BALDWIN ELECTRONIC HARPSICHORD

HENDRIK BROEKMAN

The design for the Baldwin Electronic Harpsichord originated in the early 1960's under the umbrella of a short-lived harpsichord manufacturing start-up called The Cannon Guild. Based in Cambridge, Massachusetts, on Howard Street, The Cannon Guild put effort into three main avenues: it became the corporate home for Eric Herz (who continued to issue finished instruments under his own name), it attempted to design an inexpensive acoustic harpsichord on classic lines (the Cannon Guild harpsichord, based largely on Eric Herz's input) capable of being manufactured from modern materials on a rational basis and, third, it gave support to an inventor named Caleb Warner, whose developing brain child eventually became the Baldwin Electronic. The extreme similarity of the Cannon Guild and Baldwin versions of the Electronic Harpsichord makes it clear that the design, tooling and process notes were sold in a package to Baldwin. This is stated explicitly enough in the Baldwin Owner's Manual. Although much about the Warner design was innovative and deserves admiration and consideration, the single aspect of the Warner/Baldwin implementation that concerns these pages is the jack.

Harpsichord jacks for novices

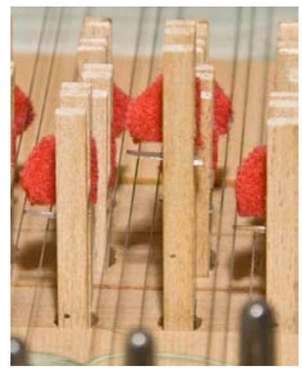
Jacks at rest. The projection of the plectrum past the string can be clearly seen despite the perspective.

The plectrum of the middle jack has encountered the string. The projection can be clearly seen.

The jack (Fr. sautereau, Ger. Springer) is the mechanism by means of which the energy imparted by the finger to the key is used to move a plectrum past a string (i.e., pluck a string). In most instances the jack is installed in a vertical orientation so that it will return to rest through gravity (photos this page & next). Due to the activity of the sounding string, in many instances in quick playing the plectrum will manage to descend past the string and be able to pluck again with little problem. However in the instance of a slow key release after the string has lost a substantial portion of its energy the plectrum would not be able to pass the string and reset itself. Thus every jack includes an escapement whereby the plectrum is mounted in a hinged part (called the tongue) that is normally held forward against a stop (i.e., in playing position) by a gentle spring. By this mechanism the plectrum, on its rise, will be pulled by the STRING and the tongue held against its forward stop during the pluck (right photo, previous page) but will, independent of the energy level of the string, escape backwards as it descends (below) and, once it has cleared the string, be reset in its playing position by the SPRING, ready to be recaptured by the string and pluck again, etc. It seems clear that this scheme was devised in the late middle ages. It has been the core of the harpsichord action ever since and, while optimum proportions have been found and various materials utilized, the conceptual basis (jack, plectrum, tongue escapement) has never changed. But the jack can't be properly considered without its partner, the string.

The String

Harpsichords, by definition, are wire-strung. The two classically most-used materials, iron and brass, each possess the capability to be drawn to the small diameters and appropriate tensile strengths demanded for good sound, reasonable touch and, when stressed to their optimum (approximately 80-85% of breaking), the relatively low values of stress necessary to accommodate a more or less flimsy wooden structure in the interest of its structural longevity. Each string and plectrum pair presents a unique two-spring problem, every one of which must independently solved in order to successfully arrive at a solution to the general task of making the action feel consistent, comfortable and reliable. (This is not to suggest that the jack/string relationship is the only parameter governing playability; in this regard the designer has had a hand in the instrument's competence from before the first pencil touched paper. But, confronted with a once-functioning instrument, it is the major variable left.)



The jack is fully lifted and the string free of damper interference.

You may have noticed the notion of a still string introduced in the description of the harpsichord pluck, above. It is this stillness, which is the duty of the damper to induce, that guarantees that each subsequent pluck will be consistent with its preceding and succeeding neighbors. One is unlikely to encounter plucking problems from poor damping when playing a simple, linear melody. Quick repeated notes, however, tax the instrument's inherent weakness in this regard: the string's excursions away from the straight line it describes in its still, resting state. The still string is the state that the pluck is judged for. There are no smart jacks that can accommodate different lateral string positions. If the rising plectrum encounters the string at some other, unpredictable position, it will be just this initial state that will govern the feel and sound of that particular pluck. Small variations may very well go unnoticed but larger ones can manifest themselves as particularly light or heavy plucks or no pluck at

The jack is being let down. On the plectrum's encounter of the string, the tongue escapes backward to allow the plectrum to pass the string.

all. Suffice it to say that in the case of strings whose length is shorter than ideal (of which the Baldwin has no short supply) the excursion is greater (photo, page 11), the problem is amplified and the efficiency of the damping function becomes critical. (The relatively slow decay displayed by the Warner design only compounds the problem - the structure can't be counted on to be excited by the string and thus absorb its energy in a pattern similar to that typical of wooden harpsichords. And then, of course, there is the electronic amplification to compound matters.)

The Plectrum

The general size of the plectrum is dictated by two things: the necessity to provide at least one for every string associated with every key (this can produce considerable crowding both across and along the strings and demands economy of use of space) and the envelope of force and travel within which the fingers find it comfortable to play on a keyboard driving such an action for extended periods. Due to these various constraints, the upper limit of length of exposed plectrum should be about 0.25" (~6mm); in fact, plectra this long are seldom encountered.

Several characteristics are required to qualify a material as a good candidate for use as a harpsichord plectrum. In the most likely sizes, the material has to be flexible yet sufficiently strong to pluck a string (the flexibility is critical - a plectrum that didn't bend would pull the string out of position but never allow the string to slip off and sound, i.e., pluck); it must display reasonable longevity in service; it should be easily acquired when replacement becomes necessary; and, finally, it would be ideal if its manipulation should be simple enough to allow successful replacement by other than professional technicians. The classical material for the plectrum seems to have been bird feather, which fulfills the preceding criteria quite admirably. The ability to manipulate feather to fine tolerances would have been cultivated by any literate person who had recourse to feather pens. Sheet spring brass and leather were also occasionally used. Plectra were always replaceable for reasons that by now should be intuitively apparent.

The Damper

In most installations the jack not only carries the plectrum past the string but holds a piece (or pieces) of material (usually cloth) that, when lowered onto the string, will interfere with the free vibration of the string, quickly dissipate the string's energy and return it to its still state. Upon the release of the key by the finger, a competent damper will accomplish this nearly instantly although some damper designs can display patterns of after-ringing, which in most circumstances in acoustic instruments would be relatively innocuous. Different after-rings can occur in cases where the damper either does not make satisfactory contact with the string, contacts the string precisely at a node or when, rather than entirely sapping the energy of the strings, serves as an end point, thus allowing the string to continue ringing at a higher pitch. Again, strings shorter than their pitch would suggest will stand at lower stress, will vibrate with greater amplitude and, in consequence, be less willing to be stilled by the damper.

The classical damper mount involves the preparation, at and just above the level of, and flanking, the plectrum, of a rough-faced cavity in one or both sides of the wooden jack body. These cavities were formed either by the cut of a fine saw or a few deft strokes of a very narrow chisel. The roughness is critical to providing sufficient friction to retain the cloth in positions where it will continually be available to lightly hang on the string whose energy it is meant to dissipate and not simply deflect. There are many different schemes that have been used to hold dampers to the jack since the instrument's revival - the most successful are designed to maintain the suppleness of the damping material, be adjustable and, when necessary, be easily replaceable. It is the odd installation in which dampers are arranged off the plucking jacks but such do exist.

Modern Extensions to the Jack

The most common modern extension is some sort of screw regulation of the tongue's forward stop. In earlier schemes the screw was placed against the tongue's bottom, the traditional site of the stop. The inability to manipulate the regulation with the jack in place was a great inconvenience (it made judging the results of a small screw movement and achieving success tedious, at best) and led designers to place the regulation at the top. The consensus solution has become a vertical screw arranged against an inclined plane formed in the top of the tongue.

Another somewhat less common extension is the addition of a provision to change the length of the jack by some means other than cutting the jack shorter or adding material to its bottom. In most instances this is accomplished with fine screws set into the jack bottoms.

Jacks used in the Baldwin Electronic Harpsichord

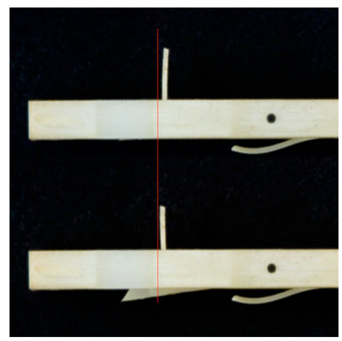
Two very different jack designs are associated with the Baldwin Electronic Harpsichord. The first dates from the instrument's Cannon Guild origins and was held over by Baldwin for a time. The second may have been a later, original design by Baldwin - but it is also possible that it was an unimplemented design that was part of the original package sold to Baldwin. Both designs are flawed, each for its particular reason. Both are currently unobtainable, as well. Most examples of either design are also at or nearing the end of their respective service cycles and, as the jacks fail, most owners of Baldwin Electronic Harpsichords may find themselves at a loss to keep the instruments functioning.

First, a little history. The current jack problem was occasioned by the otherwise happy, mid-20th-century intersection of high-quality acetal resin (Delrin), high-accuracy injection moulding capabilities and the belief that it would be possible to design a jack that would, despite high tooling costs, pay for itself easily by removing most of the handwork necessary for manufacturing and assembly. By and large most plastic jack designs, regardless of functional competence, fulfilled these expectations with ease. Whereas a wooden jack may represent as much as 10-15 minutes of labor by the time it comes to voicing, a plastic jack of a well-evolved design should have no more than 2-3 minutes invested in handling and assembly. But such a design must play tricks with the chosen material to persuade it to fulfill the widely divergent functions the scheme demands, which were classically met by discrete components made from optimally chosen materials. And, if the molding feedstock has been chosen for properties that turn out to be ephemeral rather than eternal, what then? And if the initial tooling costs were also sufficiently high to make subsequent incremental improvements or, more importantly, drastic revisions difficult to afford, again, what then?

The Herz Jack in Baldwin Harpsichords

The three ages of Herz/Lee jacks, newest uppermost. Jacks of the middle variety appear in Baldwin harpsichords.

It is certain that for a substantial time Eric Herz continued as the source of jacks for the Baldwin, ex-Cannon Guild, Electronic Harpsichord. At some point, on the basis of accumulated experience and for his own purposes, Eric decided that his jack was in need of updating. This update introduced characteristics any of which would have left Baldwin somewhat in the lurch. (For details, please see Appendix 1, The Herz Jack, below.) This took place in the early 1970's. This gives an approximate age for any Baldwin that has Herz jacks.



Composite view of one jack. Note the return spring, R., that no longer bears against the tongue. With the tongue forward (upper image) the plectrum droops away from ideal (red line).

What is important for a current owner to understand is that, by now, any Baldwin with Herz jacks is likely to have passed the half-life of those jacks by a substantial margin. As this is written we have in the shop an early Baldwin all of whose Herz jacks have dead return springs (right). The relatively fresh stock of the Herz jack that currently exists is the updated variety - essentially incompatible with the Baldwin design. Any Herz jack that is compatible is going to be an older take-out and likely to be just as old and potentially nearly as decrepit as any found in a Baldwin.

It seems clear that, for the first generations of the Baldwin (those originally supplied with Herz jacks) the voicing scheme was essentially that encountered in any classically derived harpsichord. That is to say, the plectrum was arranged to be longer than the distance to the string (with a projection of from 1/2 to 1 string diameter beyond) and, if necessary, perhaps weakened individually to achieve a consistent touch across the gamut (although the Owner's Manual advocates only screw adjustment - N.B. much of the discussion clearly relates to the Herz jack and not to the later Baldwin mouseketeer jack - an overly cautious re-write). It is true enough that the original Warner design allows the extreme length of the plectra to eliminate most of the typically necessary discretionary weakening (usually accomplished by shaving small amounts from the underside of the plectrum). This would have come close to the 'drop in and forget' solution that the later Baldwin manual seeks to espouse.

The Baldwin Jack

It is speculation on my part but I suspect that the mouseketeer jack is a Baldwin product (the mold carried no manufacturer's mark) whose design and introduction was occasioned by whichever change (ca. 1975) in the Herz offerings led Baldwin to conclude that the Herz jack was inappropriate for further use in the Warner/Baldwin register. Note well that each of the changes to the Herz jack could have been by itself sufficiently threatening to the setup transmitted from Cannon Guild to provoke Baldwin to devise a replacement that would help maintain manufacturing and service continuity. There may also have been a parallel feeling that the Herz jack was already too light and the damping not authoritative enough for either the electronic amplification or for satisfactory repetition. Both concerns could be addressed by a move to a heavier design.

Two Baldwin jacks, dampers removed. Each has lost its integrally molded plectrum. Note the difference in the damper mountings. The jack on the left shows a diagonal orientation (about 30 deg. from horizontal - perhaps derived from the Warner scheme) and that on right, vertical.

The set of design characteristics displayed by the mouseketeer jack that make this scenario likely, are:

1. The design fits the punched register with even clearance and very close tolerance on all sides. While the Herz jack thickness was perfect, it was substantially narrower than the punched slot (it displays a good deal of yaw when lifted by the key). The new jack (measured with a micrometer it clearly violates the Boston default section - 5/32" x 3/8" nominal - by substantial amounts but fits the openings perfectly) is clearly purpose-made to the punch that produced the Baldwin and Cannon Guild registers.

To a certain extent, this could constitute meaningless, unthinking precision in an instrument which, fitted with magnetic pickups, will never communicate how much the jacks may rattle (not much). In all fairness, though, the decision to retain the register but engineer a new jack to fit would have allowed Baldwin (had the company survived) to offer backward compatibility to its (and Cannon Guild's) owner base. But another feature, the plectrum, makes this precision potentially useful - perhaps critical (more about this elsewhere).

2. The jack appears to be the product of an organization with pockets deep enough and a tooling base broad enough that not only did it NOT have to shy away from manufacturing complexity but was willing to embrace it in an obvious effort to reduce manufacturing handwork to a minimum. After the proper sizing and forming of the jack bodies, tongues and plectra of conventional design, the remaining work of assembling them all into functional entities still consumes substantial amounts of time. The designers of the mouseketeer jack circumvented most of this assembly by devising a jack with an integrally molded tongue and plectrum.

3. The sheer mass of the jack - it's quite heavy with all that plastic devoted to damper holding - would seem to be gauged for damping efficiency. I would suspect that, as an amplified instrument with inefficiently short strings, reliable damping would indeed be critical to the Baldwin's potential for success as a vehicle of musical expression. I also suspect they never exactly got this particular jack design to damp satisfactorily. While the manual shows felt mounted through the damper holes (probably too leaky given the distance to the string inherent to the design), the subsequent introduction of the split grommet (found in at least two orientations) suggests that, as far as damping went, the Baldwin designers may very well have been engaged in damage control from day one on.

Baldwin Jack

Note stump of broken plectrum. Damper removed from far mount for clarity.

While the Baldwin jack displays some other quirks, experience has shown that this design has a particular difficulty with the integral plectrum - it breaks. Even though the jack was designed as a throwaway with easy replacement in mind, a minor inconvenience became an outright problem once the mold and back-stocks disappeared after Baldwin's demise. For the truly dedicated it would of course be possible to remanufacture these jacks to accept replacement plectra. This would only be putting off the inevitable, though. The second wave of calamity would be even worse: failure of the tongue mounting spring.

Over time the tongue mounting spring will also present aging problems. Admittedly, these are problems that one might never encounter since it is likely that the integral plectra will fail comfortably before the tongue mounting - but failure can manifest itself in various guises and degrees. As the Delrin ages and work hardens the spring/mounting will lose its suppleness until it becomes too inflexible and strong to function in any reliable way (see Jacks for Novices). It is possible to weaken the spring by enlarging the hole but, while this should work, it will also concentrate the working of the aged plastic in what's left of the hinge and accelerate its failure. As the spring loses the ability to allow the plectrum to escape, the plectrum will need to be shortened to make it reliably descend to playing position. As the plectrum is shortened its reliability in repeated notes will decline proportionally. This is an unavoidable catch-22.

It would also be possible to adapt these jacks to accept non-OEM tongues with a new return spring. This would likely be expensive (it's the sort of thing that makes no sense to consider doing for less than the full complement and even then it's unlikely the cost could be kept under $10/jack).

It's not clear how the Baldwin Harpsichord fancy may progress. But one direction it can't comfortably go is towards 'authenticity' - there is no fresh back-stock of either jack design to be had. As with any other industrial design, the product (both the instrument as a whole as well as the jacks in particular) is a snapshot of the manufacturing processes available at the time it was produced, processes that inevitably become outmoded and bypassed, involving machines that get declared obsolete and sold for scrap and materials that pass out of common commerce. For example, the mold for the updated Herz jack has been out of service for over 10 years (it currently serves as an overqualified doorstop and killer toe-stubber at our shop) and, while it's likely, it's not certain that it could be easily plugged into a currently operating injection molding setup even if it seemed like a good idea. Within the lifetime of most who might read this the Herz jacks to be found in Baldwin harpsichords will become unusable without the expenditure of a great deal of effort and then they won't be 'original', anyway. The same is almost certainly true of the mouseketeer jacks, as well. So, lacking a really developed market for Baldwin Electronic Harpsichords, 'authenticity' is not where the smart money should go.

These objects were intended as musical instruments and musical instruments must be able to play. For the instruments to continue to work and work well the simplest solution is now and will continue to be to replace the jacks with other than OEM material. I will gladly let others fret about the electronics but, as far as the jacks go, our Hubbard jacks can be made to work. I have no doubt that some others could, as well.

The Hubbard Jack for Baldwins

Hubbard jack in center wearing reclaimed Herz damper (red).

To replace Herz jacks, we can supply our jacks ready for assembly and installation at a cost of $4.50/jack set (sized jack body, tongue, plectrum, top adjusting/retaining screw). It is expected that you will reuse the currently installed damper clips. This price includes controlled thinning of the jack body to fit the Warner/Baldwin punched register.

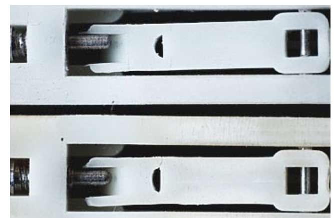
A different approach needs to taken in replacing the mouseketeer jack since the dampers are not compatible with the replacement jacks. With only very limited supplies of the early Herz tabbed damper clips currently available (no fresh stock - only takeouts) it becomes necessary to adopt a slightly different scheme. The Hubbard jack's native damping capabilities might work well enough in the high treble but would be increasingly likely to fail descending past middle c or so. Falling back on Eric Herz's revised damper clip with cloth fixed to either side is a real option but necessitates the removal of the Hubbard jack's outboard ear. The cost per damper clip with cloth attached on both sides is $1.50.

Appendices

1.
The Herz Jack

The Herz jack started life in the late '50s, before the formation of The Cannon Guild, as the Herz-Lee jack. Eric Herz and R. K. Lee collaborated on the design, one of the more elegant early plastic jacks. Its section (nominal 5/32" x 3/8") was inherited from Eric's time spent as cabinetmaker at the Hubbard & Dowd shop, which, in turn, probably retained the form factor from William Dowd's apprenticeship with John Challis. While the design exploits the inherent repeatability of the injection molding process to produce a consistently dimensioned product (thus circumventing perhaps 60% of the normal process involved in forming jacks from solid raw stock) it was still necessary to individually drill both body and tongue for further assembly. Typically the body needed three further holes (of at least two different sizes) and the tongue, one hole (of a third size). Each of these four holes had a discrete jig assigned to it. That said, three of the design's characteristics are worth noting.

First, the arrangement of very fine "ears" at the top of the tongue which engage stops at the rear of the tongue window provide a positive backward stop to control the tongue's motion (see photo, below). Sometimes, in handling, the ears break off. This is the point at which it becomes clear just how much a nuance this feature is. With sufficient age these ears become history at the slightest touch. Still, it's cool and in certain situations (but not Baldwins) can be quite helpful.

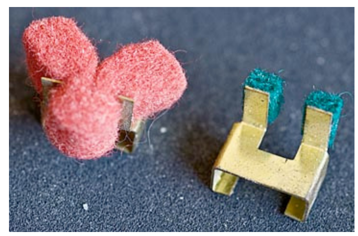


Herz Tongues, original form lowermost - note crack at bottom of plectrum mortise.

Second, the form of the tongue mortise for plastic plectra is, in my experience, unique in plastic jacks. The top of the mortise is, in effect, a modestly flattened barrel vault which widens and gains height from front to back, the bottom is flat and perpendicular to the face of the tongue - taken together the two shapes perfectly accommodate a properly tapered plectrum blank (lower tongue, right). Now, this is not unique in all tongues - it is a common feature of wooden tongues mortised for feather plectra. Be that as it may, the tongue mortise had two iterations. The first version of the mortise was large and wide, involving a relatively thin section of plastic to either side. Experience (in the form of tongues cracked at the bottom of the plectrum mortise - see lower tongue, photo above) proved these proportions to be too fragile, the result of which was the second version of tongue with a narrower plectrum mortise (I would rather have seen a widened tongue body but the less expensive fix was adopted). The ellipsoid barrel vault on top became a section of a circle (upper tongue, above). These changes strengthened the sections at the side and diminished the tendency for stress cracks to form at the outside corners of the mortise. This had the unfortunate effect of changing the taper and width of the plectra that the mortise would accommodate, thus changing the maximum strength of pluck. Although Eric, a ruthless self-editor, replaced tongues and jacks wholesale, it is not uncommon to find a mix of tongues on older Herz instruments that were maintained in the field and not sent back to Cambridge for action renovation. Eric regularly used sheet Delrin rolled to between .020" and .022" (the latter his preference).

Third, the tongue return spring is molded integrally with the jack body. Providing for and attaching the spring to the jack assembly is one of the more tedious and fiddly bits that confronts the jack-maker, so it made absolute sense to figure out a way to let the mold accomplish this onerous task. The design worked very well - at first. However, over the half-century life of this design, this detail has proven to be an unfortunate choice and the jack's Achilles Heel. With exposure to air, pollution and light, the Delrin stock degrades to the point where the springs lose their elasticity and finally end up brittle enough to break off with only minimal provocation (as in bending the spring back into its proper position). Although it is possible to remanufacture the jack with a replacement spring, this is inconvenient in the field, tedious as a one-off repair in the shop and consequently expensive. Jacks from different batches may react at different rates but the tendency is one-way, only. Especially salient to the Baldwin, with its plexiglass cover, is the opportunity for degradation caused by exposure to light and UV radiation. In addition, the design's atypical permeability to circulating air must also make a significant contribution. By this date, any Baldwin with Herz jacks is likely to have passed the half-life of those jacks by a substantial margin. As this is written we have in the shop an early Baldwin all of whose Herz jacks have substantially yellowed, dead or near-dead return springs. By the way, the next area to fail, typically, is the front of the jack at the top regulating screw.

At about the same time that the tongue mortise was changed, the section of the lower portion of the jack was substantially narrowed with the purpose of drastically lightening the jack (some of Eric's harpsichords could have five or six jacks being lifted by one finger). The tongue-mounting end was retained without change but the bottom section was lightened substantially by narrowing the bottom two-thirds to a square stem, sufficient to accept a regulating screw and little else.



Original Herz damper clips. Adaptation for Warner/Baldwin, left, original design intention, right.

And, as if that weren't enough, Herz also modified the design of his damper clip (the brass collar with two projecting tabs) to eliminate the tabs. Interestingly enough the dampers Baldwin owners find fitted to the Herz jacks are clever adaptations of a design meant for an entirely different mode of use. In the Warner/Baldwin scheme the clips are mounted upside-down and a large piece of butt felt (for use as a hyper-efficient damper) is captured by the projecting tabs. This seems to work very well and has the advantage of maximizing the footprint of the cloth in contact with the string. Scavenging and using these dampers allows the substantially lighter Hubbard jack to damp virtually as well.

2.
The Baldwin jack

The mouseketeer jack displays a curious mix of cleverness & stupidity (think Spinal Tap - there often IS a fine line between the two) that one associates with either a committee or lack of fluency with the design criteria that even moderate experience must make apparent. Or, in the current parlance, newbie mistakes.

Clever:

- The integrally molded plectrum
- The integrally molded tongue (the hinge design is really elegant)
- The metal damper mounts (clever as in, "I wouldn't have thought of THAT!" - it's just not a small-shop solution)
- The design that allowed the use of reasonably commonly available screws for tongue regulation - should you ever lose one of those screws - actually probably selected to make sourcing easier & cheaper.

Stupid, in descending order:

- The integrally molded plectrum (not replaceable - throw the jack away)
- The integrally molded tongue (not replaceable - throw the jack away)

The damper mounts (not easily replaceable or repairable - throw the jack away: to be fair, the preceding possibilities are overwhelmingly likely to make the jack useless first)

The owner's manual shows the mouseketeer jack but the discussion of plucking intensity (5.2) is clearly based on the Herz jack.

To a certain extent, this could constitute meaningless, unthinking precision in an instrument which, fitted with magnetic pickups, will never communicate how much the jacks may rattle (not much). In all fairness, though, the decision to maintain the register but engineer a new jack to fit would have (had the company survived) allowed Baldwin to offer backward compatibility to its (and Cannon Guild's) owner base. But another feature, the plectrum, makes this precision potentially useful - perhaps critical - more about this elsewhere.

Integral plectrum - The section of the integrally molded plectrum seems to be based either on a longitudinal section of a cone or an oblique section of a cylinder. Whatever shorthand was used to produce the molding cavity, the top is flat & perpendicular to the tongue face, the bottom face, which describes an arc, meets the top face at the sides in sharp edges. (Interestingly, this is a mirror of the Herz-Lee tongue mortise turned upside down, inside out and lengthened. One wonders...). Even though the junction between the plectrum and tongue is appropriately filleted all around, still the plectra do break right at the end of the filleting.

One significant feature of the plectrum is its extraordinary thickness - .040" at its base. This has important ramifications for playability and reliability. If the plectrum is used in its as-molded state then the touch will be difficult to get even and keep in regulation. The Baldwin manual to which we have access suggests a plectrum length that allows the tip to catch the string at bottom dead center with little excess projection. For the upper part of the range this will work very well (and dovetails nicely with the close tolerances of the jack with the register on both axes - especially in view of the diagonal nature of the string leading). Increasingly toward the bass, though, the normal vibration of a sounding string involves a substantial excursion from the string's expected position (its at-rest position) and it becomes possible for quick repetition (as in trills or quickly repeated notes) to become unreliable or fail altogether if the string either doesn't occupy the expected portion of the path of the plectrum tip at the instant the plectrum is driven past or is too excited (i.e., the damping failed to sufficiently quiet the string) to allow its capture by the plectrum. It is common practice in classical harpsichord regulation to allow proportionally greater projection of the plectrum tip PAST the bass strings to ameliorate this effect. This is necessary despite the fact that the bass strings of a classically-designed harpsichord can be twice as long than those of a Baldwin and thus will display substantially less displacement from the line of rest when sounding.

Bass-most string of Baldwin.

Right string, still; Left, sounding - note wide excursion.

Damper removed for clarity

It is in this light that the precise fit between the jack and register makes the most sense. This feature would have constituted meaningless, unthinking precision in an instrument which, fitted with magnetic pickups, could never communicate how much the jacks may rattle (not much). In all fairness, though, the decision to maintain the register but engineer a new jack to fit would (had the company survived) have allowed Baldwin to offer backward compatibility to its (and Cannon Guild's) owner base. But another feature, the plectrum, makes this precision potentially useful - perhaps critical - more about this elsewhere.

The major problem here is that mouseketeer plectra of an appropriate length for good repetition will be, by virtue of their thickness, far too strong for good touch. If they are to be thinned then it is imperative that the work is done in a manner that introduces no discontinuities in the progression from thick to thin. Flexing will be concentrated at thin spots - inordinate flexing will lead to concentrations of work hardening with the consequent fatigue resulting in breakage. But factory-fresh Baldwins seem to display no such thinning and the Owner's Manual doesn't mention the practice, either. Injection molded Delrin displays qualities substantially (and unquantifiably) different from sheet Delrin. In a use such as harpsichord plectra experience has proven that sheet delrin is much the superior material for consistency, ease of maintenance and longevity.

Integral tongue - The hinge design seems quite rational - the tongue is mounted on a thin flat section of Delrin which, in turn, has been further weakened by the introduction of a small moulded-in hole. We must take it on faith that these features were arrived at by careful calculation or painstaking experimentation. The fact remains that the force necessary to provoke the tongue to escape backward when lowered onto a still string is greater than a normally articulated and independently sprung tongue (and will only increase with age- and work-related hardening), but the extra mass of the Baldwin jack undoubtedly helps here. The Baldwin tongue is not the only one to combine the hinge and spring but is, as far as I have been able to determine, the only one to be integrally moulded with the body.

In our library of odd jacks we have a Baldwin jack that seems to be fresh from the mould. It is fitted with a top screw but the metal damper clips are missing and were never mounted (this matches the illustration in the Baldwin owner's Manual which shows cloth run through the holes). The hole in the hinge attachment also varies among several examples of this design we have been able to examine. The size of the hole is a potential adjustment for the strength of the hinge. Whether the observed variation was originally introduced by Baldwin or has been applied by later hands is impossible to say.

The tongue is molded to stand with its face flush with and parallel to the front of the jack. The screw is biased to have its rear edge at the center of the diagonal top regulating face. Look at that long wedge! Lots and lots of regulation, right? Wrong. Remember, the tongue is molded to stand with its face flush and parallel with the front of the jack. The only way to make all that regulating surface to the rear meaningful is to permanently BEND the tongue forward on its hinge. What happens when you bend Delrin sufficiently to induce it to change shape? Just what happens when you bend just about anything else - it fatigues. Fatigue reduces both springiness and suppleness and, further, accelerates breakage - you'll be throwing the jack away sooner rather than later.

It is a pity that the design history of this jack is not better understood. It would be fascinating to know how much of the odd set-up strategy finally adopted by Baldwin was intentional, how much was mistakes born of innocence and how much was making the best of a bad situation.

3.

The Hubbard Jack

Frank Hubbard experimented continuously with different approaches to wooden jack making and came up with quite a few ways to shave perhaps a minute or two off the time invested in a finished jack. Among the most innovative was mounting the return spring in the tongue. Without more research it would be foolish to claim he was the first to have this idea since it is quite possible that the scheme may have been conceived in the Hubbard & Dowd shop. It should be enough to say that it was an inspired choice, contrary to both historic tradition and then-modern convention.

The first Hubbard attempt at a plastic jack was not much different from the Herz-Lee approach in terms of necessary subsequent handwork but it did have the tongue return spring molded to the tongue. The two spring designs differed in section; where the Herz-Lee spring was short and round, the Hubbard spring was nearly twice as long, and wider - essentially flat. This feature has proven itself to be far more resistant to breakage than the Herz-Lee. The stock of the first Hubbard design is nearly gone and is being reserved strictly for spares.

But Hubbard Harpsichords has been fortunate enough to be able to afford two tries at a plastic jack. Frank's second design (ca. 1974), still in production, is highly evolved and one of the most successful plastic jacks available. As the jack comes out of the box the manufacturer sends us, it only lacks one hole (for any installation that involves a bottom-mounted jack-length screw - in fact it's unnecessary for the Baldwin). There may be some sizing issues (not every manufacturer uses exactly the same slot dimensions) but once these have been dealt with, the jack may be cut to length, the plectrum popped into the tongue and the tongue assembled to the jack with one screw: hey presto, it's ready! The truly useful characteristic of this jack is the ease with which either plectra or tongues can be replaced.

Selected Physical Attributes

Dimensions of return springs (thickness x width x length)

First Hubbard Jack - White .022" x .042" x .72" - the curl is induced mechanically

First Hubbard Jack - Black .021" x .042" x .72" - the curl is induced mechanically

Current Hubbard Jack - .016" x .038" x .75" the curl is molded in

Herz/Lee Jack - .021" x .035" x .40" - the curl is induced mechanically

Relative weights

Current Hubbard jack with reclaimed Herz clip   4.7 g

The lightest of the bunch but it still seems to damp the lowest strings adequately.

Herz jack with Herz clip   5.7 g

Baldwin jack - cloth but no metal clips   6.3 g

Baldwin jack - cloth and metal clips   7 g

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