The influence of new types of wind systems on the sound of organ pipes

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Introduction

In traditional organ building the very complex wind systems are the reason for the often unstable wind pressure. Large pressure drops and pressure fluctuations with high amplitudes may occur and affect the organ's sound. To improve traditional wind systems and make their design more reliable 12 organ builder companies from 9 European countries participated in a CRAFT project supported by the European Community. Several new types of open wind systems have been developed and tested. Two of them will be described in this paper.

Traditional wind systems

Since electric blowers have been installed in the wind supply systems instead of pumping by feet nothing else has been modified in the traditional wind systems (Figure 1).

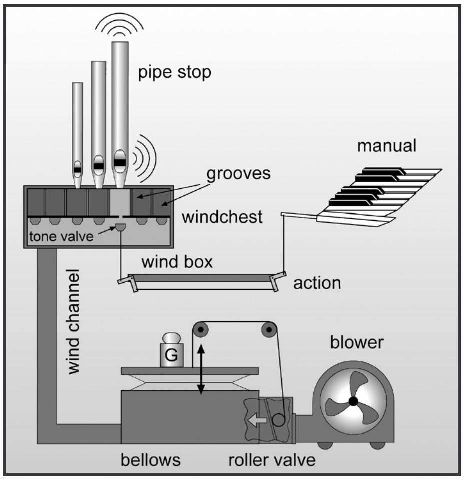

Figure 1: Simplified sketch of a traditional wind system.

They are still closed systems, i.e. air cannot flow out of the system if no keys are played. The pressure inside the pipe organ is regulated by mechanical elements like a bellows top plate driven by weights or springs. As soon as any key is pressed or released the plate starts to move and oscillate and thus influences the wind pressure (see Figure 2A). At high wind consumption a large pressure drop may occur caused by pressure losses along the wind trunks and at narrow valve cross sections (Figure 2B).

Open wind systems

We know from discussions with organ builders that it is possible to improve the sound of an organ by drilling little holes into the grooves to let some air flow out of the wind system. In other cases organ builders drill holes into a wind trunk to reduce overpressure. Apart from the fact that air flowing out of a hole causes undesirable noise, the cross section of simple holes is constant and cannot be equally effective over the whole wind consumption range.

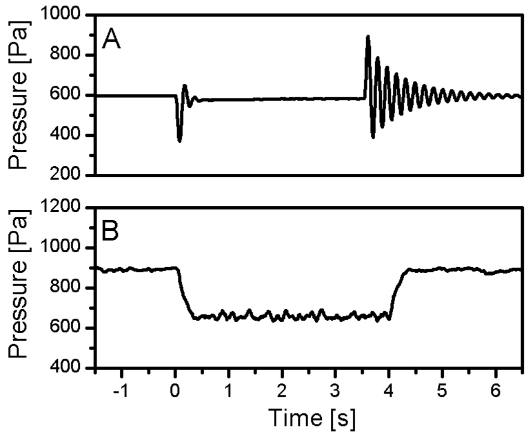

Figure 2: Typical wind pressure transients with strong pressure oscillations (A) or large pressure drop (B).

One of the tasks of the project was to develop mechanically and electronically controlled outlet valves, which keep the wind pressure as stable and the flow noise as low as possible at any wind consumption.

Wind system with bellows outlet: A solution which is very close to the traditional wind system and therefore quite suitable for organ builders, who are specialized to restoration, is the bellows outlet valve (Figure 3).

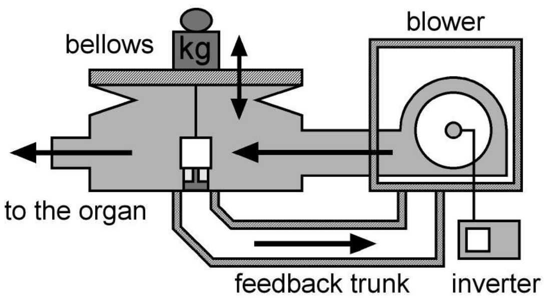

Figure 3: Bellows outlet valve with feedback trunk.

It can easily be connected to an existing organ and is invisible from outside. The feedback trunk is lined with noise absorbing material and leads the air back to the blower. A cylindrical outlet valve is mounted on the bottom plate of the bellows. The covering cylinder is moved by the top plate and closes the openings of the inner cylinder depending on the wind consumption. The rotational frequency of the blower must be adjusted by a frequency inverter to position the outlet valve at the desired working point. This valve was tested in a historic organ in

Falkenhagen (Germany). The pressure oscillations occurring in the original state could be effectively damped and the pressure drop in the bellows was well balanced (Figure 4).

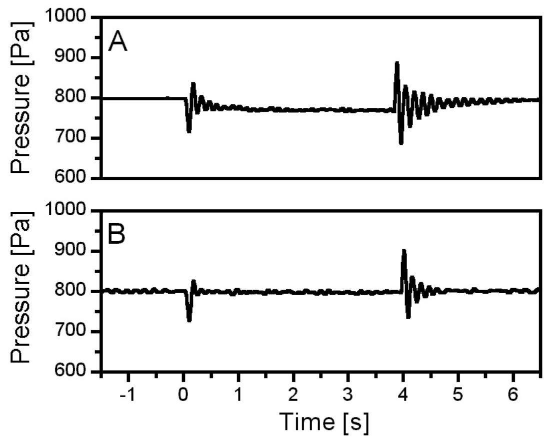

Figure 4: Pressure transient in the bellows in its original state (A) and with outlet valve (B).

It should be taken into account that this outlet valve cannot balance the pressure losses between the bellows and the windchest. So the wind trunks should be designed as short and straight as possible, if this open wind system is supposed to be applied in a new organ.

Wind system with windchest outlet: A windchest is the closest place to the organ pipes, where the wind pressure can be centrally and effectively controlled. If the pressure regulation is located there no bellows is needed. This is an important economic advantage of the open wind system, because building a bellows is time-consuming and expensive. The windchest outlet valve (Figure 5) essentially consists of four elements: a rotor, which opens or closes the outlet, a piston, which is driven by the pressure p_0 and turns the rotor, a spring, which balances the pressure force on the piston and a ceramic filter, which damps occasional vibrations of the valve.

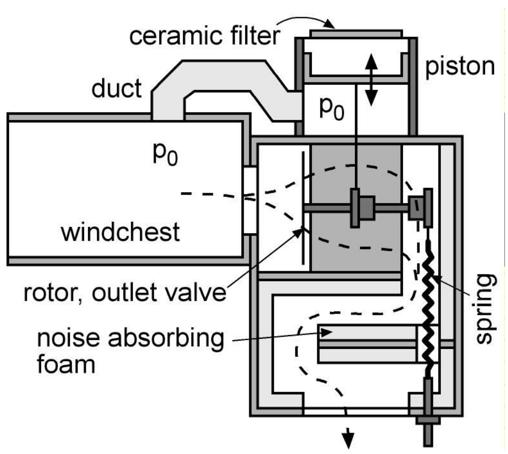

Figure 5: Windchest outlet valve, p_0 desired wind pressure.

The tension of the spring determines the pressure p_0 and can be adjusted by a thread rod. The valve was tested in a pipe organ in Plainveaux (Belgium). The valve balances the pressure drop very well and reacts very fast because of its small mass (Figure 6).

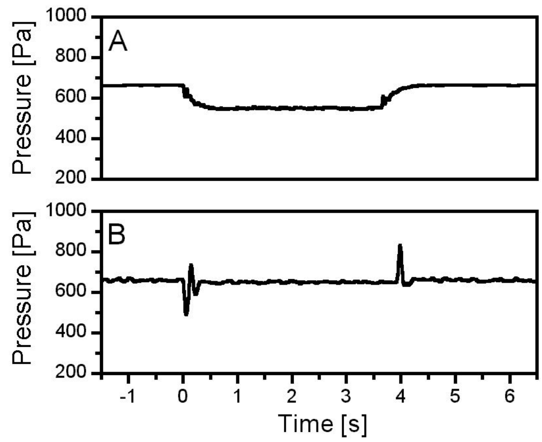

Figure 6: Pressure changes in the windchest in its original state (A) and with outlet valve (B).

Influence on the sound of the pipe organ

For organ builders the most important parameter to judge any wind system is the sound of the instrument. So a short piece of music was composed [1], played on every tested organ and recorded at various registrations. It contains different styles of playing to simulate realistic changes of wind consumption. The better damping of strong pressure oscillations by the bellows outlet valve is clearly audible. The sound with outlet valve is generally brighter because of the higher static wind pressure. The voicing of the organ pipes should be adapted to the new wind pressure. Pressure jumps at the attack or release of a tone are unavoidable (Figure 6B), but to some extent organ builders prefer a certain signal to determine the exact beginning of the pipe sound. It can be summarized that the sound recordings of the new open wind systems are convincing and well accepted by the organ builders participating in the project.

References

[1] “Valve Fantasy in C Minor”, by Pitsch, S., Nov. 2003

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