The characteristic sound of the oboe:
Can it be played with a single reed and still maintain its tone colour?

Introduction

Would an oboe with a single reed sound like a saxophone? What difference exactly does a single reed make compared to a double reed? Is it possible to build a single reed mouthpiece for an oboe without modifying its characteristic sound or tuning? Some advantages of having such a mouthpiece could be:

1. Playing oboe would be more accessible to other woodwind players such as clarinets and saxophones.
2. It would be easier to learn for beginners, since blowing a single reed requires less pressure and support.
3. The single reed excitation is less vulnerable, since the mouthpiece forms a natural protection for the reed.
4. It would not require the ability to make his/her own reeds. Buy one from the counter, attach it to the mouthpiece, and play!

Equations

The relationship between pressure difference across the mouthpiece \( \Delta P \) and the flow inside the instrument \( U \) is described by the Bernoulli equation:

\[
\Delta P = \frac{1}{2} \cdot \rho \cdot U^2 - \frac{\rho \cdot U^2}{\gamma} \frac{\partial \rho}{\partial \rho} \quad (1)
\]

where \( \rho \) is the particle velocity and \( U \) is the volume flow rate. Equation 2 is represented as the Pressure vs Flow curve in Figure 2 by the dotted curve. Hirschberg, 1995 presented a model for a double reed with a downstream neck or constriction, which presents a flow resistance, adding a virtual volume due to reed motion. A typical bore profile of an oboe can be found in Campbell et al., 2004, and is shown in Figure 4.

Mouthpiece Requirements

Mouthpiece cavity volume

According to Nederveen, 1998, the volume inside the cavity of the mouthpiece has to match the volume of the missing part of the cone, which should correspond to the volume inside the double reed without the staple plus the virtual volume due to reed motion. A typical bore profile of an oboe can be found in Campbell et al., 2004, and is shown in Figure 4.

Mouthpiece total length

Given the fact that the proposed mouthpiece will have a very different geometry than that of a double reed, it is possible that a different length will be required in order to achieve the desired pitch. However, making the total length of the mouthpiece plus staple of approximately the same length of a standard double reed seems to be a good starting point.

A quick survey on reeds and reed makers revealed that the considered standard total length of the oboe reed is 72 mm, and that of the staple is 47 mm. This is if the player wishes to play at an A4 = 440 Hz. Beads get shorter, down to 69 mm (usually on shorter staples as well), for people who wish to play at a higher pitch.

Measurements

Careful measurements of the bore profile shown in Figure 4 reveal that:

- the (half) angle of the main cone is 0.82°
- the length of the missing part of the cone is 82.4 mm
- therefore the volume of the missing part of the cone is approximately 0.12 cm³

Mouthpiece width

It is intended to use a standard clarinet bore reed that can be bought in any music store and used immediately. The maximum width at the top of a traditional Vandoren reed is 13 mm.

Mouthpiece tip shape

The tip of the mouthpiece should match the shape of a standard clarinet reed.

Mouthpiece tip thickness

The thickness at the tip of the mouthpiece should be as thin as possible, so that an oboe player can still use his/her accustomed embouchure.

Distance between reed and mouthpiece lay

It has been found by trial and error that a distance of 0.8 mm between mouthpiece lay and reed presents a good compromise between a loud and full tone and ease of play.

Other geometrical considerations

Sharp edges inside the mouthpiece should be avoided, in order to avoid turbulence and noise that would result from it.

Conclusion

A prototype has been built according to the previous requirements, and is shown in Figure 5.

The prototype shown in Figure 5 is already playable. The sound is still about 50 cents flat, and the timbre is somewhat brighter than that of the double reed. Some minor modifications are planned to try to improve sound and intonation.

References


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www.chaseoboereeds.co.uk

www.britanniareeds.com

www.reedmaker.co.uk

Table 1: Staple and reed lengths by different reed makers

<table>
<thead>
<tr>
<th>Reed maker</th>
<th>Staple length (mm)</th>
<th>Total reed length (mm)</th>
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<tbody>
<tr>
<td><a href="http://www.britanniareeds.com">www.britanniareeds.com</a></td>
<td>80 - 84</td>
<td>72 - 74</td>
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<td><a href="http://www.gramercyreeds.co.uk">www.gramercyreeds.co.uk</a></td>
<td>58</td>
<td>62 - 64</td>
</tr>
<tr>
<td><a href="http://www.reedmaker.co.uk">www.reedmaker.co.uk</a></td>
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