Behind The Guitar Chords

1. Tempered Notes

Plucking a string will create a sound that we hear with a certain pitch. This pitch depends on the thickness and material of the string, but for a fix kind of string, it only depends on its length.
Shorter length creates higher pitch.
Half length gives a sound similar of the original full length, in spite of the great pitch difference.
Between this halving, we can use other shortenings that create different pitches and subjective feelings of the jump relative to the original full length's pitch.

The exact fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{5}$, $\frac{4}{5}$ give especially pleasant pitch jumps.

Observe that our fractions in increasing order are : $\frac{1}{2} < \frac{3}{5} < \frac{2}{3} < \frac{3}{4} < \frac{4}{5}$ because:

$$\frac{1}{2} = \frac{5}{10} < \frac{6}{10} = \frac{3}{5} = \frac{9}{15} < \frac{10}{15} = \frac{2}{3} = \frac{8}{12} < \frac{9}{12} = \frac{3}{4} = \frac{15}{20} < \frac{16}{20} = \frac{4}{5}$$

These five pitches mean more possible pitch jumps because we can go from any of them to any other.

For example, to go from $\frac{4}{5}$ to $\frac{3}{4}$ is a shortening of $\frac{4}{5} \bullet \frac{3}{4} = \frac{3}{5}$, so this gives exactly the same pitch jump as from 1 full length to $\frac{3}{5}$. But most other jumps will give new fractions.

If we allow new jumps again between the new pitches, then we get even more new fractions.

In theory, this would create an infinity of pitches or fractions between 1 and $\frac{1}{2}$.

The human ear (and brain) has a mysterious ability to distort the exact jumps into the basic simplests.
So when we sing, we only use a few of the theoretically infinite many jumps.
The complicated fractions are simply cheated by our hearing to approximate them with simpler ones.

In fact, eleven equal shortenings beside $\frac{1}{2}$ are enough for all possible subjective pitch jumps.

So the necessary twelve ratios are: $r > r\,r = r^2 > r^3 > \ldots > r^{11} > r^{12} = \frac{1}{2}$

Thus, this fix r ratio as shortening factor is $\frac{1}{\sqrt[12]{2}}$ which is not even an exact fraction.

This is the unit note of this equalized or tempered note system, that we use in a piano or on a guitar.
The jumps between these twelve notes are continually cheated by our brain into exact basic fractions.

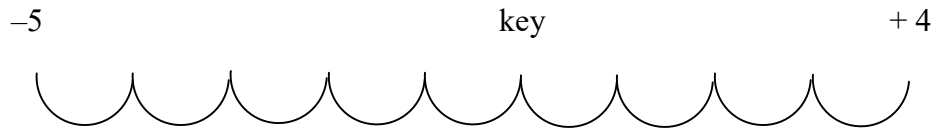
The only true exact jump in this system is the $\frac{1}{2} = r^{12}$ exact halving that gives an identical feel.

Strangely this perfect jump is called an octave because earlier only eight jumps were used.

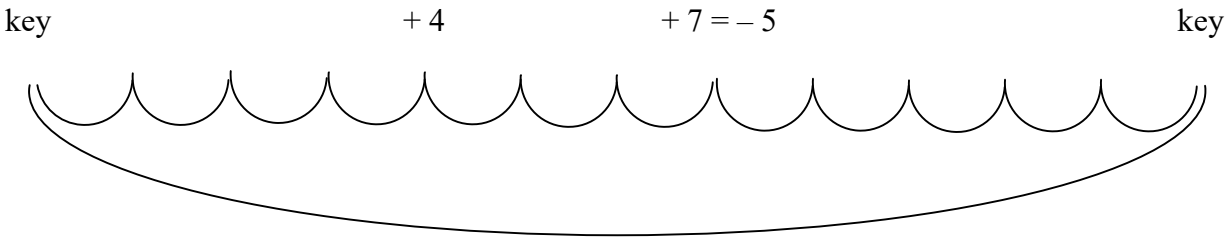
The other jump names also reflect the old system, so they make no sense among the twelve notes.

The twelve notes can be repeated between new halvings, which we can see in the many octaves, each containing twelve keys on a piano. The eight white keys still reflect the old eight step system.

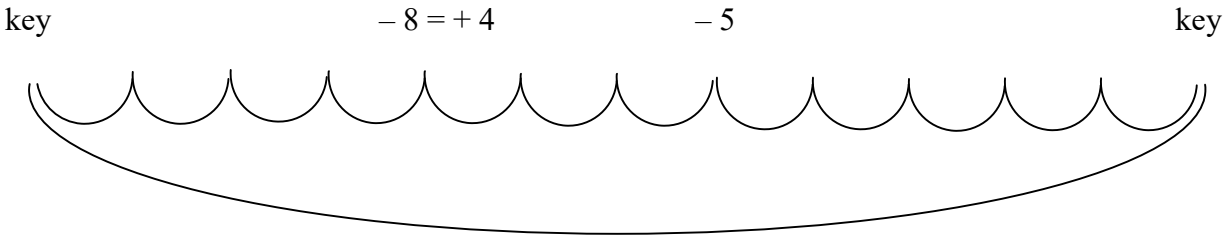
Besides the melodies or scales, using twelve notes, the simultaneously heard notes or chords also fit in this system perfectly. So our hearing corrects them to perfect chords. In fact, the more notes we hear, the better the approximation. That's the reason for the fact that the simplest chords are not merely two notes sounding together, rather three.
The most neutral chord is heard when a key note is accompanied by one five steps under, and one four steps above:



Since the full $\frac{1}{2}$ or octave jump creates a subjectively similar note, we can replace or add these octave variants to obtain variant chords. They may sound very different on their own, but when we sing a melody behind them, they fit exactly the same way. So, the basic –5+4 chord could also be called as +4+7 if we replace – 5 with its octave:



Or similarly it is a –5–8 chord if we replace the +4 with –8 :



This basic –5+4 = –5+4 = –5–8 chord is called the major and denoted by merely the key note.

In the key notation of our twelve note system, again the old eight step system is used, resulting in using only seven letters A , B , C , D , E , F , G . These are the white keys on a piano.

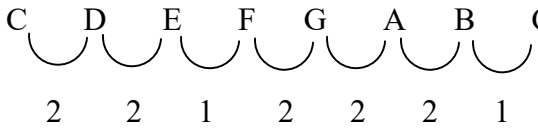
Increment by one note is denoted as # , while decrease denoted as ♭ . These are the black keys.

The old eight note system used single note jumps between B , C and E , F.

These are the white keys that have no black keys between them.

Thus, on a piano or guitar: B # = C , C ♭ = B , E # = F , F ♭ = E

The old eight note system is not old in the sense that it reflects an eternal phase in our individual music developments. Children songs all fit into this simpler system and do, re, mi, fa, so, la, ti, do are the relative names of these increments. They are exactly the alphabetical (white) keys if we start from C :



It's amazing that this scale sounds so natural and thus equal in steps, when in fact after the first two double notes, it jumps only half of that between E and F or mi and fa. Then after three double notes we again use only one between B and C or ti and do to return to the octave. This strange subjective evenness of the totally uneven jump sequence is the second mystery in our musical hearing. The first was the automatic correction of false but close to perfect jumps into perfect.

Guitar is an instrument designed for chords. The six strings are : E A D G B E.
These are all in the fundamental five jumps, except between G and B there is only four steps.
The reason for this is that fingerings could be more flexible, allowing fingers under each other.
The one step alterations of the basic or major –5+4 chords are called as:
augmented = + or diminished = – if one step is applied to the – 5 note, while
minor = min = m or suspended = sus = s when applied to the + 4 note.
So A = major, that is the –5+4 chord with A as key
A^{+} = augmented, that is the –4+4 chord with A as key ,
A^{-} = diminished, that is the –6+4 chord with A as key,
Am = minor, that is the –5+3 chord with A as key,
As = suspended, that is the –5+5 chord with A as key.
We can combine + , – alterations with m , s alterations like $A^{-}m$ meaning –6+3.
These three note chords used up seven notes. The key, plus the two three variants under and above.
To these three note chords, we can add a fourth, fifth, very rarely even sixth note from the remaining five notes left from the full twelve possible notes. The five unused notes are : –3 , –2 , –1, +1 , +2 relative notes to a key note. Of course, replaced by their octaves they are: +11 , +10 , +9 , –11 , –10.
Neither of these are used as abbreviations, rather again the old system from which the octave comes.
So the steps on the white keys of the piano but even that is modified in one case. So:
–3 ~ 6 , –2 ~ 7 , –1 ~ 7major = $7^{\#}$, +1 ~ 9minor = 9^{b} , +2 ~ 9.
If you check it out you'll see that the seventh of the white keys is not –2 rather –1 so there is an exchange. In truth, earlier the plain 7 was called dominant seventh and then the other became major.
For example, A7 means the –5 –2 +4 added notes to the key A , so a four note chord.

An interesting four note chord is A^{-}m 6 meaning –6 –3 +3 since all steps are equal and so any of the four notes could be regarded as the key. It is also called as a diminished chord and denoted as A0.
So the rule still remains valid that a single number means a four note chord.
By the way, such equally distributed chord was already among the basic three notes chord too.
Namely, A^{+} the augmented chord is again the same for all its notes as keys.

Two added numbers means a five note chord like A6/9 = –5 –3 +2 +4 which is interesting because the tuned guitar plucked without any fingerings is G6/9.
More importatntly, just the C fingered on the second string will give C6/9 , my favorite chord.
Finally, an extra possibility to make six note chords is this:
We can add the + , – , m , s variant basic notes to the non-variant version as sixth note.
Then we must write it after the numbers. For example, C6/9+ is a six note chord while C^{+} 6/9 is only a five note chord. Both can be obtained easily from my favorite C6/9 with adding one or two notes.
An other example is B7s which is a five note chord while Bs7 is a four note chord.
Both are easy to get by fingering two or three notes on the fourth fret.
The chord notations in spite of the earlier mentioned illogical octave or white key numberings are very logical. The exception is that major is not denoted by extra letter at all.
A more consistent way would be to use M for major chords too.
For example AM , AM7 could replace A and A7 .
Then the system were even more perfect. The A , B , . . . , $G^{\#}$ letters are the keys.
These include the –5 notes unless a + or – mark the altered –4 or –6 instead.
M , m , s denote the third note of the basic chords. The numbers are simply added notes.
By the way, this crystal clear notation is used on my guitar slide rule invention.

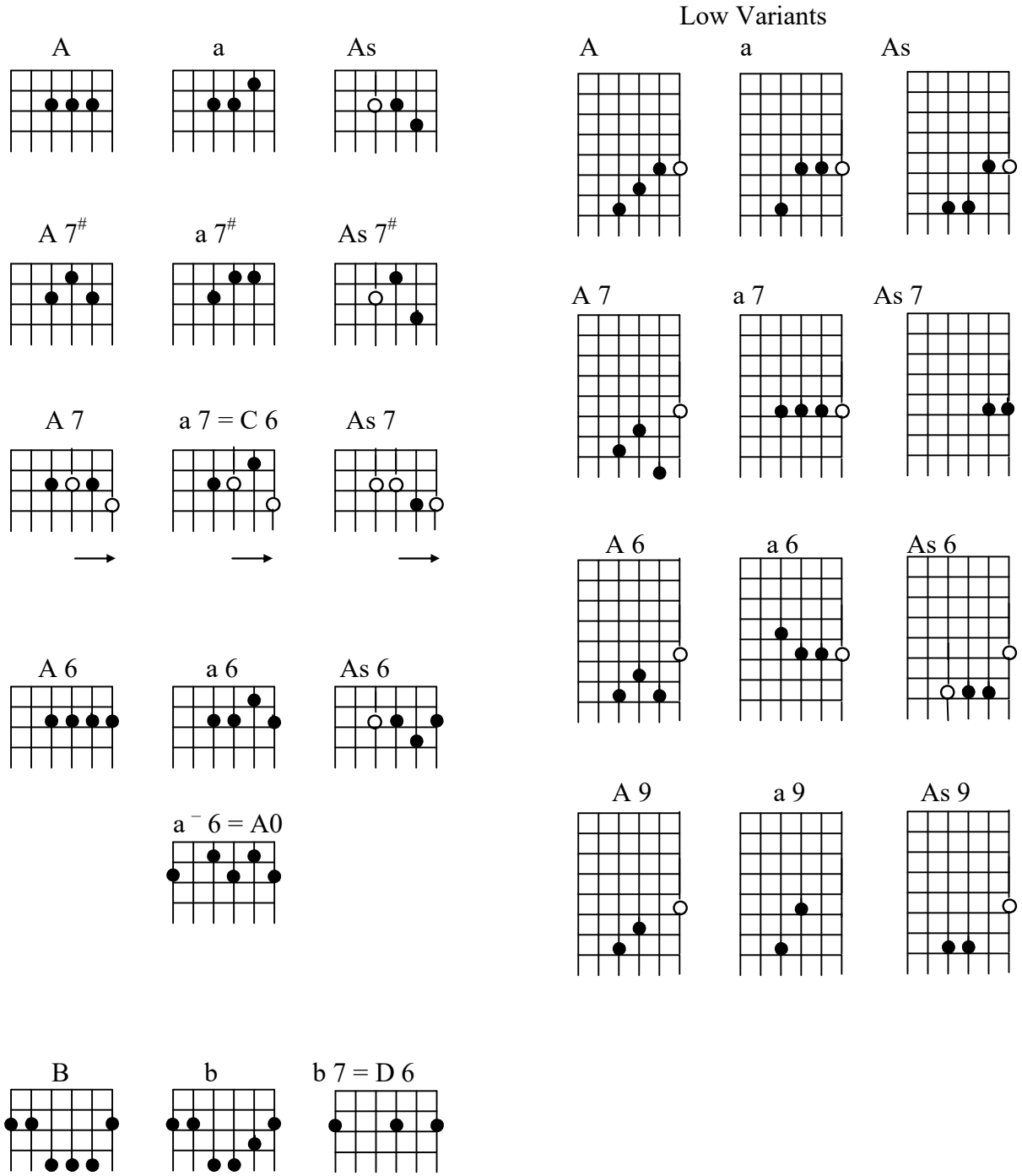
A quite opposite, simplified notation is to leave the M major unmarked and even avoid the use of m by using lower case letter for the key. So Am = a. To write down chords for songs by hand this is the most practical system because minor chords are so frequent while sus chords are pretty rare.
In our chord names in the next section we will also use this notation.

Since the guitar has six strings, if we pluck all of them, this usually means some repetitions of notes.
Some maybe with octaves replaced.
As I said, these variants in theory can always be used for the same melodies.
But in practice, this is not true because deeper notes have less effective feature in a chord.
So, the chord variants can be crucial in accompanying properly a melody.

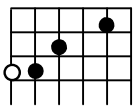
The easiest chords are using as many unfingered notes or open strings as possible and most of these easy chords are fingered on the top three frets. But some can be made on lower frets too and the particularly easy ones are above the seventh fret. So, I will give these as “low variants” too.

2. Top Chords And Low Variants

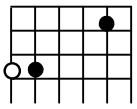
Empty circles will mean notes that can be fingered but can be left open too if you wish.
If more strings have empty circles and one can only be used with an other, then under the strings, we’ll mark this with arrows.



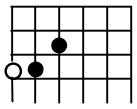
C



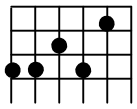
C 9



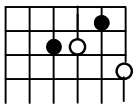
C $7^{\#}$



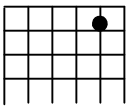
C 7



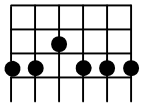
C 6 = a 7



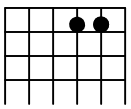
C 6/9



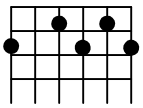
C 7/9



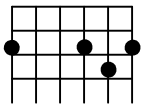
C $^{+}$ 6/9



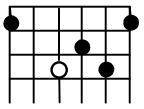
c $^{-}$ 6 = C0 = A0



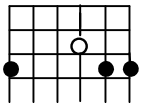
D



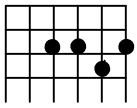
d



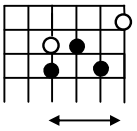
Ds



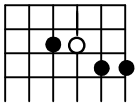
D 9



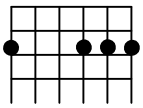
d 9



Ds 9



D $7^{\#}$



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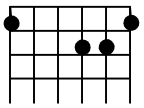

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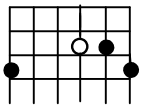
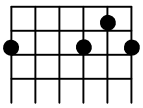
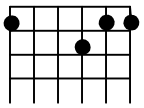


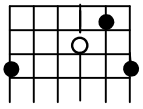
D 7



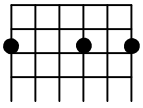
d 7 = F 6



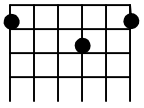
Ds 7



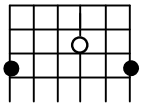
D 6 = b 7



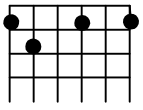
d 6



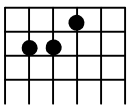
Ds 6



d $^{-}$ 6 = D0



E



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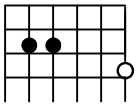

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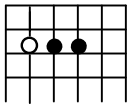
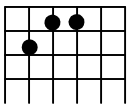


E $7^{\#}$



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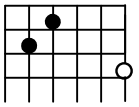

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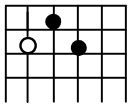
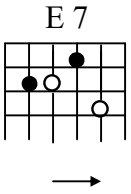
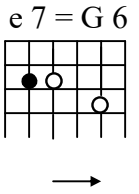


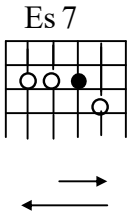
E 7



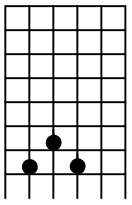
e 7 = G 6



Es 7



E 7



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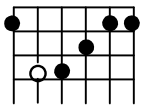

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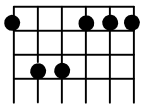

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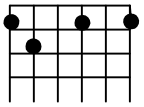

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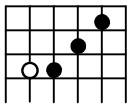

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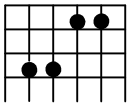

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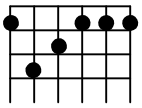

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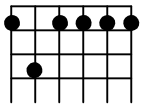

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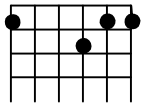

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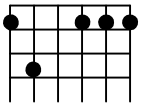

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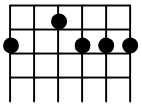

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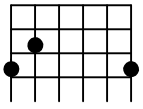

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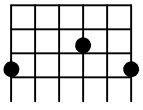

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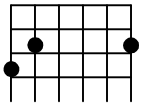

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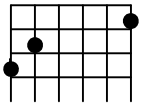

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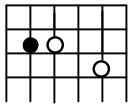

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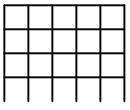

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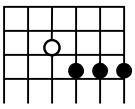
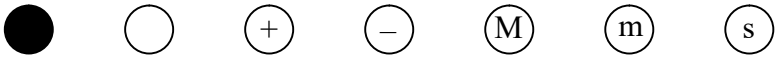


3. My Guitar Chord Slide Rule Invention

The B and b chords above, were using the fourth fret and were merely moved versions of the A and a chords. All chords have such trivial moved versions and one way to achieve these is using our pointing finger as an artificial "nut" or top fret of the guitar. Of course, this way we only have the other three fingers to actually finger strings lower. A useful device to replace our pointing finger is the "capo" a movable nut. This of course brings in new open strings and we might think that just sliding the fingerings is impossible with keeping the original nut and open strings.
Amazingly, the capo can be replaced by a sliding "cape" that combines the logic of chords melting into each other with keeping track of a fix nut position and open string values.
The crucial trick is to mark already the open strings above the nut with their chord values.
This works best with the perfect notation system, that is using letters for all chords as M , m , s.
These are the third notes and the other two could be denoted with black and white circles.
A smart choice is black as the key and white as the –5 because then the augmented and diminished can be white circles with + or – inside. These are the seven basic notes:



The rest of the positions then can be denoted with numbered circles:

Placing our imaginary capo or cape anywhere, will create a possible key choice on the guitar.
The rule for basic chords is to use only three kinds from the seven basic notes above.
Namely, having black and a letter choice for sure and a third that then must be empty or a sign.
Having six strings of course means that such basic chords must have three repeats of some of these basic chord values.
Replacing some repeated ones with numbered circles will give four, five or six note chords.
The crucial showing of the chord values of the open strings is achieved by simply having six holes as the bottom window on our cape.
The also crucial key value of the black circles on the neck can also be established on the "cape" !
Either, by using a second window that shows key values printed on the neck further above.
Or using more holes with key values next to them and aligning these with a black circle of the neck.

Decades ago I discovered this system while teaching my daughter the guitar chords.
Then I didn't use M rather three colors. Red for black that is for the key, blue for –5 , and green for M. Of course + and – also being blue and m and s also being green.
Thus the rule is simply to use all three colors.
In Hungary I ended up meeting the same assholes that screwed up the Rubik's cube.
Finally, some famous people got involved but they wanted their unfair share for their names.
When we came to Australia, in Brisbane the Innovation Centre introduced me to Milan Tucek who started to manufacture and promote the invention as the "Mega Chord".
He was well intentioned but when he went to America he didn't want me to be there and that cost our biggest market. He screwed up the same way a fellow Brisbane inventor's invention for a golf ball collecting machine. Nowadays the electronic chord finders are in phones already.
Of course they don't reveal the slidings of the chords. Most importantly, my invention can be used backwards, to find out names of chords that you figure out yourself!