Piano Melodico

A family of mechanical musical instruments

Dr. Christian F. C. Greinacher

The **Piano Melodico** is a string instrument, specifically designed for indoor use [*they have occasionally appeared at outdoor rallies—Ed*]. The strings are played with felt hammers, which are controlled by a tricky mechanical arrangement of wheels, shafts, springs, and hammers, normally driven by a crank. The "memory" is a punched cardboard book similar to other mechanical music instruments made in the same time frame.

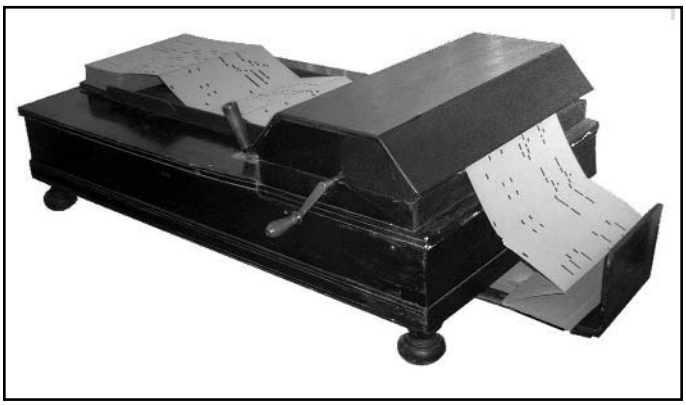

Figure 1. Piano Melodico with 48 notes. Collection C.F.C. Greinacher.

The Piano Melodico is not a piano with a mechanical or pneumatical add-on to make it self-playing but rather of specific construction of the late 19th century to bring the pop music of that time—especially melodies of the famous operas of Verdi, Puccini and others—into the reception rooms of the well-established citizens.

Where does it come from?

The Italian instrument maker Giovanni Racca (his workshop was located in the Via Milazzo 18, Bologna, Italy) designed the Piano Melodico in the 1880s and sold them until about the first world war. Giovanni Racca built his Piano Melodici in two sizes—four and six octaves (and in different case designs). Two of these original Giovanni Racca instruments are shown in **Figures 1 & 2**.

Soon after Giovanni Racca offered his instruments to the market, he contracted a license agreement with the German firm Wilhelm Späthe. Gera. Späthe built a smaller 30-note (three octaves) version of the Piano Melodico. Marketing started in 1889 under the name Pianophon (**Figure 4**). In 1890, Späthe sold a model driven by a spring-wound motor. This instrument could play for 12 minutes without rewinding the spring[5]. One of these smaller instruments is shown in **Figure 3**. Several other models were offered by different dealers throughout Europe, as one can find in dealer's catalogs from the turn of the century[3,4] (**Figures 4 - 6**). At the Leipzig Fair in 1891 the Pianophon was the "hit of the year." Mr. Späthe, together with Mr. Hlawatsch, had improved some of the mechanical details. Mr. Hlawatsch, living in Russia, was the inventor of another mechanical music instrument with vibrating hammers[6].

The Italian instrument maker Giovanni Racca designed the Piano Melodicoin the 1880s and sold them until about the first world war.

How does it sound?

The basic sound is very similar to a piano. But because the hammers are driven continuously, they repeatedly will strike the strings as long as a single note lasts. If a short note is played, there is one knock and this sounds like a piano, a long lasting note produces repeated knocks and this sounds similar to a mandolin. Depending on the skills of the arranger of the music book, this effect can make the Piano Melodico sound like an orchestra with multiple different instruments.

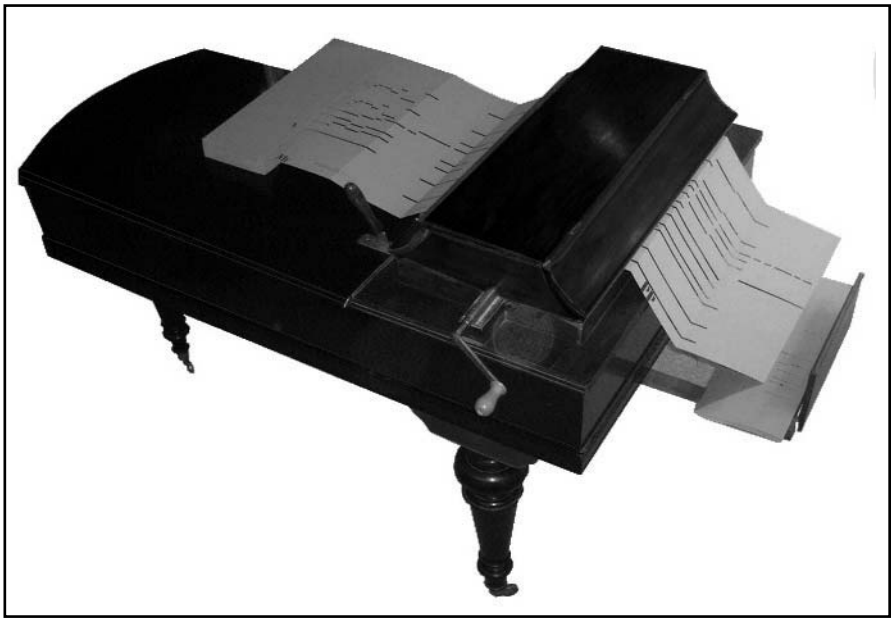

Figure 2. Piano Melodico with 73 notes. Collection C.F.C. Greinacher.

Figure3. Piano Melodico with 30 notes. Collection C. F. Greinacher.

In an advertisement from 1901 the sound of the Piano Melodico is described as following:

> "The sound of the Piano Melodico is produced by the percussion of steel strings which are strung on an iron frame as substantial as any piano has. The patent contrivance for sustaining the tone by continuous percussion gives the instrument a peculiar and wonderful tone sounding in the high range like the mandolin in the middle range like the French horn, and in the lower range like the piano. The ensemble effect is splendid and this is enhanced through the power of producing pianissimo with trills, crescendo and forte at will during the performance, thus conforming to the requirements of the original composition. Even great music connoisseurs and experts are delighted with the instrument and its tones and wonder about the richness and fullness of the instrument."

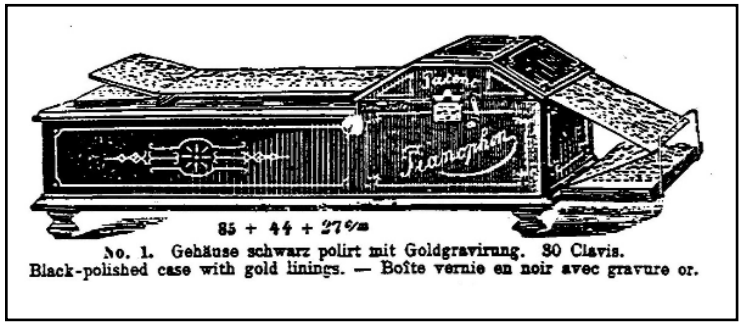

Figure 4. Piano Melodico, same model as shown in Figure 3 (from catalogue "Holzweissig, 1898).

The best music arrangements for the Piano Melodico are on the original Giovanni Racca music books (**Figure 9**). The music books for the 30, 48 and 73-note Piano Melodico measure 272, 309 and 462 mm. in width (10.7", 12.2" and 18.2").

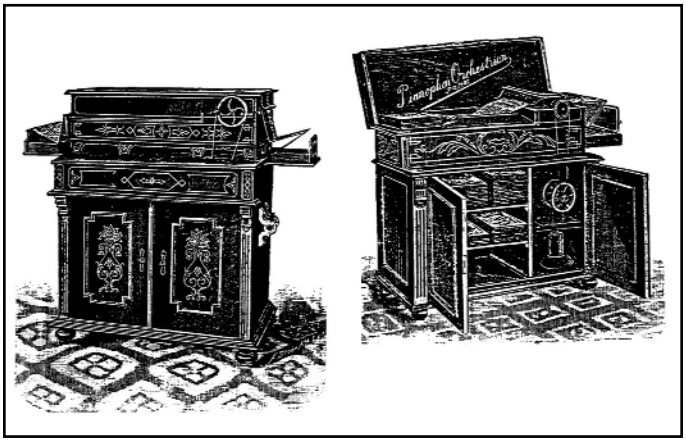

Figure 5. Piano Melodico, 30 notes, with hot-air motor (from catalogue "Holzweissig," 1898).

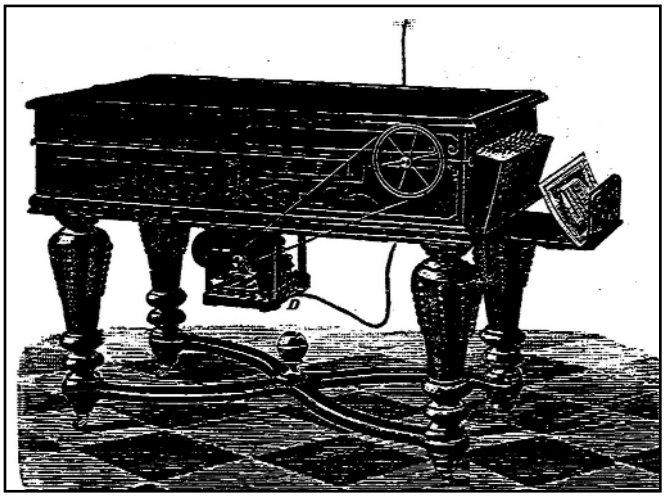

Figure 6. Piano Melodico, 30 notes, with electric motor drive (from catalogue "Holzweissig,", 1898).

Even great music connoisseurs and experts are delighted with the instrument and its tones and wonder about the richness and fullness of the instrument.

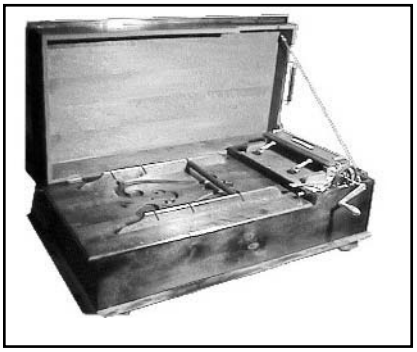

Figure 7. Piano Melodico, similar model as in Figures 5 & 6. During restoration the instrument was altered to manual drive. Collection C.F.C. Greinacher.

Figure 8. Beautifully painted Piano Melodico with 30 notes in the Museum Ruedesheim.

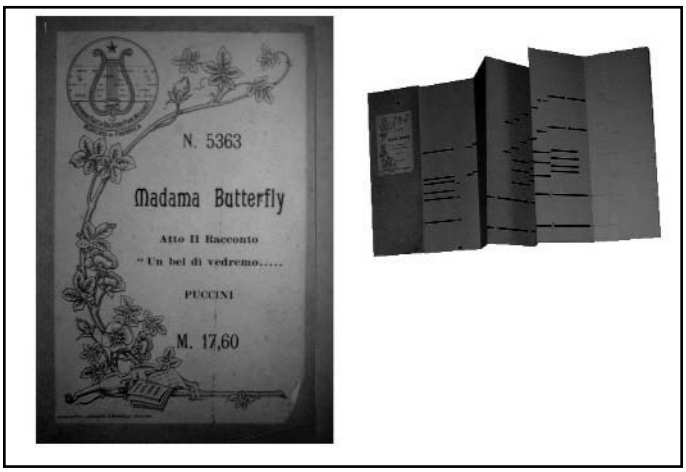

Figure 9. Original Giovanni Racca music book for 48-note Piano Melodico. Collection C.F.C. Greinacher.

The Mechanical Components of the Piano Melodico

The main mechanical components are similar for all the different models. These components (shown schematically in **Figure 10)** are:

- the case
- the drive module for the music book transport and for the hammers
- the tracker bar
- the stringframe with strings
- the soundboard

Figure 11. 73-note Piano Melodico. Collection Marino Marini.

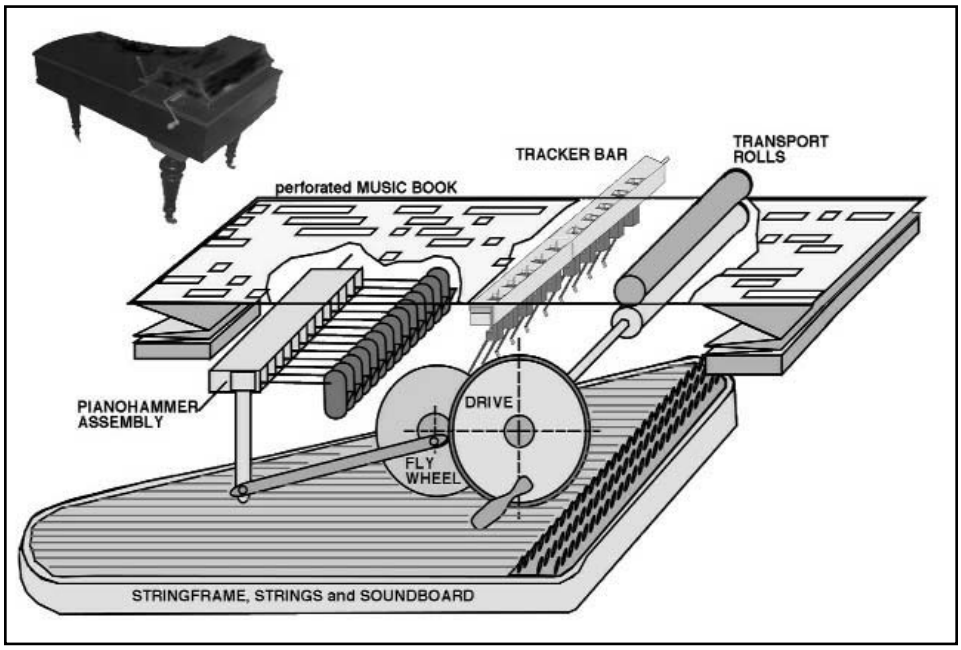

Figure 10. Components of a Piano Melodico.

• The Case

The case of the 73-note Piano Melodico looks like a small grand piano and stands on three legs (**Figures 2 & 11**). It measures approximately 138 by 83 cm and is 80 cm high (54.3", 32.7", and 31.5"). The weight is approximately 80 kg. The 48-note model is slightly smaller: 110 by 60 by 25 cm (43.3", 23.6", 9.8") and it stands on four small feet (**Figure 1**). The 30-note model is the smallest one: 87 by 45 by 25 cm (34.3", 17.7", 9.8") without the long legs. Standing on the long legs as in **Figure 3** this model is 82 cm (32.3") high.

The cases are normally painted in black (occasionally in brown) with golden ornaments on it and the signature "Piano Melodico Patent" is written in golden letters on it (**Figure 12**) The grand model looks more elegant, usually with a shiny

black polished finish. Some instruments are made from valuable woods and do fit the interior of living rooms of the end-of-the 19th century (**Figure 11**).

Figure 12. Signature of a 30-note Piano Melodico. Collection C.F.C. Greinacher.

• The Drive Module

The drive module in a 73-note Piano Melodico (**Figure 13**) is nearly the same as in the 48-note version, and consists of the hand cranked main wheel (1), 150 mm (5.9") diameter. The rubber ring of this main wheel engages with the arbor (3) (17 mm [0.7"] diameter) of the second wheel, the flywheel (2). On the same arbor an eccentric (4) is fixed which is driving the hammers via a connecting rod (5) and a simple but most tricky mechanical assembly which I will explain later on.

The main wheel engages with the primary transport roll (see **Figure 13**) via two gears. The gear ratio is 3.5: 1. Cranking the main wheel with about one turn per second, the transport roll will turn with 0.28 turns per second. The diameter of the transport roll is 33 mm (1.3"), i.e. the speed of the book music is about 30 mm (1.2") per second.

When turning the main wheel with one turn per second, the flywheel and the eccentric will run with 8.8 turns per second. Via the connecting rod the piano hammer assembly oscillates with a frequency of 8.8 Herz.

In the 30-note Piano Melodico the construction of the drive module is different. Here the drive module consists of the hand-cranked main wheel of 88 mm (3.5") diameter. The rubber ring of this main wheel engages with the arbor (6.5 mm [2.6"]diameter) of the second wheel, the flywheel. On the same arbor an eccentric is fixed which is driving the hammers via a connecting rod and a simple but most tricky mechanical assembly which I will explain later on.

The main wheel engages directly with the primary transport roll. Cranking the main wheel with about one turn per second, the transport roll will turn with 1 turn per second too. The diameter of the transport roll is 9 mm (0.4"), i.e. the speed of the music book is about 30 mm (1.2") per second.

When turning the main wheel with one turn per second, the fly wheel and the eccentric will run with about 10 turns per second. Via the connecting rod the piano hammer assembly oscillates with a frequency of about 10 Herz.

When restoring the hammer assembly (**Figure 14**), especially the hammer springs, it is important to know the frequency of oscillation of the hammer assembly. The hammer springs have to be designed so that their resonance frequency is high enough compared to the frequency of oscillation of the hammer assembly. The measured resonance frequency of the hammers of my Piano Melodico with 73 notes is a little bit more than 16 Herz., i.e., there is a factor of two between resonance frequency and oscillation frequency of the hammers.

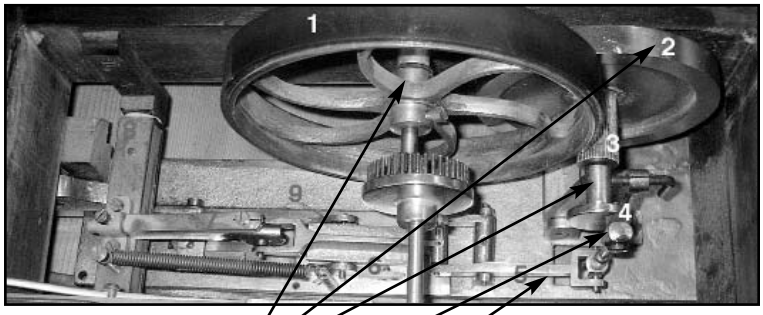

Figure 13. 1. Main Wheel
2. Fly Wheel
3. Arbor
4. Eccentric
5. Connecting Rod

Drive module of a 73-note Piano Melodico. Collection of C.F.C. Greinacher.

When I restored the Piano Melodico with 30 notes, (**Figures 21 & 22**), I ran into severe problems because I did not consider the above factors. As one can see from the picture, this instrument really was a wreck when I found it on the loft in an old man's house. There he had two of these instruments, slightly different from each other but both in very bad condition. No hammers, no hammer springs, only parts of the gears. He offered to give me either one of these two instruments provided I would restore them and give him back one in playing condition. I met the challenge and restored both instruments.

Figure 14. Hammers, hammer springs and stop and go springs of a 48-note Piano Melodico. Collection C.F.C. Greinacher.

I restored the first one, just by looking at other similar instruments in museums and on pictures. Some measurements I

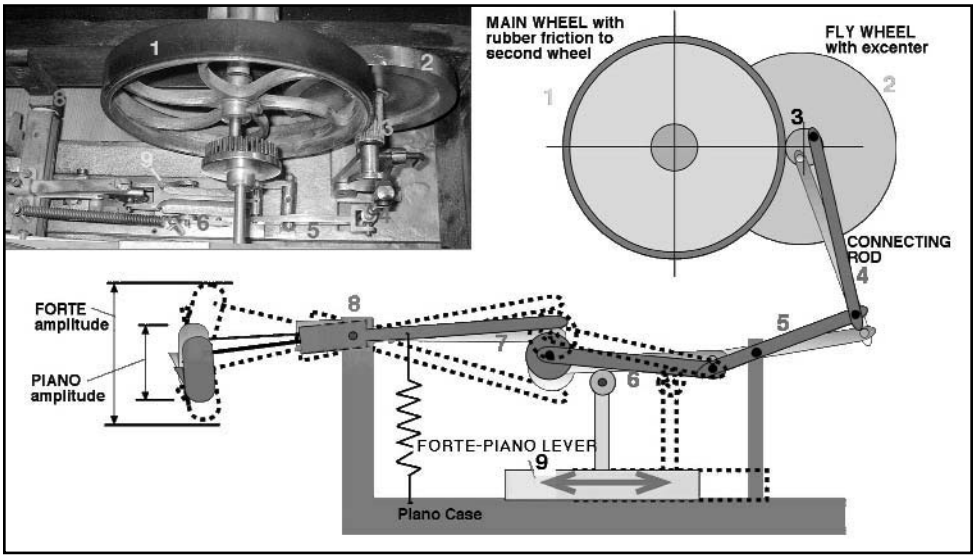

Figure 15. Drive module of the 48 and 73-note Piano Melodici.

could take from the remains of the two wrecks. The hammers and hammer springs for the first instrument I designed just geometrically but I did not care for the resonance frequency of the hammer/spring unit. After more than 100 hours of working on this instrument I started it for a first test run. It did sound quite good, the melody played clearly. But when I altered the speed of turning the crank slightly, it all of a sudden made a terrible noise. Shocked by this noise I unconsciously reduced the speed of cranking and the loudness decreased suddenly. It took me a lot of time to find out what had happened: The resonance frequency of the hammer/spring unit was exactly in the same range as the oscillation frequency forced by the speed of turning the crank. When the hammers came into resonance, their oscillation amplitude increased and the loudness of the instrument increased tremendously. In other words—the sound of the instrument was totally unstable.

To solve the problem I had to cut a new set of hammer springs, about twice the thickness as it was before. That doubled the resonance frequency and the problem was solved.

Now I am going to explain how the drive module makes the hammers oscillate. Concentrate on **Figure 15**. with the following text: turning the main wheel (1) with one turn per second makes the fly wheel spin around with about 8.8 turns per second. The connecting rod (4) translates this movement via the lever (5) to the lever (6). The small wheel at the left end of lever (6) moves up and down with 8.8 Herz. The right-end handle (7) of the hammer assembly is pressed down onto this small wheel by a spring. So the up and down movement of the small wheel is converted to a corresponding up and down of the hammer head. The amplitude of the hammer head movement depends on the geometrical ratios of the different lever-arms. The real tricky solution introduced by Giovanni Racca is the Forte-Piano lever (9). Moving this Forte-Piano lever, as indicated by the double arrow, allows altering the ratio of the lever arm (6) continuously. Moving the lever (9) to the left, the amplitude of the small wheel on lever (6) is small, moving the lever (9) to the right, the amplitude of the small wheel increases. As a result the hammer head amplitude is at its minimum when the Forte-Piano lever is at the very left position, the instrument plays Piano, or soft. Shifting the Forte-Piano lever to the very right position, the hammer head amplitude reaches it's maximum and the instrument plays Forte, or loud.

This ingenious forte-piano mechanism is built into the original Giovanni Racca Piano Melodico, i.e. these instruments with 48 or 73 notes. The smaller 30-notes license remakes from Leipzig do not have this forte-piano mechanism. For marketing reasons they have a small lever, labeled “Forte-Piano.” But, this lever works very poorly—moving it to the piano-position puts a very week felt onto the hammer-springs. Some fraction of the oscillation energy gets absorbed, they are damped, and this reduces their oscillation amplitude. This really simple solution works in principle but it is hard to realize a continuous transition from forte to piano and vice versa.

• The Tracker Bar

The tracker bar is the most delicate component of the Piano Melodico. It has to scan the perforated music book and controls the oscillation of the hammers. The principle of this control mechanism is shown in **Figure 16.**

The perforated or punched music book moves over the tracker bar. As long as there are no holes in the paper (book),

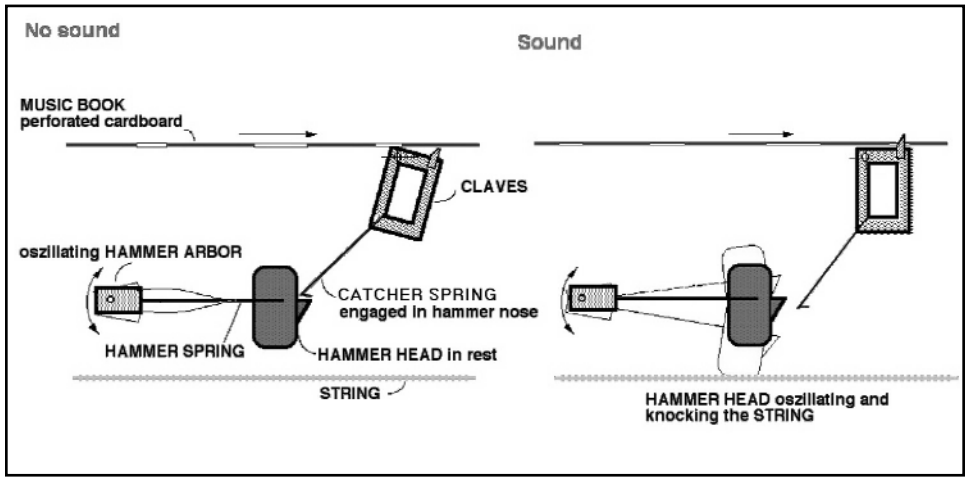

Figure 16. Hammer Control Mechanism of the Piano Melodico.

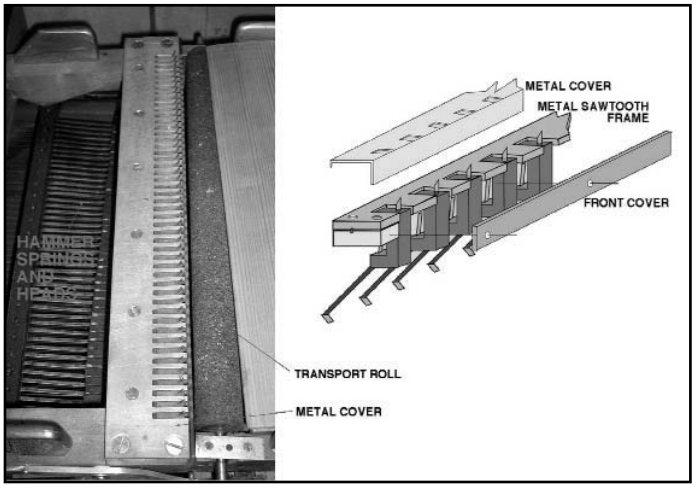

Figure 17. Tracker bar assembly.

the paper presses against the steel pins on top of the claves (keys). One clave for each note. This forces the claves to turn by a small angle and the catcher spring on the bottom of the claves engages with the nose of the related hammer. Despite the fact that the hammer arbor is continuously oscillated by the lever-action of the drive module, the hammer heads are blocked from oscillating by the catcher spring. As soon as a hole in the paper comes over the appropriate claves, the steel pin falls through the hole, the claves turns up by a small angle, the catcher leaves from the hammers nose and immediately the hammer head starts oscillating and knocks the string.

Figure 17 shows a picture of the tracker bar assembly of a 48-note Piano Melodico and a drawing of its construction. A much more detailed drawing is shown in **Figure 18**. The distance between the steel pins (the raster) is the same for the 48 and 73-note Piano Melodico: it is 6.2 mm (0.2"). For the 30-note Piano Melodico the raster is 8.8 mm (0.3"). With the help of some adjustments to press down the not-used claves and to feed the smaller music books of the 48-note Piano Melodico, it is possible to play music books of the 48-note Piano Melodico on a 73-note instrument. The lowest note then will be played as G# instead of G. One could accept this or tune the appropriate string half a note lower.

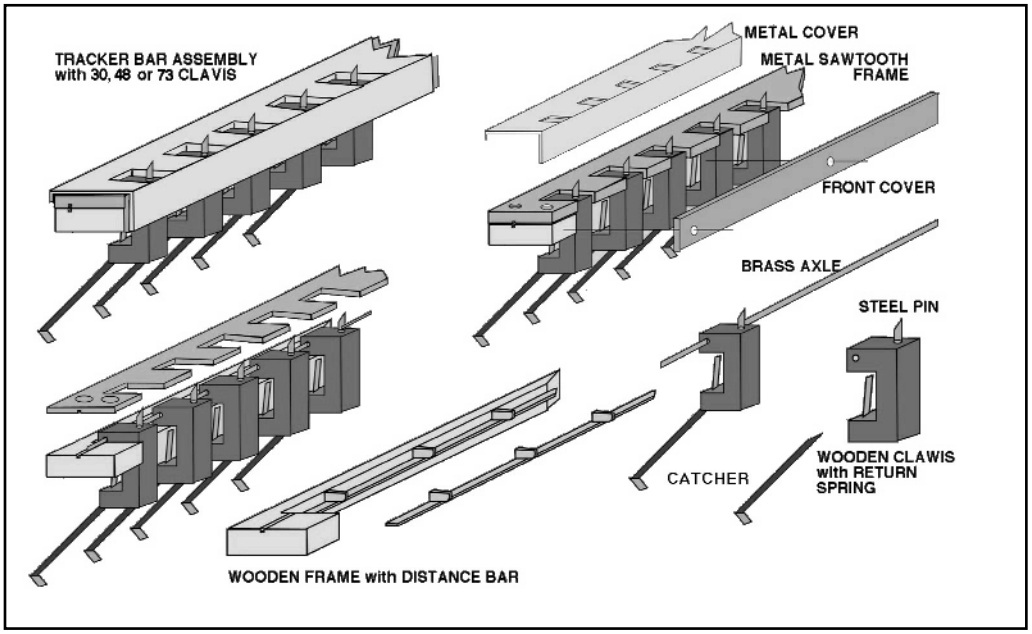

Figure 18. Tracker bar assembly and its components.

Figure 19. Stringframe, strings and soundboard of a 73-note Piano Melodico. Collection C.F.C. Greinacher.

• The Stringframe, Strings and Soundboard

All Piano Melodici have a solid stringframe from cast iron. **Figures 19 & 20** show the stringframe of a 73-note Piano Melodico. There are 18 single bass strings, ranging from G1 to C3. These are copper-wound steel strings. The 55 discant and treble strings (ranging from C#3 to G7) are all two strings per note. So in total the 73-note Piano Melodico carries 128 strings.

Whereas the soundboard of a 30-note Piano Melodico shows a much simpler construction, the soundboards of the larger Piano Melodici (48 and 73-note) are very well designed and manufactured. **Table 1** shows the main string data for the different Piano Melodico models.

How much does it cost?

Browsing through catalogs one can see that the prices for the Piano Melodici have been quite stable between 1892 and 1901.

Table 2 shows some figures for the well-known models of Piano Melodici.

These prices in Table 2 need some explanation: The list prices are given in Marks, the German currency of that time. In order to get some feeling which value these prices would represent, the Marks are compared to the amount of liters of beer you could get for the same money and how many days an average industry worker had to work to earn that money [2]. This equivalent is given in EURO and in US dollars.

It might be of interest for you to get some orientation about the prices to be paid for a Piano Melodico showing up on the antique market. In **Table 3** some prices are listed which were

Scale and Strings of the Piano Melodici

PM 73 String #	PM 73 Note	PM 48 String #	PM 48 Note	PM 30 String #	PM 30 Note	PM 73 String #	PM 73 Note	PM 48 String #	PM 48 Note	PM 30 String #	PM 30 Note
1	G1					38	G#	25	G#	17	G#
2	G#					39	A	26	A	18	A
3	A							(All tuned to 440 Hz)			
4	A#					40	A#	27	A#	19	A#
5	H					41	H	28	H	20	H
6	C2					42	C5	29	C5	21	C5
7	C#					43	C#	30	C#	22	C#
8	D					44	D	31	D	23	D
9	D#					45	D#	32	D#	24	D#
10	E					46	E	33	E	25	E
11	F					47	F	34	F	26	F
12	F#					48	F#	35	F#	27	F#
13	G					49	G	36	G	28	G
14	G#	**1**	G			50	G#	37	G#	29	G#
15	A	**2**	A	**1**	A	51	A	38	A	30	A
16	A#	**3**	A#			52	A#	39	A#		
17	H	**4**	H	**2**	H	53	H	40	H		
18	C3	**5**	C3			54	C6	41	C6		
19	C#	**6**	C#	**3**	C#	55	C#	42	C#		
20	D	**7**	D	**4**	D	56	D	43	D		
21	D#	**8**	D#			57	D#	44	D#		
22	E	9	E	**5**	E	58	E	45	E		
23	F	10	F			59	F	46	F		
24	F#	11	F#	**6**	F#	60	F#	47	F#		
25	G	12	G	7	G	61	G	48	G		
26	G#	13	G#	8	G#	62	G#				
27	A	14	A	9	A	63	A				
28	A#	15	A#			64	A#				
29	H	16	H	10	H	65	H				
30	C4	17	C4	11	C4	66	C7				
31	C#	18	C#	12	C#	67	C#				
32	D	19	D	13	D	68	D				
33	D#	20	D#			69	D#				
34	E	21	E	14	E	70	E				
35	F	22	F			71	F				
36	F#	23	F#	15	F#	72	F#				
37	G	24	G	16	G	73	G				

Bold numbers indicate bass string—steel and copper wire wrapped; others (deskant and treble strings) are steel strings, two per note.

Table 1. Scale and strings of the Piano Melodici.

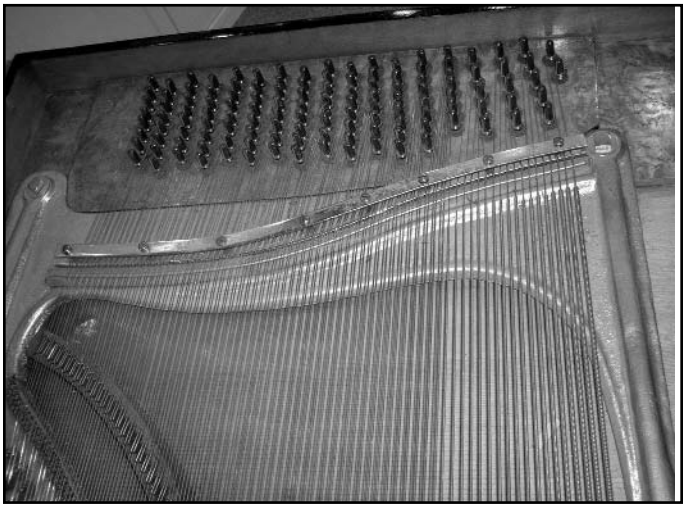

Figure 20. Stringframe, strings and tuning pins of a 73-note Piano Melodico. Collection C.F.C. Greinacher.

In order to get some feeling which value these prices would represent, the Marks are compared to the amount of liters of beer you could get for the same money

paid in Europe during the last few years. It is interesting to see that the antique market prices of today for the small models (PM 30) are very close to the today's equivalent of the list prices of 1900 [3, 4]. The top model, the Piano Melodico with 73 notes, you can get for half the equivalent price of the price list of around 1900. Seen from this point of view, you can make a bargain when buying such a Grand!

	List Price (Marks)	equivalent liter beer 1900 0.22 Mk/L.	equivalent working days in 1900 5.60 Mk/day	equivalent EURO 2002 100 Euro/day	equivalent US $ 2002 1 Euro = $0.88
1892/93[3]					
PM 30 hand cranked	82.00	370	15	1,500.00	1,320.00
PM 30 hand cr. with table	104.00	470	19	1,900.00	1,670.00
Music book per meter	0.80				
1897[3]					
PM 30, El.motor on desk	215.00	980	38	3,800.00	3,340.00
1898[3]					
PM 30 hand cranked	83.00	380	15	1,500.00	1,320.00
PM 30 hand cr. with table	103.00	470	18	1,800.00	1,580.00
PM 30 on desk, auto P/F	156.00	710	28	2,800.00	2,460.00
PM 30 with hot air motor	250.00	1140	45	2,800.00	2,460.00
PM 30 with electric motor	215.00	980	38	3,800.00	3,340.00
PM 30 el.motor + Accur	300.00	1360	53	5,300.00	4,660.00
Music book per meter	0.84				
1901[3]					
PM 30 hand cranked	86.75	390	15	1,500.00	1,320.00
PM 30 hand cr. with table	106.75	480	19	1,900.00	1,670.00
PM 30 on desk, auto P/F	164.50	750	29	2,900.00	2,550.00
PM 30 with hot air motor	267.00	1210	48	4,800.00	4,220.00
PM 30 with spring motor	417.00	1900	74	7,400.00	6,510.00
1904[4]					
PM 73	800.00	3640	143	14,300.00	12,580.00
mean price for a hand-cranked PM 30 with table around 1900	**105.00**	**480**	**19**	**1,900.00**	**1,670.00**

Table 2. List prices of the Piano Melodici around 1900 compared to today's values.

But if you will get a 30-note Piano Melodico for a small price, you should look for an instrument in not very good condition. You might get it for less money (500 US $?) and restore it. In the next chapter I will show you that it might work well.

Example of a Difficult Restoration

Some years ago I was looking to buy my first Piano Melodico but I would and could not spend too much money for it. During a collectors meeting I met an old man and asked my standard question— "Do you know somebody who would sell a Piano Melodico for little money?" I was very much surprised hearing his answer— "Yes, I know. I have two Piano Melodici lying around somewhere at home. They are in rather poor condition. If you would restore them and give one back to me, you could take the other one for you and you don't have to pay me any Deutsche Mark."

I was so happy! Some weeks later I drove 300 km by car and visited him. We climbed up on his loft and looked for quite a while. After about two hours I had two pasteboard boxes full with remainders of two Piano Melodici: broken wood, undefinedable pieces of felt, steel and brass, remainders of strings, three out of four legs, broken parts of hammers and some undefined pieces.

The owner asked me to take it with me and to give him back either one of the two instruments in playing condition, if possible "not later than in about 14 months from today." The reason for this date was an organ rally that he would join with his instrument.

Back home, first I took some pictures of what I brought with me. **Figures 21 and 22** shows one of the instruments. On January 22nd, 2000, I started the restoration of these instruments. The first one was finished, after 143.5 hours working on it, on November 14th. Adding some time for writing the restoration report—which is a very important part of the restoration—the total amount of working time needed to restore this instrument is 150 hours.

	Prices Paid Euro	Prices Paid US $ 1 Euro = $0.88	List price around 1900 in today's equivalent US $
PM 30, private sale 2001	1,530.00	1,350.00	1,670.00
PM 48, private sale 2000	2,560.00	2,250.00	
PM 48, auction 2000	2,560.00	2,250.00	
PM 73, auction 1998	6,650.00	5,900.00	12,580.00
PM 73, private sale 1999	6,900.00	6,100.00	12,580.00
PM 73, private sale 2001	5,110.00	4,500.00	12,580.00
Music Book PM 30, recut, list price per meter (Le Ludion)	9.00	7.90	13.00
Music Book PM 48, recut, list price per meter (Le Ludion	11.00	9.70	
Music Book PM 48, original, prices paid per meter	10.00 to 20.00	9.00 to 18.00	

Table 3. Prices of Piano Melodici on the European market today.

Figure 21. 30-note Piano Melodico as I found it on the loft of the old man's house.

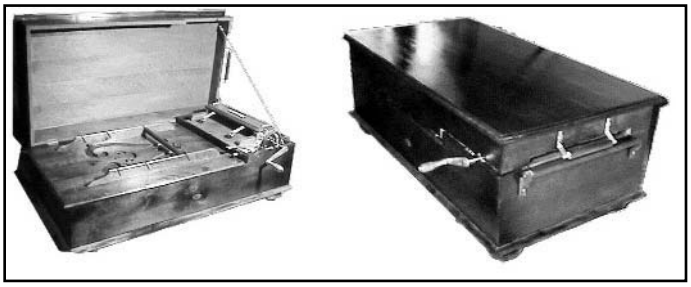

Figure 23. Same instrument as in Figure 21 but now it has been restored.

The Restoration Report is part of the Curriculum Vitae of the Instrument. It is a document belonging to the restored instrument.

Figure 24. The second instrument found on the loft after 120 hours of restoration performed. Collection C.F.C. Greinacher.

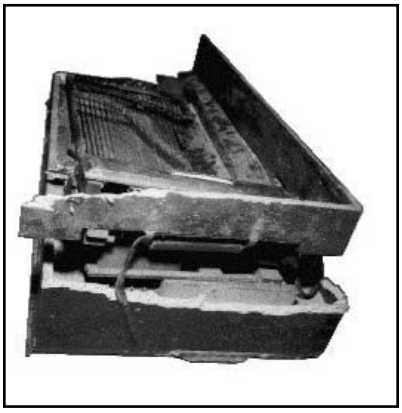

Figure 22. Same instrument as in Figure 21.

The Restoration Report

In my opinion it's a must to write a Restoration Report. It is a document belonging to the restored instrument. The Restoration Report is part of the Curriculum Vitae of the Instrument. The Restoration Report for the instrument described before and shown in fig. 21 to 24 includes 18 pages. It lists each step of the work done in detail, the time needed, drawings and measures. It describes special problems coming up during the restoration process and how they were solved. The report tells clearly which parts have been replaced and why this was done. Interested readers may contact me directly for a copy of the report.

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Bibliography

1. Wonneberger, Lothar: Piano Melodico—ein reizvolles Objekt. *Das Mechanische Musikstrument*,16. Jahrgang, No. 51, Dezember 1990, p. 37
2. Scheuerer, Kurt: Die Kaufkraft des Geldes. Homepage Kurt Scheuerer—Numismatik, Antike—Mittelalter und Neuzeit in Bayern, www.bingo-ev.de/~ks451/numismat/geldwert.htm
3. Catalogue Ernst Holzweissig, Leipzig, 1892/93, 1897, 1898, 1901
4. Catalogue J.M. Bon, Leipzig, 1904, as mentioned in 1)
5. *Zeitschrift für Instrumentenbau*, Jahrg.10, 1 April 1890, p.230
6. *Zeitschrift für Instrumentenbau* Jahrg.11, 11 April 1891, p.282

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