Additions to the Bassoon Mechanism

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In comparison with other woodwinds, the bassoon is sometimes described as primitive and flawed. This may offend many bassoonists, but even the most virtuosic players admit that with the existing mechanism, some passages are extremely awkward. A lot of this awkwardness is due to the simplicity of the key mechanism.

Of course the bassoon mechanism does not appear to be simple at all. If you examine the mechanism closely however, you'll see that each key is usually an independent entity with only one function – to open or close one tone hole. This is the simplicity of the mechanism. There are few interconnections or dual function keys. (The low E key also closes the whisper key. The low B key overlaps and closes the low C key, which overlaps and closes the low D key. The right hand $F^\#$ key also closes the low F key.) There are also two automatic systems (the ring keys or the wing and boot joint) but they only really affect three notes.

I believe that a few additions/alterations to the existing mechanism can overcome many of its limitations and make the instrument much easier to play. Why not design a totally new mechanism? It is probably possible, but producing and marketing a totally new instrument (new mechanism) would be very difficult. Would it be worth it for one of the major bassoon makers to make the investment required in producing a new instrument that would compete with their existing product? Would it be worth it for the buyer to make the considerable investment in a new instrument and then the additional investment of time to learn to play it? It seems that it would be more practical to add to or alter the existing mechanism than a total redesign.

How do you determine what additions/alterations would be most useful? Rather than starting with a list of awkward fingering combinations, I think it would be useful to closely examine what makes a fingering combination difficult. With this idea in mind, I'd like to consider two types of difficulties: 1) mechanical and 2) acoustic. Many playing problems will combine the two types.

Mechanical difficulties deal with fingering motions. The simplest finger motion is just moving a single finger up and down. It can be over an open hole, a hole with a ring key, or a single key. Since in one direction of motion there is a definite "stop" – the hole is covered, or the key can move no further, the finger can bounce off that stop. There will be differences in speed between fingers, hands and people, but usually this motion can be done as fast as necessary. More that one finger moving in the same direction usually isn't more difficult.

The situation is more complex when two fingers move in opposite directions. Moving between the two fingerings needs to be quick enough so that the "in between" position, one finger half way up and the other half way down, doesn't last long enough for the bassoon to respond to it. Not every pair of fingers has the same degree of dexterity, which adds to the complexity. (For example, the first and middle finger can alternate with much greater ease than the ring and little finger.) While not unique to the bassoon, the motion of sliding a finger from one key to another is required more frequently than in other woodwinds. In the lowest and highest registers, it is a frequent motion of the thumbs, and to a lesser extent, of the little fingers. Sliding between two keys has the same problem as moving two fingers in opposite directions. The motion needs to be quick enough so that the instrument doesn't respond to the "in between" position. (An example would be slurring low E to $F^\#$, but actually playing E – F - $F^\#$.) A further difficulty of the finger slide is that there is no definite stop in either direction as when covering an open hole or depressing a key. This lack of a "stop" means this motion has no "bounce" to it – it is inherently slower than a motion that does have a "stop". This is especially apparent if the slide needs to be repeated, back and forth. Low register trills are especially awkward, (try E - $F^\#$, C - D, $C^\#$-$D^\#$) so much so that we usually have to use alternate fingering to execute them at all. I do not believe that we should automatically add to the mechanism every time we encounter a difficult trill (not that it doesn't already seem that for every awkward trill – that's most of them on the bassoon – someone has invented a trill key or mechanism change to make it easier.) However, the motion that makes these trills difficult is encountered repeatedly in the low register. How quickly can you move, in the low register, between the 3 notes of a $B^\flat$ major triad? D major? C minor? Clearly the thumb slide is a limiting motion. I cannot say how quickly anyone should be able to play these patterns. But, if we can provide alternatives to the thumb slide, it should make the low register easier, smoother and faster.

To accomplish this, I'd like to suggest the six following additions/alterations to the mechanism. Individually they are of limited use. Together they provide enough alternatives as to almost eliminate the limiting thumb slide motion in the lowest register of the bassoon.

1) Left Hand Little Finger Whisper Key. (Figure 1)

This key frees the left thumb from whisper key duty, allowing greater freedom for low register technique, middle register flicking or high register technique. The actual lever sits below the low $C^\#$ key. It can be a bit of a stretch, but all three left hand little finger keys ($D^\#$, $C^\#$, alternate W key) can be repositioned to accommodate the reach of the player. Mounted on the wing joint, there are a couple of configurations, the simplest requiring only 2 new posts. It is so useful by itself that I am surprised that it isn't a standard key.

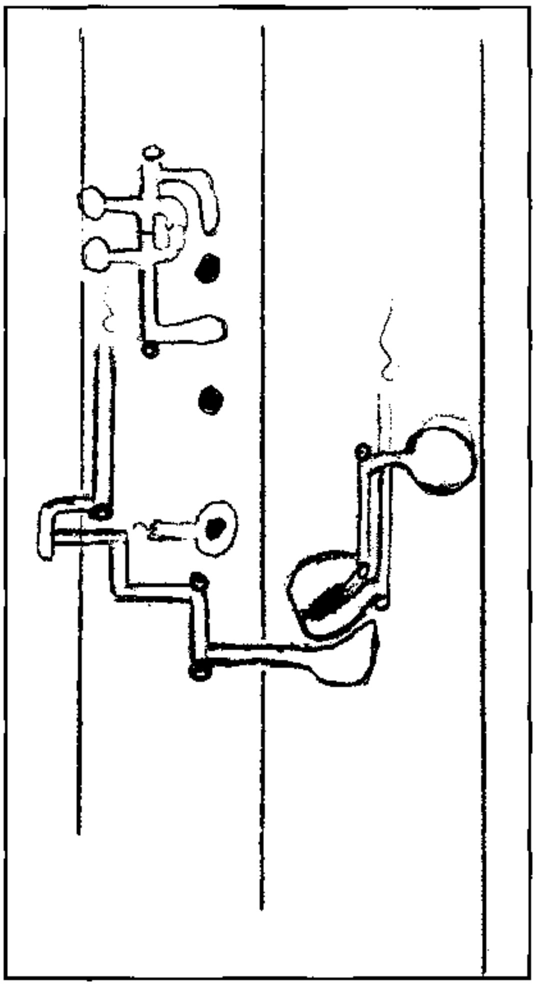
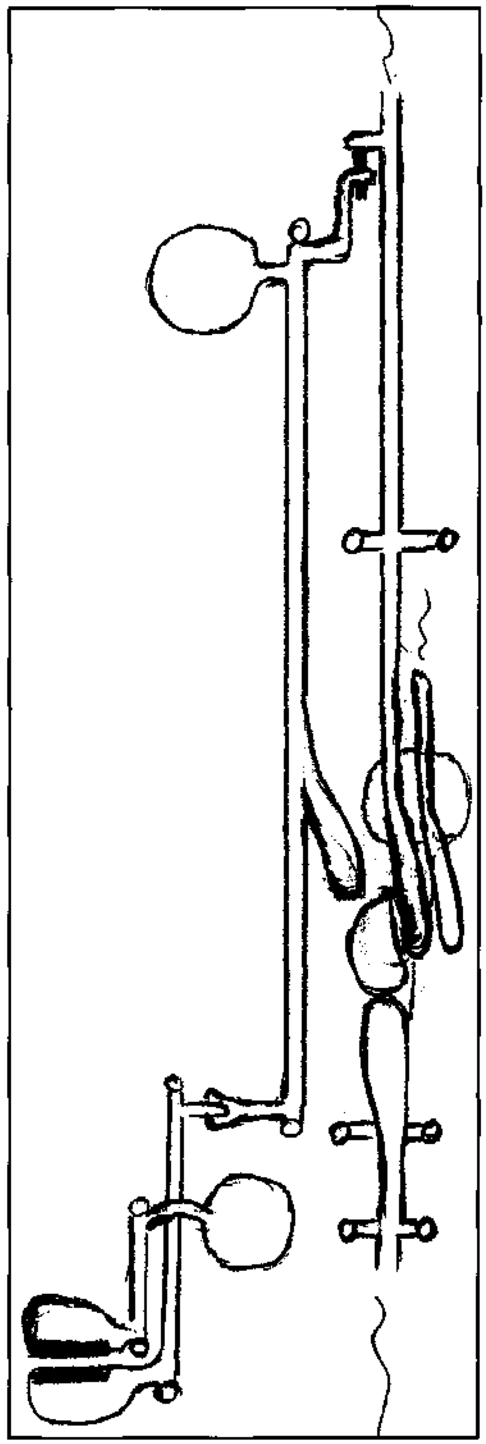


Figure 1: Sketch of general position of left hand little finger whisper key.

2) Left Thumb Alternate Low $C^\#$ Lever (Figure 2)

Sitting just above the low C key, this allows the low $C^\#$ key to be operated with the left thumb. The lever can

can be mounted on its own separate pivot rod, which may result in a smoother action, but it would be a more expensive installation.



These two keys overlap the low E key and can be built as a single unit utilizing a rod within a rod configuration. A double bridge from boot to bass joint leads to another rod within a rod mechanism, so that there are only two posts on each joint required. The tail end of the low C key needs to be lengthened to provide a long enough lever arm. The earliest use of these keys that I am aware of is on a bassoon in the collection of the Metropolitan Museum of Art in New York City. It was built by Heckel in the 1930's on special request and includes many other innovative features.

4) Automatic Low C# Mechanism (Figure 2)

Much less complicated that it sounds, this allows the low C# key, once opened with the left hand little finger, to be closed by closing the low B key, without moving the little finger from the low C# key. This is

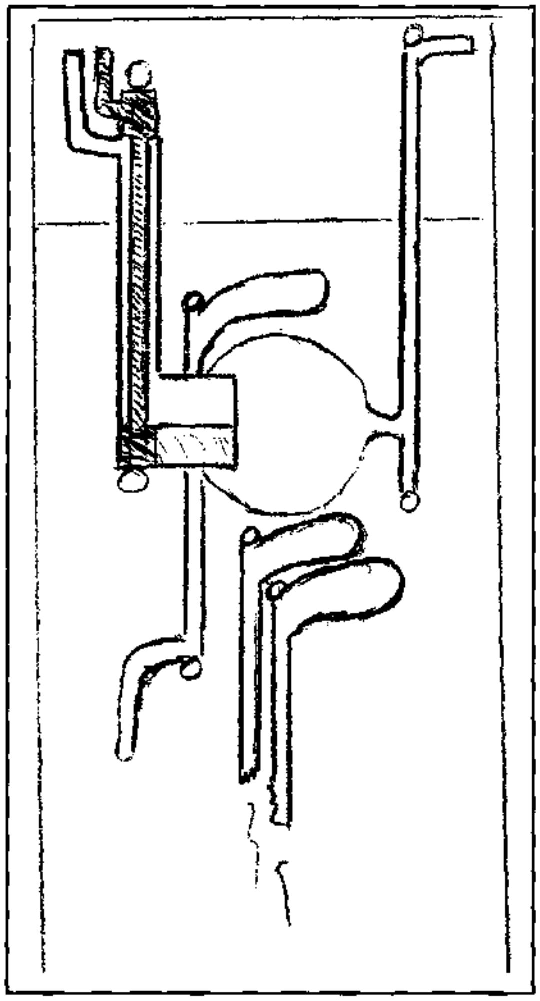


Figure 3: Sketch of boot joint showing placement of right thumb (alternate) low C and D keys.

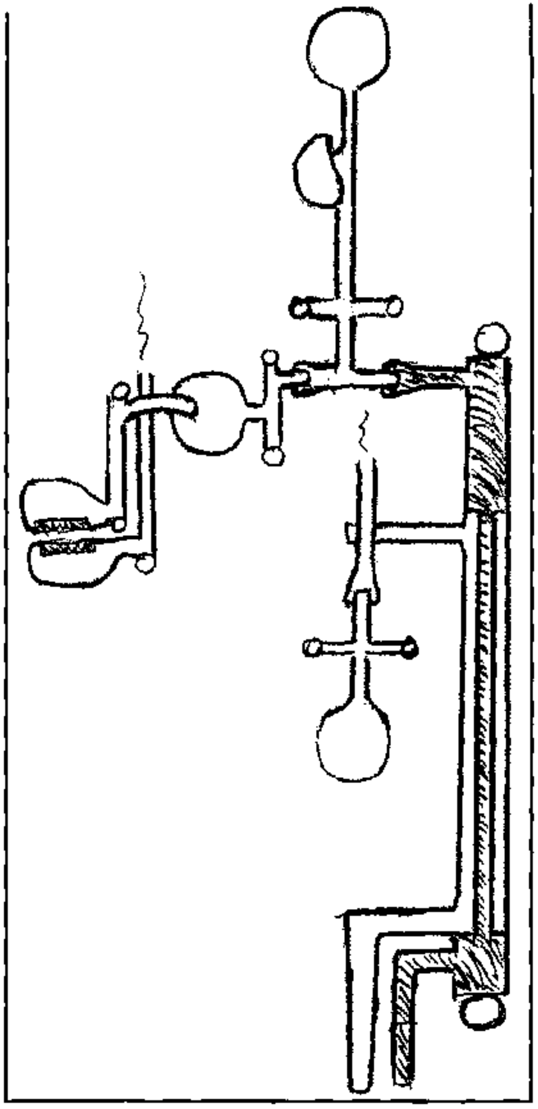


Figure 4: Sketch of bass joint showing continuation of alternate low C and D mechanism and automatic low Eb mechanism.

accomplished by reversing the levers and springs of the existing mechanism. Instead of the left hand little finger C# key *lifting* from under the actual C# pad (held down with a heavy spring), the key lifts off the C# pad, allowing it to open from the push up of a light spring, leaving the possibility for it to be closed by something else, (the low B key) without moving the little finger. Of course, a consequence of this is that the low C# key cannot be opened when fingering a low B or B♭. This might effect a multiphonic, microtonal or other special fingering.

If you have trouble visualizing this mechanism, compare a "normal" low C# key with the action of the low F key and ring key on the boot joint. Pressing the low F key (closed) allows the ring key (g vent) to open. Releasing the low F key will naturally close the g vent, but it can also be closed by the ring key, without removing your little finger from the low F key. The F key "enables" the g vent to be open or closed. This is the essence of any automatic system. It is surprising that the standard Heckel system uses it so sparingly.

5) Automatic Low $E^{\flat}$ Mechanism (Figure 4)

Because the low $E^{\flat}$ key is usually a one piece key, this mechanism is a little more complicated to build than the automatic low $C^{\#}$ mechanism, but it is basically the same idea. The original key must be disconnected from the actual pad cup and provided with a strong spring pushing down. The pad cup must be mounted on a separate(new) pivot axle and given a light spring to push it open. The original lever now allows the $E^{\flat}$ pad to open. Without moving the original lever, the Eb pad can be closed by something else, in this case, the low C key. A consequence of this is that whenever the low C key is closed (notes low $C^{\#}$ and below), the low $E^{\flat}$ key cannot be opened.

6) Low E and F Key Linkage (Figure 5)

With this mechanism, closing the low E key also closes the low F key. This eliminates the need to slide the right hand little finger from the low F key to the $F^{\#}$ or $A^{\flat}$ key. The mechanism can be easily set up with a linkage to the through boot push rod, which normally allows the right thumb $F^{\#}$ to close the low F key. To keep the action light, it is advantageous to shift the lever arm of the low F key that actually closes the low F pad, so that the through boot push rod will only close the low F pad and not move the low F key and g vent mechanism. (Figure 6) This also lightens up the action of the right thumb low $F^{\#}$ key. (Thanks to **Mike Sweeny**, principal bassoon of the Toronto Symphony for that tip.) Of course, with this mechanism once the low E key is closed, (normally low E and below) the low F key cannot be opened.

The combination of these additional keys and mechanism changes allows most intervals in the low register to be played without sliding the thumb between keys. This is especially advantageous if a slide needed to be repeated. (Think of the second bassoon part in the third movement of Tchaikovsky *6^{th} Symphony*.) I leave it as an exercise for the reader to visualize these much simpler fingering combinations for trills, intervals and chordal patterns that these mechanisms provide. The Fox Corporation offers most of these mechanisms as options on new bassoons. Retrofitting another instrument should be well within the skill of a competent repairman.

The inefficient "thumb slide" is also a major (and

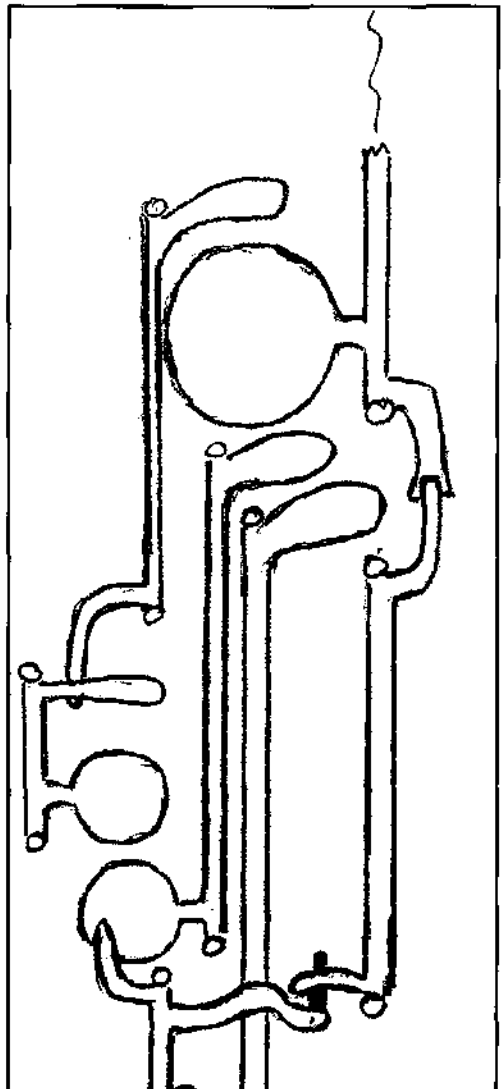


Figure 5: Sketch of boot joint showing a possible low E to F connection.

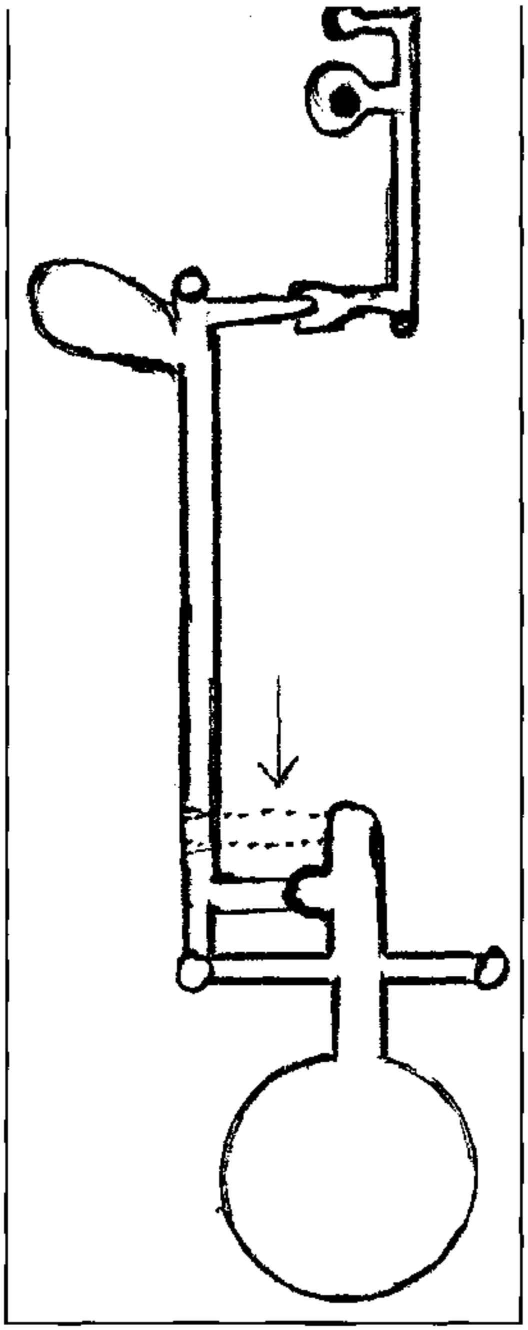


Figure 6: Sketch of low F - high g vent mechanism showing shift of low F lever arm.

wing joint, the system would be enabled by depressing the high A and $C^{\#}$ keys with the left thumb (the high A fingering). (This is similar to how depressing the low F key enables the g vent mechanism on the boot joint.) For notes above high A (and B^{b}), the thumb is not moved at all – the wing joint thumb keys are opened and closed by ring keys on the open finger holes. Mr.

nisms that would fit those criteria. After wearing out several erasers each, many of us did come up with a mechanism on paper, but the general feeling was that these designs could only work on paper. Actually building any one of them did not seem practical. However, at the IDRS convention in Madison, Mr. Weisberg displayed a working prototype! It works extremely well! Though it feels very peculiar to play the highest register without moving the left thumb, it should be noted that all of the wing joint thumb keys are still there. The system can be "ignored" and the high notes fingered as usual. (This is an important feature of the system, as it will take a while to "untrain" the left thumb.) Unfortunately, the system is not yet available.

We might consider the category of acoustic difficulties to be more of a concern for the instrument maker than the performer. Evidence of this can be seen in the choice of different bore styles, bocal models, even different bell joints offered by various makers. One acoustic difficulty that the player must contend with concerns the 9 notes of the middle register ($f^{\#}$ below middle c to d above middle c). These notes are fingered the same as the notes an octave lower. The problem is that there isn't an efficient, reliable way to differentiate between the octaves for each note. (Brass players must be laughing at us.). Theoretically, for a conical bore, each note needs its own octave (register) key. Open the key and the note will jump an octave. But 9 more keys (for the left thumb perhaps?) wouldn't be very practical. Happily, there is a degree of flexibility between these octave keys. We can (and do) use a half-hole as the octave key for at least 3 notes. ($f^{\#}$, g and $g^{\#}$.) A very small half hole can even be used for the next note (a), but it is very touchy. The half hole will not work for the remaining notes, but the higher register speaker keys (high D, high C/B and high A) are in the same area of the wing joint where the proper vents would be located. These existing holes are too big and not in the optimum location to truly serve as octave keys – simply holding one of these keys open for the duration of a middle register note tends to be out of tune and of poor tone quality. However, flicking one of these keys open at the beginning of a middle register note provides enough of a disturbance to the air column, at almost the right place, that we can use flicking as an improvised octave key. While bassoonists are not in universal agreement as to when flicking is required, the acoustic reality is that whenever one of the problem notes is played, the potential for the note to mis-speak or crack is present --the instrument doesn't "know" which octave is intended. Flicking technique can be highly developed, but it has limitations. For instance, is it possible to reach the proper flick key for every note that requires one in the short fast solo in the 4th movement of Beethoven's *4th*?

This middle register difficulty has been virtually eliminated with the introduction of Arthur Weisberg's double automatic octave key system. With this system, the half hole notes f#, g and g# are unchanged. Lifting the left thumb off the whisper key enables the system, opening the first of the new vents which is the octave key for a, b♭ and b. A right hand first finger ring key switches to the second vent which is the octave key for c, c# and d. Additional linkages with the G key (boot joint) and left hand little finger E♭ key insure that the new vents are only open when needed. The system makes legato leaps to the middle register notes very easy. There is also a noticeable improvement in tone quality and intonation, especially on c, c# and d. Articulation (tonguing) is especially crisp and precise – which is a distinct pleasure when playing that Beethoven's 4^{th} solo, or the Mozart *Concerto* and many other excerpts. Presently, the system is only available through James Keyes, who designed the system with Mr. Weisberg (see their ad in previous editions of this Journal).

These mechanisms I've described are all "broadly useful" – they come into play in a variety of circumstances. There are many other available mechanism adjuncts of more limited use (i.e. numerous trill keys). Of course, whether or not to alter the mechanism at all is a personal decision. Altering the mechanism to improve one's technique is not without merit but its true value is only fully realized when it leads to greater expressiveness.

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