# AUTOMATIC TUNING GLASS HARP

*by*
*Salvatore Incarbone copyleft 2016*

**Actual tuning.**
The glass harp ("arpa a bicchieri") is a very fascinating instrument. Its sounds seem mysterious and full of deep meaning , so much that someone was afraid to become mad.
Thus, this delicious instrument merits any possible improving.
Actual tuning in the actual glass harp is relatively simple. It is achieved by regulating the amount of water in each glass. On the other hand it needs time and must be frequently made.
The rims may be put at the same level. The water levels in the glasses in general will be different from each other.

**An alternative method of tuning**.
An alternative method of tuning is proposed here. It implies an innovative design of the glass harp. Tuning is made only once and may last for a long time – one year or more.
Nevertheless, this method requires, but only once, laborious calibration and setting of the parameters related to the glasses. In fact let us suppose that all the water levels are equal in the glasses (at least in eache group of glasses, say, f. e. one group be high tones and another bass tones).
Consequently, if we also want all the rims at the same levels, the maker will be obliged to make or to select set of glasses closest to the desired tones and perhaps to remove material near the stems.

**Parameters or variables affecting the proposed tuning:**

Quality of the substance (crystal glass)
Distance between the water level and the rim – must be constant and equal for all the glasses.
Thickness of the glass, specially important near the rim.
Diameter of the glass – supposed of circular horizontal setion.
Shape (specially the shape of the vertical central section) of the glass.
Weight.

To prepare the "glass harp automatic tuning" here proposed, it is necessary making pipes in the stem of each glass. That is another reason to prepare a right set of glasses by a procedure of trials and errors.
However, when the glasse have been choosed and be satisfactory, each glass pipe is connected to an elastic pipe wrapped around it. All the elastic pipes are connected to a single main pipe and this one connects to the water reservoir.

All the water levels in the glasses and in the tank are equal because of the principle of the communicating vessels (see figure).

The high notes need small glasses standing upon a plane while the bass notes need big glasses standing upon a different plane in order to put the rims of all the glasses at the same level, if possible. This target supposed accomplished after the procedure "trials and errors", will go by successive approximations.
Really, the described operation, almost certainly, is not possible during the first trial of tuning.
We found in artiche (see sitology) that a certain number of glasses of different size may be choosen closest to the desired tones. It is possible to remove some material near the stem. The pitch can be lowered to about a half tone by this manner.
Moreover, it would be a miracle that the levels of water be equal while, at the same time, the rims were all at the same height.
We think that for realizing the latter circumstance, it is necessary that each glass be prepared and calibrated in shape and dimensions (thickness, weight, diameter).

Unfortunately there are no quantitatives rules for making this. Physicians have not discovered the complete equations and relations regulating the sound of the musical glass and we must trust in empirical data.

However, in the instrument we propose, the tuning is obtained by a right calibration of each glass in order to obtain always the same distance between the water level and the glass rim. The height of the whole body of the glass is not a problem because it may be lifted or lowered by means of right pedestals. The operation of calibration and the glasses building would be made in a laboratory or in a factory.
May be that little differences between the levels of the rims would be tollerate by the musician if they do not contrast his ability and virtuosity.

Once the trials have permitted the construction of the right glasses, we suppose that the musician will be satisfied about the tuning and – at the same time - about the rims heights. Really, the tuning is no more necessary for each glass, but only in general for all the glasses, only once, by regulating the level of the water in the reference glass. This level is actually the same in all the glasses.
The levels will be maintained constant for a very long time – one year or more - because after finish to play, all the water may be made enter in a water reservoir and here will be kept without evaporation.
However, the glasses and all the instrument may be closed in a case.
The different operations are accomplished by an electronic device driven by a dual level probe: the two probes work together in a speial manner to prevent oscillations in the water level regulation. Their height ca be regulated during the installation.

The dual probe is supplied by a sinusoidal electronic signal (some years ago I made and sold some devices of this kind: they worked at 1 kHz of a sinusoidal electronic frequency; 1 volt, amplitude, duty cycle about 5%). Thus, the a. c. signal will be active only few milliseconds, to minimize electrolytic reations in the water.

The probe signal is given and then used by the electronic device wich drives a motor (clockwise or couterclockwise). The motor move a little pomp (may be just like that used in fish aquarium).

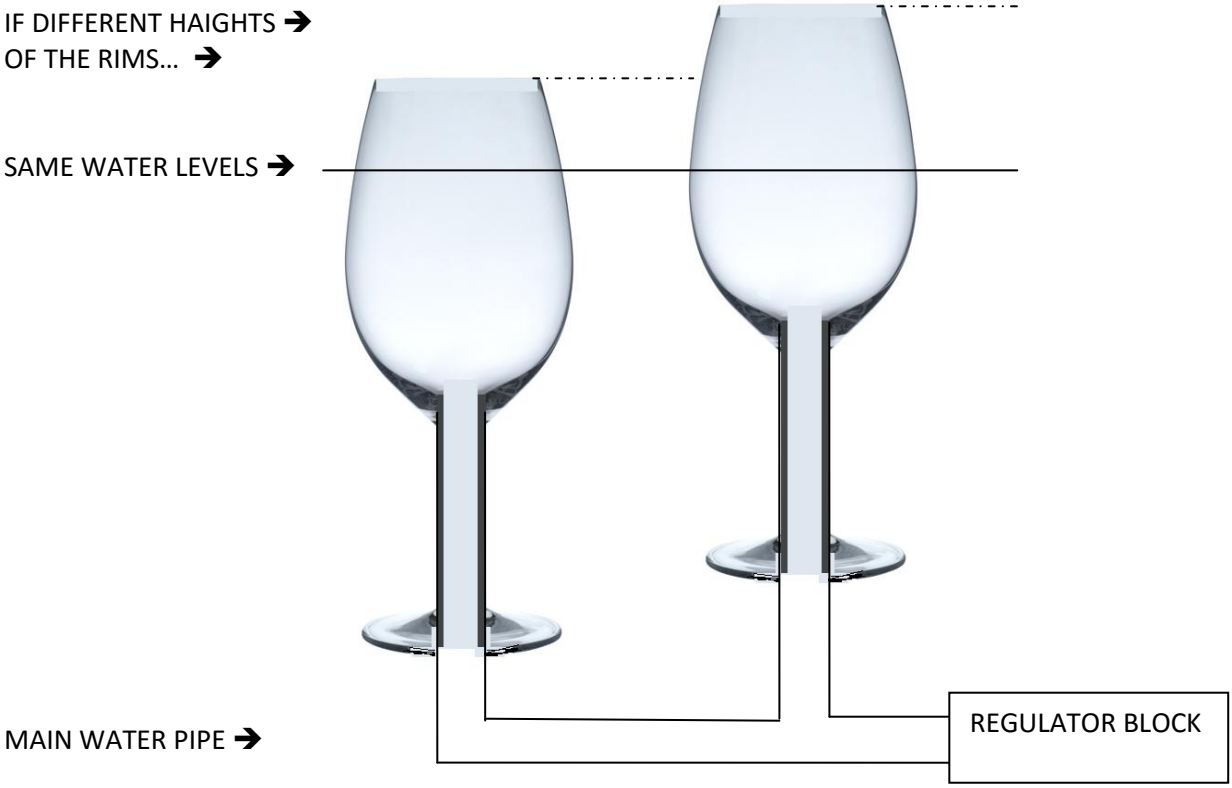
The major problem will be perhaps to find glassworks able and ready to make the empty stems.

I think a good idea the instrument closed inside a long wood case (just like a piano for reducing water evaporation).

In fact, if the instrument is not in use, the water may be sucked again in the water reservoir by means of a simple “on/off switch” bypassing the electronic device. New operating after the switch is on.
Obviously, when the instrument will be used, the device acting the pump permits the water come at the right level without the necessity of any tuning.

All the tubes that originated from and inside the pedestals of the glasses meet together in a unique main pipe which lead water to or from the reservoir. This pipe may be elastic and can be pressed by a wheel (driven by a pedal) to obtain a “vibrato” or a little range “glissando” (or something like a hawaiian sound, more or less).

On the left: normal glass
On the right: the modified empty stem and a little neck in the empty conical pedestal.

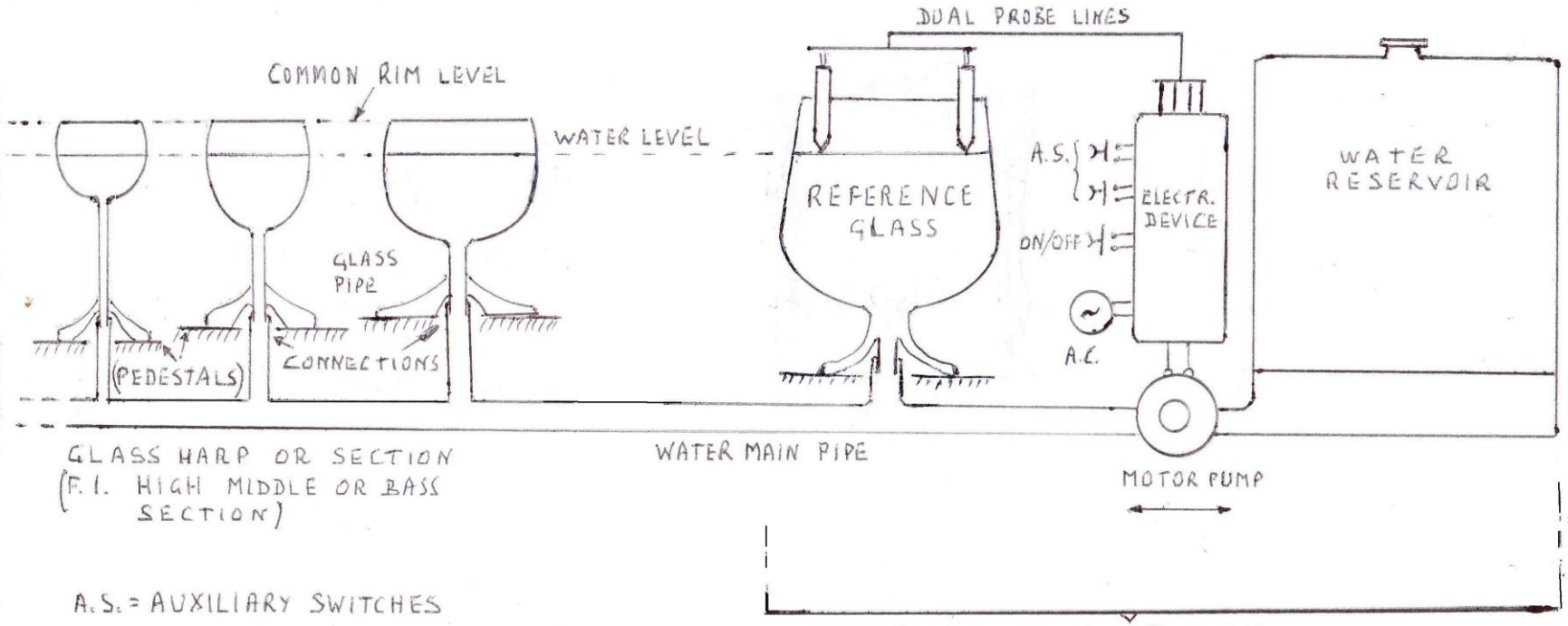



When two or more glasses are connected and driven by a regulato block, the water levels are forced to be equal. Furthermore, even if the heights of the glasses are shifted to one each other.
Thus it is necessary to work the material to obtain the right tones with the rims at the same heights.

Measures.
In a glass of 42,5 mm diameter, I observed a rate of 1 tone/1 cm.

**Sitology**

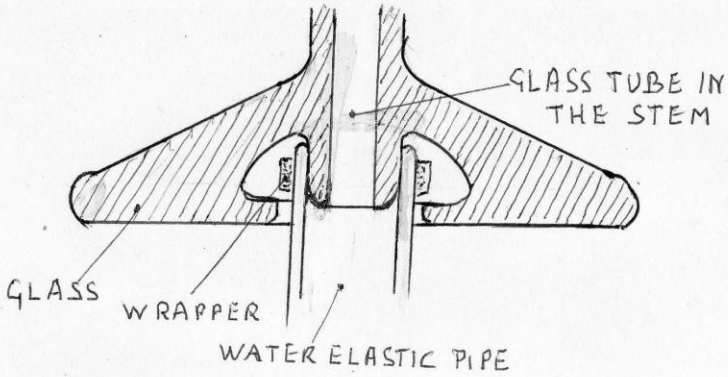
(1) https://infoscience.epfl.ch/record/112607/files/poster.pdf (Tuning of musical glasses through material removal)
(2) http://www.conforg.fr/cfadaga2004/master_cd/cd1/articles/000044.pdf (Tuning of musical glasses through material removal)



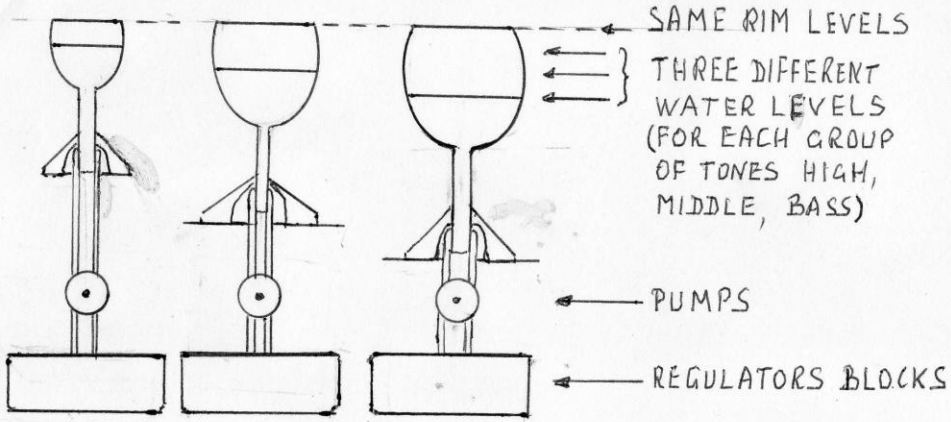

A. S. = AUXILIARY SWITCHES

PIPE CONNECTION = BY WRAPPERS

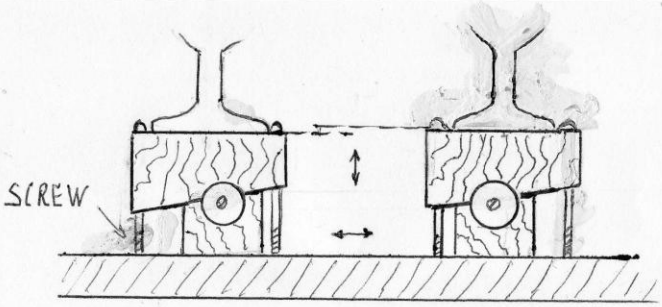
SKETCH OF AN AUTOMATIC TUNING OF A GLASS HARP by Salvatore Incarbone 



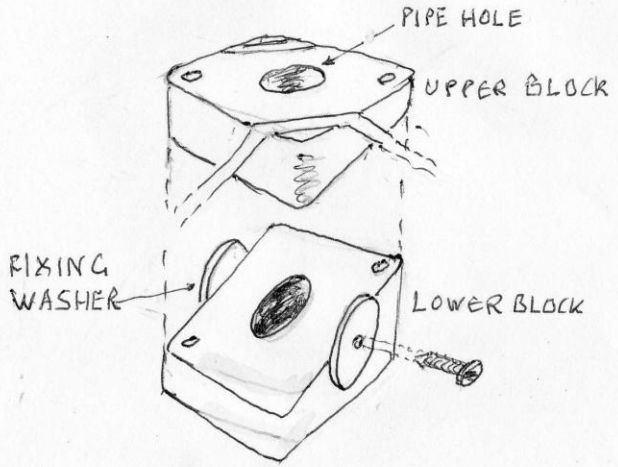

THE WRAPPER FASTENS THE PIPE TO THE GLASS TUBE



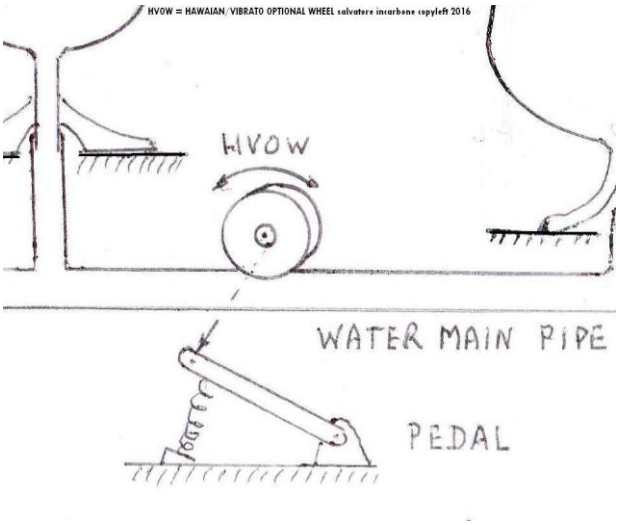

IT IS POSSIBLE SUBDIVIDING ALL THE GLASSES INTO TWO (HIGH AND BASS TONES) OR THREE GROUPS (HIGH MIDDLE AND BASS TONES).

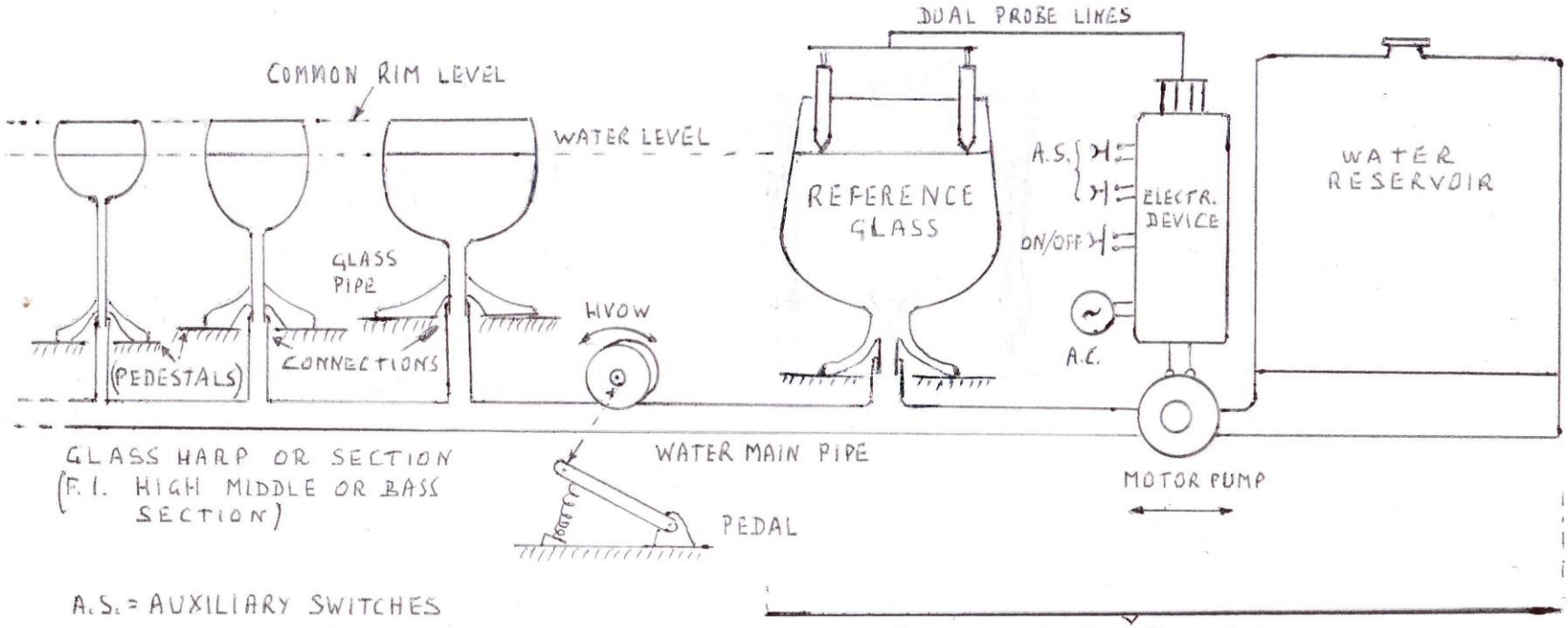



SMALL TUNING REGULATING THE HEIGHTS OF THE GLASSES.
THE UPPER BLOCK MOVES VERTICALLY THE LOWER ONE HORIZONTALLY.




EXEMPLE OF SYSTEM THAT MAY REGULATE THE GLASS HEIGHT. MANY OTHER SYSTEMS ARE CERTAINLY POSSIBLE.


HVOW = HAWAIAN/VIBRATO OPTIONAL WHEEL salvatore incarbone copyleft 2016
HVOW
WATER MAIN PIPE
PEDAL




A.S. = AUXILIARY SWITCHES

HVOW = HAWAIIAN / VIBRATO OPTIONAL WHEEL

PEDAL = DRIVES THE WHEEL

PIPE CONNECTION = BY WRAPPERS

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