paddler

Post subject: Re: Rockstro

Posted: Sat Feb 22, 2020 11:31 am

offline

Joined: Sat Nov 03, 2007 7:19 pm
Posts: 531
Location: Hood River, Oregon, USA

> **Terry McGee wrote:**
>
> Now, I've had a quick whip through of all my other period and more recent books on flutes - not one mentions chambering in its Index. A search on-line for "flute chambering" finds nothing apposite.
>
> So, I have to challenge Paddler's assertion: "It is well documented in books and articles on flute making". Let us flush out these references and see if they speak to us....

If you read the book "Woodwind Instruments and their History" by Anthony Baines, you will find the following statement:

"Tuning, in this sense, mainly entails such things as undercutting a hole or chambering the bore to sharpen a note (a local expansion of the bore will sharpen the note which has an antinode at that point)."

Similarly, in the book "Baroque Woodwind Instruments: A Guide to Their History, Repertoire and Basic Technique", By Paul Carroll, you can find the statement:

"By making a flute in several pieces or joints, it also became possible to tune the instrument more carefully. Apart from the reliability of boring shorter lengths of wood using the only available tools, that is a shell bit and reamer, with less risk of misalignment or splitting, local reaming, including chambering to improve general intonation, could be carried out more easily."

Does this satisfy you, or would you like me to go on?

There is lots of evidence that chambering was used by woodwind makers, there are makers today who use it, there is a clear scientific basis to explain why it works, and there are instruments in existence that have measurable chambers in their bores.

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Posted: Sat Feb 22, 2020 1:02 pm

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Here is a little more for you to chew on regarding the underlying physics and how long it has been widely known.

Take a look at Arthur Benade's book "The Fundamentals of Musical Acoustics", pages 473 onwards. Specifically, read section 22.3 "Adjustment of Natural Frequencies by Means of Small Changes of Air-Column Shape". You will find the following
statements, and a lot more.

The interlacing of pressure nodes and velocity nodes allows us to deduce the following general principle, which was first enunciated a century ago by Lord Rayleigh:

1. A localized enlargement of the cross section of an air column (a) lowers the natural frequency of any mode having a large pressure amplitude (and therefore small flow) at the position of enlargement, and (b) raises the natural frequency of any mode having a pressure node (and therefore large flow) at the position of enlargement.

It is possible to calculate curves giving the effect of a small, localized enlargement or contraction on the frequencies of each vibrational mode of an air column. We call such curves perturbation weight function curves, or W curves for short. The mathematical techniques for putting them to use are a highly developed part of mathematical physics. These techniques are known collectively as perturbation theory ...

The book has extensive discussion of this, and even shows diagrams to illustrate the tuning effect of specific cavities in the bore of a woodwind instrument on the first three modes of its oscillation.
If you want to understand this, I suggest you read some books and do some research.

On page 251 and 252 of Cris Forster's definitive work on "Musical Mathematics" you will find extensive discussion of this topic, specifically in the context of flute tuning. There is even an analysis of the impact of the tone hole cavities in an Armstrong Boehm silver flute.

This section starts out with the following statements:

"Another important fine-tuning technique consists of changing the bore diameter of woodwind instruments at the location of a pressure antinode, or at the location of a displacement antinode for a given mode of vibration. If we expand the bore by lightly sanding the inner surface of the flute tube at the location of a pressure antinode, such an increase in diameter causes a local increase in volume (V), which in turn produces a local decrease in pressure."

It then goes on to explain the impact of this in terms of the springiness of the air, the energy in the air and the frequency at which it will vibrate. I can include more of that explanation if you really want,
but I think it would be more productive for you to study the literature. Hopefully, I have given you enough starting points. There is a lot more about this in work by Nederveen who has written books on
the acoustic aspects of woodwind instruments.