Thank you for the kind words ☺

But I am afraid my academic credentials will disappoint you a bit…

I hold a Master in Bioscience Engineering: Organic Chemistry and an advanced teaching degree (but I do not hold a Ph D nor am I a professor).

I work as an auditor (less financial more process optimalisation) in an institution of the Belgian government. In essence every Belgian is automatically insured for occupational diseases and work related accidents. My institution is responsible for investigating

- That the disease/accident is effectively work related
- Paying the compensation (money)

My hobbies include playing the mouth harmonica. Unfortunately I do not have a perfect hearing. I am capable of playing songs but I can not jam or improvise on the spot. This is a big disadvantage and is the reason why I can never join a music band. To compensate for this I looked into mechanized musical instruments and I ended up at music boxes.

For a long time I wanted to make an automated music box myself and I spended quite a lot of time in the research of building one. Unfortunately I grossly underestimated the IT knowledge you need to have to make something user friendly…

So a few years ago I contacted a lot of people about the (mechanical) construction of a music box and sometimes I got a reply back. It is that info that I am sharing with you. Please appreciate it, it was not so easy to get!!!

> (As a side note I should mention I restaured a grammophone myself together with several clocks. An old clock maker was so kind to teach me the beginnings so simple repair and maintenance jobs I can do myself)

Best regards,

Siegfried

PS1

Some last thoughts. You told a long time ago the comb of your music box is not weighed with lead. This means your music box only plays in a high register of notes. As long as you can not change that, this seems me your biggest restriction.

If you can, in the future, solve this problem I really think you have a product that can compete with the old, highest quality (disc) music boxes. **The entire procedure how to add lead resonators to an existing comb is explained in an old book of 1971**

The disc musical handbook

Author Graham Webb

ISBN code 0571 09378 7

I really urge you to find a copy of that book for yourself. I think you will find it a treasure of information. (he also wrote “the cylinder musical handbook”, this book I do not have)

If you can not find it. Let me know, than I will send you my copy by post if you promise to send it back to me…

PS2

I have **one (detached) Zither** for a Fortuna disc music box. If you want I can send you pictures of it via Whatsapp so that you can see its construction in detail.

Annex 1: music box collection

Annex 2: Wat is sound, timbre and noise

> When I bought my first professional mouth harmonica I was completely stunned at the possibilities: wooden ones, brass ones, silver ones, aluminium ones. Brass blowing reeds, stainless steel blowing reeds, … I was completely lost!! And ended up researching a long looooong time to know what to exactly buy. I wrote this document for myself a long time ago. Now I translated it in English and adapted it a bit so that it also makes sense for a music box. I hope it can be usefull to you

Annex 1: Music box collection

Since I am not a collector I do not hold many. The ones I do have are of swiss or german fabrication

The most noteable ones are

- A reuge 4/50 note cylinder music box
  Something like this https://www.youtube.com/watch?v=rya2QsWpb80
- A few reuge 1/36 note movements. (In Europe you can find them reasonably easy and low priced on second hand websites
- Kalliope disc music box (+12 discs)
  https://www.youtube.com/watch?v=JJLJ4svpkMU
- A fortuna disc music box (60 notes) (+ 20 discs)
  It was my idea to automatise this one myself (the pictures in my first mail 2021). It still lies unfinished in my wardrobe. All the mechanical parts are there. The wooden case I needed to throw away (woodworm)
  https://www.youtube.com/watch?v=VT-LF44aDTY

  Fortuna music boxes are quite rare. Especially this one, the thines are thicker and larger than normal to produce more and richer sound

Interesting music box parts I have

- 2 adler music combs (Adler took over the production of Fortuna music boxes. Although adler combs are less thick they can be used to replace fortuna combs) I got them very cheap
- A detached Zither for a fortuna/adler

Annex 2: Sound, timbre and noise

I made this document myself. I am not a music professor, it is possible there are some errors in it.

1. Theory

1.1 Noise and sound

In wind instruments, by blowing in a certain way, a stable waveform is created in the instrument itself, which is responsible for the sound.

https://en.wikipedia.org/wiki/Waveform

This stable waveform in turn consists of several stable standing sinusoidal waves:

https://en.wikipedia.org/wiki/Standing_wave

- The desired note (first harmonic, fundamental frequency)

  The sine whose frequency is as high as the waveform itself is called the fundamental.

- The overtones (partial tones)

  Since the frequency of every other stable sinusoidal wave in a wind instrument is integer-related to this fundamental, these sinuses are called harmonics (the overtones).

Extra info

A tuning fork is a very special instrument. It is the only instrument to my knowledge that (almost) does not produce overtones. What you hear when you hold it in your hand is (almost) purely the sound of the first harmonic; the desired note

At the other side of the spectrum you have a string instrument. They have a lot of integer harmonics, and if you have access to a piano, you can observe an effect called sympathetic vibration very easily.

First, press down (lightly, so as to not play a sound) the C5, G5 and C6 keys on the piano and keep holding them down. Then strike and release the C4 key — and you will hear the C5, G5, and C6 notes play This is because when you strike the C4 key, you are exciting the string with its fundamental (261 Hz) as well as a large number of integer harmonics (n=2 is the octave at C5, n=3 is the octave-plus-fifth at G5, and n=4 is two octaves at C6) in that single string all at the same time. Sympathetic resonance will cause the fundamentals of the C5, G5, and C6 strings to vibrate since those frequencies are present in the sound of the C4 note, even though those other notes/keys were not struck.

The small print is info I got from a Teaching Professor in accoustics

The difference between “noise” and “nice sound” can be made in the same way.

Nice Sound = all stable sinusoidal waves that are related to each other by an integer

Noise = all stable sinusoidal waves that are NOT related to each other by an integer

In reality, every instrument will also create stable sinusoidal waves whose frequency does not relate to the desired note according to an integer. This is avoided as much as possible by the instrument maker. The strength of the “Nice Sound”-waves should be as large as possible in relation to the background noise (noise-waves). **It is clear that every Nice Sound is composed of overtones that have a high, mid or low frequency**

1.2 amplification of sound

The generated sound (+noise) of the mouth harmonica or a thine from a music comb is so weak that amplification needed.

To the best of my knowledge there are three ways to do that (without electrical amplification)

I. By means of a sound board

This is the wooden plate/table on which you music box brass/aluminum bed plate is screwed on. By choosing the correct length and width of your plate you can optimize this part. Please take another look at the document "a mechanical music box" I sended to you.

II. By means of a sound box/resonator box

A mouth harmonica does not have a sound board. All its amplification comes from a sound box (this is the mouth cavity). The vibrating reed causes the air to vibrate and, if you are lucky, creates a stable waveform. When the vibrations are stable it increases in power right until

- it becomes unstable and the energy (that is accumulated in the air vibration) "bursts" (continuously) out of the sound box hole. When you whistle/sing a tune the sound box hole this is your mouth.

- The vibrating air forces the other walls of the music box to vibrate as well. At that moment all the walls begin to act as sound boards. (when you sing a tune this amplifying effect is not present. Your mouth does not have resonating, wooden walls)

III. Sympathetic vibration (see extra info in 1.1)

You do not have this effect in a mouth harmonica, so I highly suspect you also do not have this in a music box.

1.3 the timbre of your musical instrument

In a mouth harmonica the airflow causes the reed to start vibrating in a stable waveform. On the link you can see that this stable waveform consists of both "nice sound"- and "noise"-waves. The "nice sound"-waves are all integers of 3.49 (the frequency of desired note): 6.98; 10.47; 13.96;…

Unfortunately the vibrating reed also creates noise-wave frequencies. These are not desired and usually small (the not integer ones)

https://www.seydel1847.de/epages/Seydel1847.sf/en_US/?ViewObjectID=18740&Currency=EUR

The entire body of a harmonica (the comb, the reed plates, the covers and the mouth cavity) or a music box has two important functions

- amplify the sound

- directing the sound towards the audience

To evenly amplify the stable waveform (which consists of nice sound and noise waves) of the reed or thine in a music box, the body should be able to vibrate/resonate at every possible frequency that the waveform consists of.

In reality, this is never the case and the body of the instrument prefers certain frequencies that it can more easily vibrate with than others (eg natural frequencies).

Extra info

A dramatic example is the shattering of a glass by a human voice. The glass body begins to vibrate the sung note until it bursts. If the singer would sing another note (frequency) nothing would happen to the glass.

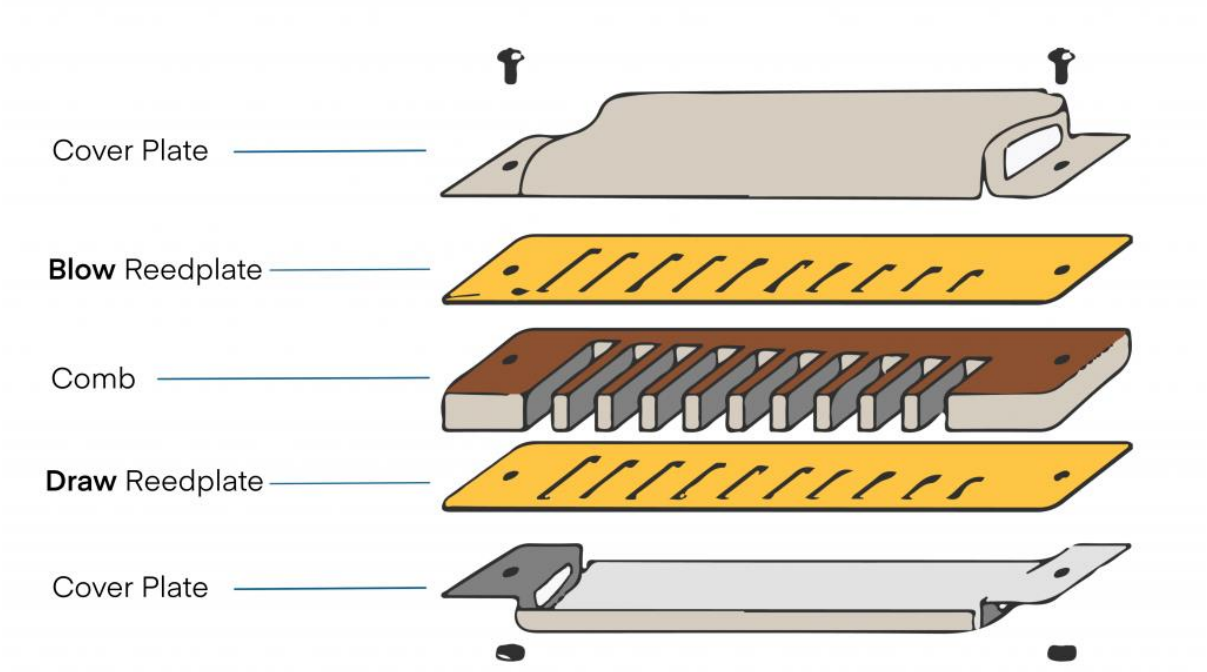
https://www.youtube.com/watch?v=CdUoFIZSuX0

https://en.wikipedia.org/wiki/Mechanical_resonance

The frequencies where the body can easily "vibrate" will be amplified (louder) compared to the overtones that the body cannot easily sympathize with. In this way, **the object has a very important influence on the final timbre of the sound** (which overtones of the struck tone are amplified? which are not? Which noise waves are amplified?)

1.4 Which materials are used?

The body of a harmonica is made of three possible materials: plastic, wood or metal.



Please note that **comb has a different meaning** in the mouth harmonica world than in the music box world!!!!

Plastic is considered dead material that has little or no influence on the final timbre. After all, it does not vibrate. This is why many speakers are made in the plastic. (The speaker material is not intended to affect the timbre of the sound reproduction.)

Wood was used for the harmonica comb (different meaning: not the same as a music box comb) because there used to be no plastic and people had little other choice. The wood was also cut without much attention to the fiber structure. It therefore had little influence on the sound and is now best avoided as comb material because of the moisture problem (splitting) in harmonicas

Metal provides the final “first timbre coloring” of the sound. After all, this is a highly resonant material. Every quality harmonica therefore has metal (brass) reed plates. The combs of music boxes are attached to brass/ iron or aluminum bed plates.

Extra info

I asked this to Seydel (manufacturer of harmonicas) for their thoughts. I think it will hold true for music boxes as well

My question: After a long and hard search on the internet half of the people seems to think that comb material does little to improve the sound. (Only the thickness of the reed plate would make a difference in the lower registers.) Others say that there is a difference that comes down to the density of the material. The denser the better going from aluminum, brass to silver. I do believe your engineers have pondered on this question with more knowledge than the quacks I find on the internet :-) So I am very curious about the reply.

Reply: Usually the comb material does not have any measurable influence on the sound - if a note or chord is being played. However players can feel a difference and the more dense material give them the impression the sound is more crisp...this could be an effect of the more dense material and take effect on the sustain-behaviour of the reeds....we never measured sustain-times, but I personally think that this could be a logical reason why players (not listeners) can feel/hear?! a difference. I'm a player, too and can tell the difference of wood vs. aluminum on Blues models though there is no difference in the power spectra if you measure the same note in a frequency analysis.

As I already wrote you, I strongly believe that they used dense heavy metal to eliminate undesired sounds from the mechanism (noisy flyer, noisy motor, …) I can not find it anymore but I came across this technique a few years ago. It also conducts vibrations to the music box wooden sound board.

Since a music box needs a wooden sound box (unlike a mouth harmonica) I think that this link can be usefull for you

http://acousticguitar.com/a-tonewood-primer-how-to-pick-the-right-materials-for-your-optimal-sound/