 2008), s.v. "Film Music, 2. Early sound films," by Mervyn Cooke.
[63] British patent number 5013 of 7 October 1824.
[64] For an illustration see Reginald Morley-Pegge, *The French Horn: Some Notes on the Evolution of the Instrument and of its Technique* (London: Ernest Benn, 1973), 38.
[65] In his 1859 patent, Sax also announced the improvement in the construction of the valves. A narrow tube attached to the exterior of the valve casing prevents dust from entering the valves, thereby making them more durable. This small tube replaces the opening that is normally found on the bottom cap of the valve and allows displaced air to escape from below the piston, without the intrusion of dust when the valve is operated. It can be found in most, if not all, Sax instruments with independent valves.
[66] One of the surviving instruments displaying a combination of regular and independent valves is a contralto saxhorn, part of the collection of the Musée de la musique, Paris (inventory number E.744), originally from the collection of Sax. This has three regular Périnet valves and an ascending valve. The sale catalogue for this collection (1877) described it as "very rare."
[67] J. Forestier, *Monographie des instruments à six pistons et tubes independants. Etudes pratiques et théoriques pour le nouveau système de Mr. Adolphe Sax* (Paris: Adolphe Sax, 1867), 12.
[68] Day, *Descriptive Catalogue,* 208–09 .
[69] British patent no. 2967, 3 December 1860, for *Improvements in Wind Musical Instruments.*
[70] Day, *Descriptive Catalogue,* item 418; Horniman Museum 2004.827.
[71] See Myers and Eldredge "Brasswind Production," 43–75.
[72] Hans Busch, *Verdi's Aida, The History of an Opera in Letters and Documents* (Minneapolis: University of Minnesota Press, 1978), 417–18.
[73] French patent 2493 of 18 November 1845.
[74] French patent 24419 of 9 August 1855.
[75] A copy of an ancient Egyptian trumpet that used to be part of Sax's collection (inventory number 400), today at the Musée de la musique (inventory number E.762), might have served as a model for the bell shape.
[76] He also suggested a version with two bells; he understood that the use of the same bell would disturb the instrument's sonority, since the size of the bell has an important effect on the instrument's sound, and the bell might be too large for the higher register.
[77] *Musical Instruments in the 1851 Exhibition* Peter and Ann Mactaggart, eds., (Welwyn: Mac & Me, 1986), 69.
[78] See Bevan, *Tuba Family,* 475.
[79] Musikinstrumenten Museum, University of Leipzig, No. 1872.
[80] They were all made in the 1870s.
[81] Day, *Descriptive Catalogue,* 223–24.
[82] For a reproduction see Horwood, *Adolphe Sax,* 54.
[83] Adam Carse, "Adolphe Sax and the Distin Family," *The Music Review* 6, no. 4 (November 1945): 193–202.
[84] French patent number 54212.
[85] Robert Eliason, *Early American Brass Makers* ([Nashville]: The Brass Press, 1981), 36–67.
[86] There is a surviving bugle in E♭ dating from ca. 1848 that has the shortest valve first.
[87] Jacques Cools, "A propos des cylindres droits ou pistons dits 'belges'," *Larigot* no. 36 (October

2005): 12–20.
[88] Heyde, *Das Ventilblasinstrument,* 45, 196.
[89] Bad Sackingem Museum, inventory number 14403.