

PIANO REGULATION

THE GRAND ACTION

A Brief Outline for the Courageous Owner

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Prefatory Note

A few years ago I had my Steinway M dating from 1929 completely rebuilt by Ole Hansen of HANSEN AND SON, of Shelburne VT, and since I live nearby he permitted me to come in when I was in town and observe what he was doing,. I asked a lot of questions and over the course of a winter learned a great deal about the inner construction and workings of my piano. The action was completely rebuilt with new hammers and all new Renner action parts, and since the sound board was solid and an extremely lively one, I found myself, in springtime when the snow melted, the proud owner of a first rate Grand Piano.

Several years later I figured it was time to check the action and see if everything was in adjustment. Felt parts have a tendency to compress under use with time and use, and I knew a basic regulation was often called for in two to three years. But this also seemed a good time to go over my learning curve and see what I remembered.

I found I remembered the basics but there were part of the procedure which were not completely clear in my mind, so I went back to Hansen and asked more questions, which he cheerfully answered. Coming home I went over the action carefully, adjusting and examining until the design was clear in my mind and the action brought up to its best performance. Doing this work was not only interesting to me, it made a considerable difference in the sound and feel of the piano, and I feel the days I spent with this review phase of my learning were well spent.

The Grand Action is a complicated piece of extremely ingenious design, virtually the same as the original action designed by Erard early in the 19 th century. I believe that having a good understanding of your instrument is important as a foundation for the more careful and sensitive playing. Far too many pianists have a poor sense of what the "loud" pedal does with the dampers, how the open strings reverberate sympathetically, what "una corda" actually means with a triple strung frame, and what the middle pedal is put there to actually do.

I discussed in an essay on [Temperament and Tuning](#) the importance of keeping a piano in tune and becoming aware of dys-harmonic "beats", rather than pressing merely the keys and ignoring the sound. Tuning is difficult for an amateur, but touch up of aberrant notes can be done with an electronic instrument, which I mention in that article. But a good deal of practiced hand-dexterity with the tuning hammer (actually a wrench!) is required before a tuned string can be properly set. Most people will leave tuning to a professional, and play on the piano until the sound becomes intolerable. I have found it better to use the Electronic Tuner and do it myself, thus always having a well sounding piano ready to play, but this is a matter of preference and personal inclination.

But the action is another thing. When the tuner comes for his session with the strings, his hour goes fast and if you ask about Regulation, you will find that will be another job. But unlike tuning, regulation is a mechanical process, and a person with interest and a mechanical sense of things will be able to do some basic work on the action for himself (a.k.a. themselves). There is nothing much that can be done wrong to harm the piano if you go carefully, and if you give up in the end, the technician can come back with a told-you-so smile and do it over again.

Even failing you will have learned a lot and will have a better idea of what a complete tune-up of the action does for the feel of the piano, and in a general sense how much work it involves and what it should cost.

There is on my website a useful [Check List](#) for all the keys of the piano which you can print out as a list for keys on your piano which need work or tuning, and some of the [essays on music](#) may also be of interest.

First, as a matter of general caution:

If you have a mechanical sense of things, you have (or could) take apart and repair a lawnmower engine, a wind-up alarm clock, or you do home woodwork for fun, you should be able to face your piano's "action".

If you have no idea of what is inside the works of your car, if you scrap a lawnmower when it fails to start, if you think a plumbing job requires high knowledge and years of apprenticeship ----- perhaps read this essay for fun and information, but keep your hands off the piano. For you it may be enough to play your piano and drive your car, there are after all many ways to configure your time and lifestyle.

But even if you never plan to pull the action out of the piano and see what is in there, it will do you no harm to understand something about the operation of the works. And when you decide to have something in your piano repaired or replaced, you will be in a better position to find a technician capable of doing the job right. Just so with your car, knowing that replacing the oil filter is cheap but replacing the catalytic converter expensive, are things a car owner should be aware of. Technicians tend to respect owners who know something.

Now we can go ahead with this discussion, which I suggest reading through first for general background, before taking off the music stand and removing the Fall Board.. Only then, if you think you understand most of what I have said, you can proceed to open up the works, slide the action forward to take a look at it, and decide if you want to go further. If you are frightened looking at that array of keys, hammers and wippens in 88 fold display, push the action back and reassemble everything. You still learned a lot and all learning is always worth your time.

OPENING UP THE DESK

The first thing to remove is the music stand obviously, then take off the strip of wood which sits between you and the ends of the keys. This should lift up vertically, use a knife blade to slide it up if stiff. There are usually three slots in the board which engage with the heads of screws in the front of the desk, so this comes off in a jiffy.

Next remove the screws from the underside which go into the two end-blocks which you see at right and left ends of the keyboard. These have a pin on which the fall-board pivots, lifting up the fall board, it and the two blocks will come out separately, so lay these aside carefully.

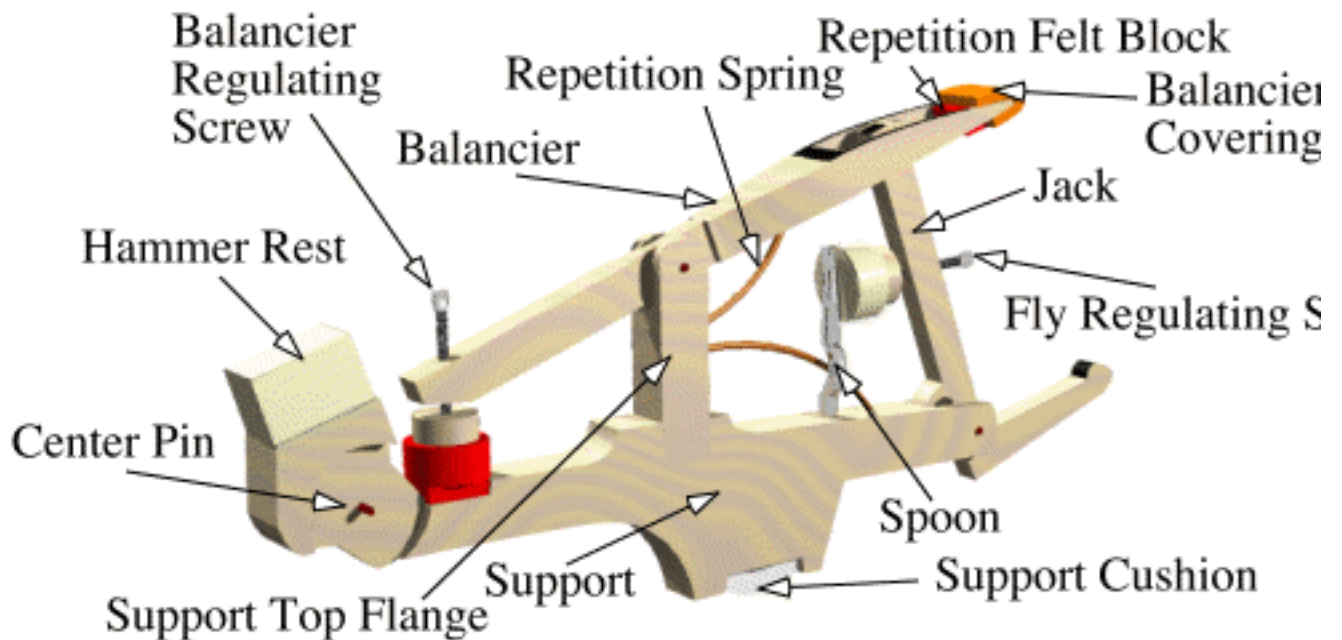
Putting these back can be annoying, but if you do any home carpentry, you might want to countersink the metal parts on the end blocks and put a flat head screw in the fallboard to replace the pin pivot. Then that whole assembly can go in or out together, this makes a nice improvement and you don't have to juggle three pieces of wood into place together. But this is for later.....

Now you are ready to slide the action out toward you, but one Caution is needed. Be careful not to depress any key, which will raise the hammer, so if you pull the action out quickly, it will break the hammer off. You are not likely to do this, just a caution to keep hands off the keys and pull out slowly watching what you are doing.

Before pulling the action forward, take a flat blade screwdriver or knife and make a clear scratch in the desk right up against the front of the action, at right and left end. This will be useful to put the action back in approximately correct position when working on it. The end blocks have a slot to locate the action, but this is quicker to use with these marks when you're putting it in and out when doing the adjustments. .

First time it is always surprising to see the action slide out so easily. But now push it back in to the marks, and let's look at a picture of the action, which will be a lot easier to comprehend than the actual parts coming out of the desk.

Wippen Assembly



Take some time and trace out in your mind the route of motion from an uplift of the back end of the key at the Support Cushion, up through the top tip of the jack. That is the essential power train route.

And look at the next page for a picture of the wippen in relation to the key which you press when playing the piano:

Next thing is to pull the action out completely, getting a hand on each end at the middle for balance, lift it out and away (not up) and carry it to a large table. If unsure have someone take each end, but I find I can lift it myself fairly well. Once the action is on the table you are ready to inspect and start thinking about some adjustment.

Now look at the first diagram more carefully.

The Wippen contains in those few insignificant looking little parts of wood, the brains of the Erard action. What we are concerned initially with will be the Jack, with its projecting arm at the lower right. The Jack impart motion to the Hammer via its Knuckle, and that driving the hammer up to the strings makes the sound.

There is a screw with a padded button which goes down right above the little jack arm projecting to the right on this picture, which kicks the jack tip out from under the knuckle right after it has thrown the hammer arm up to strike the string. This screw and pad are not shown on the diagram, but you will find it on the action when you pull it out, with a loop ended screw or a screwdriver screw on some pianos. Adjusting this to kick the jack out at the right point is called Regulation of the "Let Off", which disengages the hammer from the jack just under the contact moment when hammer strikes string. This is the most critical function of any piano action, since it lets the hammer strike the string and immediately fall back to be ready for another blow. Early pianofortes of the 18 th c. without this "clever escapement" could not do a fast repeat or a decent trill.

Regulation of the Let Off proceeds as follows. With the action in place in the piano desk, reach in with a piece of coat hanger wire or a long nosed pliers to operate the let-off screw I just mentioned. Take a key at the top range of the center section of the action, that is the range between the castings, and slowly press down that upper key watching with a flashlight to see at what point the hammer comes free under the string. The ideal point will be 1/16 inch or a little more below the string, and you will adjust the aforementioned let-off screw up or down to get that dimension. Go slowly, watch carefully, when you have that one just right, do the lower key in that section. These two hammers will be used to set the others in-between on the bench when you have the action out later.

One section done, proceed to an upper and a lower key on each of the four "ranges", always aiming for the same dimension or distance of let off. The lower hammers are harder to see under the overstrung strings, but they will be less important since repeats and trills in the bass are less often played.

Now is the time to take the action out (watching that rising odd hammer which can catch on the piano frame), and you can set it down on a large table and take a careful look of what you have there. Try to mentally connect the parts of the action with the diagram, look carefully and take your time.

Setting the level of the "Let Off" can be done on the bench with a light strip of wood or a 1/4 inch straight dowel used as a gage to touch right and left adjusted hammers for height, so you can bring the other hammers up to a matching level. This is the basic process of regulating the Let Off, and one which will make a clear difference in both the sound of the piano both for brilliance and also the feel of the keys as you play.

If you do no more, and put the action back to the marks you made before, reinstall the end blocks and close it all up, you have done a nice job of basic Regulation. This should be done every two years or so since the felt parts of the action compress and the dimensions change with much use. But this is just a light afternoon's work, and if you do it once, you may find you want to check it more often.

That said, I must mention other adjustments, which should be checked even if you don't plan to do any of the adjusting yourself. If the piano is fairly new or has been worked over in the last half dozen years, these things should still be in order, but why not check it while you have the action out and in view?

The Jack can be observed in its contact with the Knuckle under the swinging hammer arm at one end of the action where everything is visible. The front edge of the Jack tip, which is the edge toward the let-off screws, should come up right at the center of the rounded knuckle leather, so to give a the Knuckle and hammer a strong kick but can get out of the way adroitly.

The "Fly Regulation Screw" which adjusts this with a special screwdriver, will probably be OK, but if far out and the action is not crisp, this can be adjusted by the technician. Or you can do it yourself, but only if sure of what you are trying to do and have a lot of time. The screw is hard to reach, the operation requires 88 adjustments, so for the moment just observe how it rests and leave it alone.

You notice how the Balancer arm is cut away so the Jack can go between its two sides. It is important that the Jack be a few thousandths below the level of the Balancer sides, just enough to feel with a sensitive finger. A strip of manila folder thickness is probably too much for this adjustment, which permits the Knuckle to come down and stand ready above the returned Jack for another blow. This screw is not hard to reach at the other end of the Balancer arm. Pull the hammers back to view these jack ends all in a row, if the Balancer edges seem a cat's whisker above the jack, you can leave them alone. Again, adjusting this wrong does no harm, and if you can't get a nice trill, the Jack is probably up a bit too high and won't snap back under the returning Knuckle.

The spring which actuates the Balancer arm has a double function. The lower arm of this spring actuates the Jack to return, while the upper part brings the end of the Balancer up around the Jack with a little lift. Incidentally there is another screw involved, the one on the swinging hammer arm, which you find right near the pivot.

This is adjusted to touch the end of the balancer arm, both permitting a 1/8 inch drop back of the hammer after a blow, and also lifting the Balancer arm up when the hammer returns, thus clearing it out of the way for the return Jack to come in unimpeded. This complex relationship of different things going on with the same parts at the same time is hard to visualize, indeed.

This "Fall Back" screw I just mentioned is adjusted right after the Let Off is done, it is set so the hammer falls back about 1/8 inch. You see this when slowly pressing a key down and watching the hammer as it rises, then lets go and "falls back" a fraction of an inch. This is a sensitive adjustment, which helps make the action quick and clear. If the fall back is not more than 1/8 inch leave it alone or defer until you are more familiar with the action and its many requirements.

On the back side of the action as you face it on the bench you will see leather faced wood parts, each on a bendable wire, which are called the Back Catches. When you strike a key hard on the bench you will see it falls back and catches on this part, held ready for a repeat. The back catch adjustments not critically important but should catch the falling hammer about half an inch from the release let-off you have just established. Bend the wire carefully if you do this adjustment, just a gentle nudge of one finger with the hammer raised out of the way. A low Catch point means a less quick action, but unless you are a fast pianist doing quick repeats, you might well leave this alone, since the only mis-adjustment for the last setting will be from actual wear on the leather faces over a long period of time.

But here is one more thing to check. With action on bench, strike a key firmly, hold the key down while the hammer catches on the Back Catch, and then release the key VERY slowly while watching the hammer. The hammer should spring up slightly, showing that the balancer spring is operating to clear the jack for another blow. This is NOT a job for you to adjust, since it requires skillful bending of the balancer spring with a tool which only a technician can wield.

On my Steinway the action was replaced with a new Renner German action, which has a screw atop that spring, and I did adjust that myself for the relative weights of the heavy bass as against light treble hammers. This is the trickiest part of the whole action adjustment, since it involves the balancer action, its spring, the clearance at the jack, and also the fall back adjustment on the hammer arm. It took me much time and several visits to Ole Hansen for advice before I got this one in my mind. I did get it done but suggest passing this one by.

Yes, there is one more adjustment, one which can be done easily, and which probably gives a more dramatic effect than all of the above others. That is the actual Let Off.

Look at the hammer arm and the way it hangs down over the Hammer Rest. As pianos are used over time the hammer arm will compress inner felt parts and move down until it finally rests on this Rest. But the action of a grand piano requires the hammer to be suspended in the air when at rest, and that felt is only there to avoid a clunk when the adjustment is totally out.

I repeat: The hammer is poised in the air ready to strike as its normal position, if it touches the felt this allows a slop in the motion. This is like a "zero clearance" in a hydraulic automotive engine valve. There is no room for an open space in here. The elegance of the action depends on this.

Another adjustment, which does not affect the other adjustments to the wippen since it moves the whole wippen on its single pivot, is made with the Capstan, which is a round bodied screw with drilled cross holes for adjustment, found on the far end of each key. Adjust is made with an eighth inch length of stiff wire, a section of old coat hanger does fine, and if one end is bent to about 15 degrees, it can be flopped over to work the screw further when the tool runs out of range. As a basic adjustment, the hammer arm should when adjusted to be at least a quarter inch above the felt rest. That will change the tone accelerate the response of the action quite noticeably.

But if you want to do it better, you can check with a scale (= "ruler") to see that the rise of the hammer from rest position to its adjusted let-off (on bench again) is about 1 3/4 inches, which is the Steinway recommended figure. That will give a nice firm strike to each hammer stroke, and with the let off set close to the strike, the sound of the piano will be fine while the action is less heavy than with the two inch stroke which my piano had at one point .

Recently I went one stage further and screwed the capstans up a quarter turn further to get a 1 1/2 + inch stroke, with which I am well pleased since I play a lot of baroque style music and this offered a quieter and "tougher" sound with some slight lightening of the action at the keys. A piano which is too loud can be quieted easily by adjusting this way, and once the capstans are set right so the hammers are even at rest on the bench, you can adjust later them with the action in place.

A flashlight, the wire and some contortions of the neck joint are all that are required, and it is quite feasible to adjust different ranges of the piano with different strokes to compensate for any inequalities of sound which you feel need correction. If the bass notes tend to boom, and you find playing them lightly is difficult, a shorter stroke on those heavy hammers will do the job nicely. I especially like this Capstan adjustment since it can be done whenever you want without going through other adjustments in order.

One more observation before I close this rudimentary paper on the piano and its Action. I found some very annoying ringing on the middle range of my piano, which was not due to miss-tuning or even to an overly long hammer stroke (although reducing that helped). I finally determined that overtones were being produced on the length of the struck string which stood between the striking point and the hole of the agraffe where the string went on toward the tuning pin. Tuners know about this and you may seem them touching a finger to the string hear the agraffe to damp those harmonics which interfere with their tuning ear.

I found a few layers of dense 1/8 inch felt laid over the whole area covering the tuning pins and on to the dampers, cured the ringing. You can try it first with a couple of thick bathroom towels and see if that helps, if so you have put your finger on the problem and can use any cloth which does the job and looks acceptable on the insides of a Grand Piano. Especially in recording from microphones inside the lid, this damping is essential since it not only removes harmonics but tends to de-emphasize hammer and damper noise. A piano action after all is a noisy business, something we ignore until we record a piece and then wonder where all; that sound came from.

SUGGESTED ORDER OF OPERATIONS

- 1) Open the front of the piano so you can see the action and slide it in and out a few time (careful with those hammers) to get the feel of its size and weight.
- 2) Pull it out and see if the hammers fallback and are touching the felt block, in which case they are to be raised up with a Capstan adjustment. Might as well do this first since it is a basic adjustment to the wippen.
- 3) Fold the hammers back with action on the bench, and check that the Jack tips are just a hair below the two side of the balancer beam, if OK leave it alone, if not adjust with screw on other end of Balancer. While in this area check the jacks to see they match the knuckle, as pointed out above.
- 4) Might as well check and adjust the Back Checks if needed. If they drop half inch or a little more on fall back after a strong stroke on bench, leave.
- 5) Set the "Let Off". Put action back and set a right and left hammer in each of the several sections between the cast arms, to about 1/16 to 1/8 inch clearance below the hammer touching the string. This adjustment is done with a wire/tool or screwdriver on the vertical screw which contacts above the lower jack outboard tip. Then pull action out and adjust hammers between these two for the same level. A straight edge is enough if lightly held, or you can make up a stand to go on the table behind action and lean over with an adjustable straight bar (only if you really like to make jigs, and will be doing this again...)
- 6) After setting the let off, press each key down with a slow key motion to raise the hammer, watch for the let off, and set the Hammer Drop for 1/8 + inch with the screw near the hammer arm pivot.

7) Now check for the "spring up", by giving each key a stroke so the hammer falls back onto the Back Check. Release key slowly and if this moves the hammer up even slightly, this shows that the let-off and drop are correct AND that the spring does not need bending or adjustment.

8) Putting the action back, you set the end blocks in place to hold the fall board between them (or do the screw as I said before) and the blocks will set the action to the right in-out depth. An adjustment in the right hand block can be tried to move the right side of the action for the best sound of the upper keys, by finding the accurate striking point of the hammers on the upper short strings.

9) The left "soft" pedal should move the action so that the hammers hit on the two right-most strings of each three string unison, leaving the left string unsounded. This can be attended to by carefully adjusting a stop screw on the right side of the action which you can see when it is out, then trial and error to get the right motion.

That left string resounds sympathetically with the struck strings, giving a gentle sympathetic lute-like resonance which many pianists prize. If some of the hammers do not match this string pattern, you can slide the action out and releasing the hammer attachment screw you can move a hammer slightly right or left. This takes time but once it is done it will stand that way forever.

THE HAMMERS

Hammers get grooves after time, when these are filed off the hammer loses both size, weight and contour (which should follow the original curve of the hammer's head). Irresponsible filing can cause much harm, but light touch up with a 50 grit open coat 5/8 wide strip glued to a strip of wood makes a nice tool for mere touchup. This is done with a light stroke to hammers when action is on the bench, hold each hammer lightly in one hand and with the file bring a mere tuft of fuzz from before and aft the string marks, so the fuzz stays on but is rearranged over the impact area.

If further filing is done, have an expert do it, since filing and subsequent voicing are work for a hand which is not only skilled but also experienced.

At a certain point one may consider replacing the hammers, if the rest of the action is good enough to warrant the expense. A good suggestion is to get the rest of the action brought up to the best standard, and then consider replacing the hammers if the instrument and your use are worth it. A hammer job is work for a real technician, since hammers come undrilled and must be drilled on jigs with special angles for each hammer in each series on the instrument.

I did this once under supervision, and can aver that it is doable, but with much labor and ingenuity, and must admit perhaps that I would not do again. On the other hand a \$200 at cost set of hammers can run to a installed cost of a few thousand dollars. Before considering a hammer job, be sure the technician knows which hammers are best for which piano, and if possible play on a job which he did for a customer. Again check costs with

various shops, some can call a hammer job a "rebuild" without replacing any action parts, and if you are not aware he can charge inordinately.

A good hammer job might cost \$2000 depending on shop, market and conditions, while a total rebuilt from the bottom up, meaning pin block, strings, hammers, sound board repaired and refinished, all new action parts above the original keys, could run for or five times that sum and still be a fair price. Case refinishing is a separate item and can be done separately by a furniture shop at any later date. After all a piano is a musical instrument, not as some would believe, a piece of household furniture.
