A Boehm flute for a one-handed player

By Maarten Visser

Edit van der Burg won the first prize at the Dutch National Flute Competition in 2003, has recorded two CDs and has given many public performances later. Amazingly, because of a disability, she plays with her left hand only. I first produced a flute for Edit six years ago, based on a student Yamaha, and it has been modified six times since. Now, Edit needed a new and better instrument. I made her one based on an Altus flute, this time to low B. The new flute was beautifully finished, and brimming with improvements. When Edit was presented with this instrument, Mia Dreese, editor of the Dutch flute magazine *Fluit* asked me to explain how the thing works.

Rules and exceptions. The less you have to think, the easier it is to play. One operates a fingering system by applying rules. The more complicated, the more rules; the more rules, the more lost time, the more lost concentration, the more lost energy. The brain has an amazing ability to automate frequent processes. We call this learning. Learning goes quickest when the new structures are connected to existing knowledge. That is what I knew when I was trying to invent a one-handed system for Edit. I knew the system had to have as few rules as possible and that it had to connect to what Edit already knew. There were three possibilities I could think of. Each possibility would use a mechanical system and a fingering system, each with its own set of rules and exceptions to these rules.

The recorder technique. The first system is based on a trick which is also used in one-handed recorders: the functioning hand plays the lower holes of the instrument. The top holes are closed by keys which are operated by levers near the open holes on the lower half of the instrument. This can be attained on a Boehm flute by reversing the spring action. Then some levers must be built to operate the top hand keys. This system is not very complicated to construct, especially if the playing hand is the right hand. But to learn this system is difficult, because the top keys have a reverse action to the down keys. Fingers have to jump from holes to keys, and it is often required that the player simultaneously closes one hole and opens another.

Double keys. The second system, like the recorder technique, had been used before. The keys for the index, middle and ring finger (second, third and fourth) are extended so that they can be operated by the like finger of the playing hand.

Maarten Visser studied woodwind making and repairing in Newark (UK). In 1986 he started his own business in Amsterdam, specialising in flutes and adapted wind instruments. He has made a one-handed Boehm flute, one-handed recorders and adapted saxophones, flutes and clarinets. Work on ergonomic flutes started in 1993 and resulted in creating the Swan-Neck headjoint and the Vertical headjoint. He has been interviewed on Dutch radio twice and appeared in numerous press articles.
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Figure 1

Each of these three fingers has now two keys: the one that was already there and the corresponding key for the missing hand. For example, the index finger may control the keys for F and C♯ simultaneously. For F they both have to be pressed. If you play G next, you have to slide, because the C♯ key has to remain depressed. The advantages of this system are its logic and its flexibility. All key fingering combinations remain possible. The downside it that it requires a lot of finger dexterity.

An echo from Theobald Boehm. In the third system we hear the echo of Boehm's words that one finger should have one key. Boehm had to make a few compromises (though not as many as me) but his remains a good idea. The result would be that one key has multiple functions. The simplest way to do this is to pair the keys of the right and left hand. So the C♯ (left little finger) becomes paired with the F (formerly right little finger), the A with the E and so forth. When you play the notes for left hand, some keys down the flute will move at the same time. Some notes will be a bit flat. If you want to play the lower notes (for the right hand), you use the same keys. plus a special feature to keep the top keys closed. A special key closes, in one movement, all the top keys. This special key can be operated by the thumb, a foot pedal or other means. The keys that are used for playing now only control the lower holes. A great advantage of this system is the simplicity of its operation. The disadvantages are that the key system becomes complex and sensitive, and a lot of force is required to close all the top keys at once.

A letter to Edit. From these three systems I then distilled three fingering tables. These were sent to Edit, with a letter in which I asked her to play scales, mentally, using the different fingering tables. I asked her to indicate which system she found easiest to work with. I was aware thet Edit had studied the flute before her accident, so it was all the more important to link to her own mode of thinking. Her answer came quickly: she was sure it had to be system three. This was by far the most challenging to make, but, for it good ergonomical reasons, it was the most promising. Edit rejected the idea of a pedal because, of course, because she is paralysed on one side of her body. If she used her good foot to operate the pedal, on which foot should she stand?

Figure 2

The thumb keys. There are still two thumb keys (Figure 1). The upper one is soldered to the pad cup and is used to close the C hole, the opposite to the system we are used to. The bottom touch, formerly the B♭ key, lifts a lever, attached to a new axle. A lot of force is transferred here, so the lever is equipped with a Delrin roller to reduce friction. The extra axle is built over the existing key system. With four arms it closes C♯, A (which in turn closes B♭) and both the G keys. (The coupling between these two has been undone). And the thumb key also closes the C on the back of the flute. So fingering the special thumb key fingers a G, in one movement.

The first dual function keys. Now the keys must be made to control the lower holes with the left hand fingers. Down to G the holes are controlled by the left hand (Figure 2). Now let us look at the F key. It makes sense to bring the F to the left index finger. So the long F key would have to close the C♯ simultaneously. But

we have some tones that require the C♯ to be closed when the F is open. With the first and second octave F♯ there is no problem: the C♯ is closed by the special thumb key, and the F can remain open. But we also need a high F. With the A and B♭ keys open we cannot use the special thumb key. The same problem arises with high G and G♯. Is is unfortunate but neccesary: two touchpieces next to one another, one for the C♯ and one for F, to be pressed separately or together as necessary. This long F key has no further bearing on the actions of other keys so it is mounted hovering over the B♭ key. The C♯ is given a new touchpiece which is made right next to the F key. For the technically inclined: the pin is removed from the B♭ key, which is now disconnected from the F–B♭ link. The hinge tube above the cup arm is sawn off and here come a short hinge for the F touchpiece. This hinge tube is now pinned to the steel rod. An extra piece of metal is added, fitted over the old B♭ link. If you press the new F touchpiece, the steel rod turns, the old B♭ link goes up, hits the extra piece of metal and the F key closes.

Figure 3

A lost B♭. At this point there was no way left to play B♭. The thumb B♭ has been re-assigned to the special thumb key that closes all the top hand keys, and there is no right index finger to help us. So a new B♭. Right on top of the actual B♭ key I mounted a touchpiece, one position down from the F key, that closes the B♭ without further complications. So to play a B♭ you put your fingers on the C♯, thumb C key and B♭ touchpieces. Indirectly, the B♭ key will be closed by either the A key or the special thumb key.

The E key. The E key also posed some difficulty. Over the steel rod of the trill keys a new hinge tube is fabricated. On the high end a touchpiece is mounted which closes the A key (which in its turn, closes the B♭ key). At the lower end an arm is attached which closes the E key. The long rod feels unstable, so to stabilise it the half-supporting pillar that is under the trill key rod is modified. A split bearing bushing of Delrin it fitted over the rod, and the bushing is enclosed with a cap which attaches to the old half-pillar.

Figure 4

Disconnected G keys. The D key also turned out to be quite complicated (Figure 3). First, it has to close the G key (in fact, two keys). Unfortunately, playing an A♭ has now become very cumbersome, as it involves pressing the special thumb key to produce G, and then pressing the old G♯ key. So the flute was converted to an open G♯ system. Only the higher of the G keys must be closed to produce a G♯, which is very easy coming from A. But the special thumb key now has to close the two G keys simultaneously—and so does the D key! The D key closes the G holes, and low down also the D key, where a new problem awaits.

An extra hole for E♭. On an ordinary flute there is an E♭ key and most of the time it is held open by the right little finger. In this case there is no right little finger to do that. Of course we could transfer the motion of the left little finger with a long key, much like the long C♯ keys that can be seen on older instruments. Ring finger and little finger share an extensor tendon, which makes it difficult to use them independently. Because these fingers are physically so connected, motoric control of the fingers is also developed in a like manner. Because of this, extensive use of the little

Figure 5

Edit van der Burg with the one-handed flute adapted for her by Maarten Visser.

finger hampers free use of the ring finger. As this is to be avoided, the E♭ must be made to stand open by itself, and only close when needed. In a first attempt, a Dorus-like system was employed, but it proved unreliable. Therefore a new system is invented (Figure 4). A second E♭ hole is made opposite the old hole. A special key is made to close this extra hole in conjunction with the D key. So when the D is pressed down (by a lever which also closes the G keys) the D key and the new E♭ key both close. The old E♭ is maintained, in its normally closed position, and is operated by the left little finger by a long lever. Does this sound familiar? First you close two holes (to go a second down), then you open a duplicate of the lower hole to go up a semitone. That is what happens on your own flute when you play A—G—G♯.

Sax little finger. Not only E♭, but also low C♯, C and B are transferred to the left little finger by long levers (Figure 5). At Edit's request these were fitted with rollers. Also taking into account the old G♯ the little finger has now 5 keys to control. That poses no proble, as this finger is quite strong and it has a mobile joint at its base. Sax players never complain.

Even more touchpieces. Finally, some more touchpieces are added. The old G♯ is fitted with a smaller, round knob, as the old G♯ touch was in the way of the other pinky keys. The A got a small extra knob for playing trills. The special key that closes the top holes is given an extra touch so it can by used by either ring or middle finger. This way, the C hole at the back is left free, so high G and G♯ can be played. Newly-added touches for the trill keys are given to ring and middle fingers.

Edit's flute has also special facilities for cleaning, a special headjoint, a specially made case, a unique flute stand and a large leather grip for the right hand. The result is a flute that enables Edit to play all flute parts with a range of three octaves chromatically.

This design is not protected and all instrument makers are free to implement these inventions to facilitate disabled players to make music.

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