# Harpsichord & fortepiano

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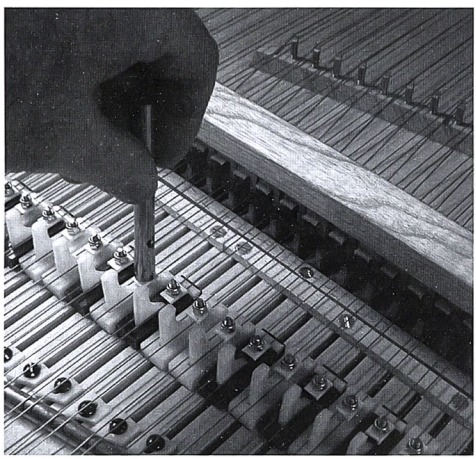
# THE FLUID PIANO

*By Christopher Barlow*

OK. This is neither a harpsichord nor a fortepiano, but a tangent piano though not quite as we know it. Recently I was commissioned to develop a design and build an instrument with microtonally adjustable tuning to be known under the trademarked name of the "Fluid Piano". Geoff Smith is a composer and performer on the hammered dulcimer with a serious interest in music from beyond Europe, where the western scale of equal temperament does not rule supreme and a more flexible approach to pitch is normal. Some years ago he developed and patented an idea to make the tuning of instruments "fluid".



**The concept behind the commission**

Harpsichords and early pianos have appeared throughout history with many more notes to the octave than our present arrangement of twelve. 20 - 36 note examples still exist from several 100 years ago. The concept of a microtonal keyboard dates from the earliest origins of the idea of the keyboard itself. A fortepiano from c.1795 in the Kunsthistorisches Museum in Vienna and the *archicembalo* by Trasuntino, 1606, are just two examples with multiple keys.

Smith's concept, however, goes beyond just solving problems of temperament. Altering temperaments is quick and easy on the Fluid Piano but his instrument questions why we need notes with fixed pitches at all. The keyboard's layout remains just the same; no extra keys are squeezed in like some quarter tone pianos. There are no extra strings either, but the wrestplank bridge (the nut) is replaced by a series of individual sliders: one for each note enabling any note to be changed by plus or minus one semitone and anywhere in between. Perhaps it would be clearer to say that every frequency from the lowest note to the highest can be achieved. In fact it is possible to set it so that a B will pitch higher than the C above it, for example, as well as setting some adjacent notes to the same pitch like the enharmonic possibilities of a harp.

When you consider the musical scales that Indian, Iranian, Chinese and other cultures have developed and their more flexible approach to the pitch of any particular note it becomes clear that a modern piano has real difficulty fitting in with such music. Any tuned scale can be pre-set for a performance and all notes can be modified at will during it too. Pitch bending whilst a note sounds is also a feature.

Instruments with moveable individual bridges are by no means new; indeed Pythagoras may claim credit for this working over 2000 years ago. His monochord was at first a scientific device but it developed into a musical instrument (and not restricted to one string!). However these bridges would be awkward to manipulate quickly during playing.

**The design develops**

Geoff Smith first approached me with a one note model and asked me to develop this into a working prototype. The design of a fortepiano offered itself naturally as a starting point for a one off experimental instrument. Budget and technical reasons pointed this way too.

It soon became clear to me that the slider design employed in his one note model would not work successfully in any kind of piano. Firstly his slider rose up a ramp to maintain or even increase downbearing [the force of the strings on the bridge]. Raising and lowering the position of the string would render any

regulation of the set off point meaningless. The upward hammer blow will be attempting to lift the string off the slider or the slider off its seating. Either way, tone could be lost or at worst odd noises introduced as the slider snaps back down. The one note model had not been set up as in a real situation; the set off was far too low. Once set up properly this problem was easily demonstrated.

I considered if a down striking action would solve these problems but rejected the idea for many reasons. Along with the slider design other problems presented themselves with the action and wrestplank. To accommodate the travel of the bass sliders the plank had to be about twice the normal size from the player to the far edge. This obviously alters the layout of the keyboard and action. The plank must also have grooves cut into it thus reducing its strength considerably, so its thickness must increased to allow for this. The distance the hammer travels from rest up to the string is an integral part of the geometry of the action and cannot be simply increased without a series of undesirable consequences.

However much I tried I could not find a solution that satisfied all these and other criteria. Every possible solution I tried and considered produced as many other difficulties. Things seemed to be heading for a dead end but then I realised that many of these problems would not exist if a harpsichord rather than a piano were the basic instrument. The thickness of the plank and the length of the jacks are not so tightly governed by practical factors; there is scope for adding thickness or longer jacks quite easily. The lightness of the strings and the plucking action would also make things easier. It was a short step from this realization to conceiving the instrument in terms of a tangent piano rather than a pivoted hammer action.

The advantages were mainly in the geometrical relationship of the wrestplank and action. Good use could now be made of the resulting extra long keylevers, and the lighter impulse transmitted to the string from the lightweight tangents would facilitate a practical design for the sliders. I also felt it could lead to an instrument very different to a modern piano but one whose sound and possibilities could give much scope when employed in non western music.

Tangent pianos usually had bare wooden heads to strike the strings but employed mutation stops to modify tone. One minute it might sound like a harpsichord, the next a piano, the next a harp, so not only fluid tuning but fluid tone as well. By now I had come to the conclusion that to try to add sliders to a conventional piano was only going to result in a compromised and less than satisfactory instrument.

The starting point of the design of a piano has everything to do with the strings – the "scaling". Sounding length, weight, tension and precisely where they are struck are carefully calculated and chosen to achieve the expected sound. Inharmonicity and the strike point will affect the timbre of each note and how it relates to all the other notes of the piano. Adding sliders that change the length of the strings will also change the strike point, rendering these fundamental considerations unachievable. No consistency is possible when string length is variable.

I explained my thoughts to Geoff and he agreed the tangent piano route was a good way forward. He had also specified that the case should be as open as possible. As a dulcimer player he wanted to be able to access the open strings like a hammered dulcimer. After further discussion a section of extra strings was added at a higher level too. These can be struck or plucked like a harp and they have fluid tuning too. Now the general scheme was established, my detailed design and construction work could begin.

**Construction**

For an early visit from Geoff to my workshop I had prepared three full sized drawings of possible layouts of the proposed instrument so that he could choose the one he wanted me to continue to develop. I had also built a model of the tangent action that I had designed so that he could visualize that. I had not finalized the design of the sliders at this point to my or Geoff's satisfaction but could demonstrate that any lack of rigidity had a severe influence on tone. These, after all, replace the agraffes and pressure bars that are to be found in pianos from the mid-nineteenth century onwards.

There is no iron frame to restrict access to the sliders or strings and although it is wooden framed the design of the carcase is more robust than a fortepiano and tuning stability is better.

I designed the frame based on the "A" frame of the Viennese fortepianos but extended it to become a complete "A". This eliminates the twisting tendency of early wooden framed pianos and gave me room to develop the design of the additional "harp" set of strings and their sliders. The width of the piano is therefore somewhat wider than the keyboard itself. The tangent action was designed to operate through holes in an extended wrestplank and, perhaps

uniquely for any sort of grand piano, there is no gap between the wrestplank and the belly rail beneath the leading edge of the soundboard.

Stringing is a little heavier than the *Tangentenfluegel* tangent piano of the late eighteenth century and power can be boosted electronically if required. The sliders do not eliminate the need for the instrument to be tuned in the normal way and the basic tuning is still A440 equal temperament when the sliders are in the central position. (In fact due to their interaction with the strings they probably disturb the basic tuning a little.) Each note can be altered smoothly, plus or minus one semitone.

**The Finished Fluid Piano**

The compass is just over five octaves FF to $a^3$, bi-chord [two strings per note] throughout and straight strung. The keyboard player has three pedals: moderator, bass sustain, and treble sustain, and one stop which applies dampers to the extra harp strings. The sliders are easily accessible and arranged like a mixing desk in front of the player, black ones for sharps, white ones for naturals.

An extra set of strings is arranged at a higher level above the main set giving a three octave range, seven strings to the octave and each with a fluid tuner situated along the bentside (away from the keyboard end). These wires are designed to be plucked like a harp or koto but will also work if struck like a hammered dulcimer. This section is about 350mm wide. A player standing in the bentside has two pedals arranged like bars so that they can be depressed from any point along them. The left bar raises the treble dampers of the piano whilst the right bar applies dampers to the harp strings. The default position is therefore undamped for these strings.

Like some of the early English pianos the sustain pedal is "split". This allows the treble and bass to be sustained independently or together. As the instrument sounds a little like a cimbalom I felt this arrangement gave extra control and scope. (Beethoven and Mendelssohn owned instruments that had this facility.)

The resulting instrument has to be seen as something quite different to a modern piano or even a fortepiano. Firstly this only ever set out to be a prototype but its tone is quite unique, the action very responsive and only a little different to the touch. There is no escapement so repetition is instant and from any point in the key dip. An unwanted rebound is rarely noticeable. The power is obviously less than a modern grand but it is still dynamically responsive and the intention was always that it could be electronically boosted.

The timbre does change according to the position of the slider, becoming more like a muselar when a note is flattened and like a lute stop when sharpened (seen in harpsichord terms). Players may like to approach this feature creatively rather than see it as a problem.

It is certainly a fascinating instrument; call it a new twist to an "early keyboard" perhaps. On reflection I felt labelling it as a piano was misleading as it has to be seen as something quite different in my opinion. I concluded that if a Fluid Piano was to be conceived in terms of a modern concert piano the only way forward would be through the digital world of electronics. No problems with changing timbre, thick spun bass string riding over sliders, no action difficulties, no iron frames to redesign and so on. It has been interesting too, to see the reaction from players and listeners. Search *Fluid Piano* on YouT ube and you can see and hear it.