7.10.2 Bridges without Vibrato

7.10.2.1 Gibson's ABR-1-Bridge

Orville Gibson was a guitarist and a luthier – characteristics that were not originally natural to Leo Fender, who of course was a builder of guitars, too – but not in the traditional sense. As Tom Mulhern notes in his book on Gibson guitars [Rittor 1996], Orville's ideas often originated from violin making, and it is therefore not surprising that the famous Style O guitar features an arched top that carries merely the bridge but no tailpiece. The strings are anchored in a trapeze tailpiece that is mounted to the end-side of the guitar body. This separation of bridge and tailpiece resurfaces half a century later in the ES-335, although that guitar is based on a very different principle of construction. The top of Orville's acoustic guitars needed to be thin in order to radiate sound. While it was still possible to anchor gut strings in a combined bridge/tailpiece that was glued to the guitar top, this approach became a problem with the steel strings increasingly demanded by musicians: their higher pull (parallel to the top) could warp the top, or rip off the glued-on bridge and destroy the thin top. Conversely, with a tailpiece mounted to the side at the end of the guitar, the top was subjected merely to a perpendicular force it was able to withstand due to its curvature similar to the arch of a bridge.

The bridge of the Gibson Style O is of a single piece and not adjustable – again similar to that of a violin. However, 2-piece bridges soon found their way to the Gibson acoustics, presumably so that the action that increased with age could be compensated for. The 2-piece bridge includes a base and an upper part both made from wood; the 2 sections can be spread apart via screw and curled nut. Starting out from this construction, it is not all that far to Gibson's patented Tune-O-Matic bridge (US patent 2,740,313, filed in 1952), the top part of which carries six individually adjustable bridge saddles. 6 bridge saddles, 6 adjustment screws, one bridge base, 2 post screws, 2 curled nuts, and the fastening wire that arrived later: all in all that's 18 individual pieces. With this bulwark between the string and the guitar body, it is no wonder then that the latter has so little influence on the string vibration. Worse, though: the **joints** occurring between string and guitar body are undefined to a high degree! The T-shaped bridge saddles are positioned within a groove to which they have contact in some kind of way. The contact between bridge and the curled nuts is not defined, either, and consequently it is no surprise that the mechanical characteristics change as we lightly press against the bridge. Still, the contraption does work – in fact some masterful guitar playing happens using it. A word, however, to all you Gibsophiles ecstatically dancing around every golden calf-o'-1956: before pondering about the woods, you should target the bridge, beginning with the question which way round the bridge should be mounted. On most of the guitars shown in the Gibson book, the heads of the setscrews point to the pickups, but for quite a few, they point to the tailpiece. Indeed, the screwdriver access is easier in the latter case, but now the strings run across the screw heads! These are the residual strings between bridge and tailpiece; they may contribute to the vibration absorption, as shown in Chapter 7.7.4. Thus: it may not be the hairline cracks in the varnish that *"are of highest significance to the resulting sound [G&B 2/07]"* – rather, the bridge may contribute much more.

The strings excite the bridge saddles (T-shaped when seen from the tailpiece, and of monopitch-roof shape seen from the side) to vibrate – the saddles should resist this excitation so as to keep the vibration energy within the string as much as possible. The force fed from string to bridge saddle splits up into an inertia force (to accelerate the mass), and a remaining force that is conducted on to the bridge base. Between bridge base and bridge saddle there are several joints the mechanical impedance of which is of significance to the string vibration. Therefore, requirements regarding the manufacturing tolerances of these components would be very high. That formulation should be agreeable even to laywers, shouldn't it?

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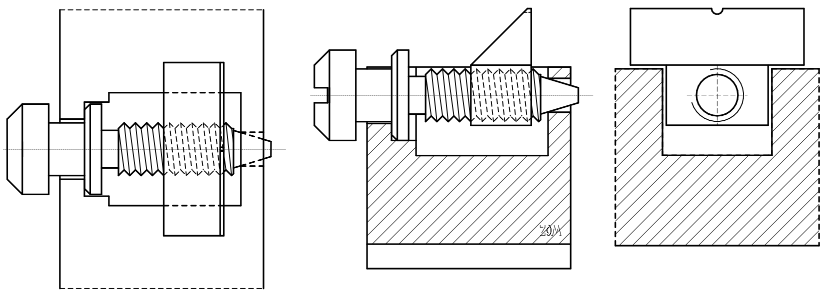
If there were any burrs on the Gibson bridge (with “were” expressing purely hypothetically a possibility), the setscrew in its end position would lever the bridge saddle halfway out of its embedment, and the bridge-base/bridge-piece impedance would drastically change. Where in fact does the line of force-flux between string and guitar body run for this bridge? **Fig. 7.104** shows several views of the Gibson ABR-1. A bridge saddle (T-shaped or of the shape of a monopitch roof depending on the view angle) is movable within a groove via a setscrew, with the string (secured in a small groove) resting on the saddle. On what does the latter rest?



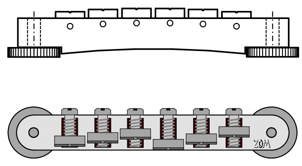


Fig. 7.104: String bearing in a Gibson ABR-1 bridge.

Since the middle section of the “T” does not reach to the bottom of the groove, we could surmise that the bridge saddle rests directly on the sidewalls of the bridge. That, however, is not the case – not for the Historic Les Paul under scrutiny, anyway, nor for the ES-335 from the 1960’s. Every introductory course for mechanical engineering includes the lesson that objects not supposed to move need to be fixated with regard to three translational and three rotational movements. **Translational movements** are longitudinal movements (in the direction of the string-axis z), lateral shifts (x) and changes in height (y). In the z-direction, only the setscrew can absorb any forces – but it does so with some slack. Pressing the bridge saddle to the right (in the figure), the conical screw-termination has contact, pressing it to the left, it is the chamfered collar that stops the movement. Possibly, the whole setup was at some point meant to remain under tension and therefore be without slack – the implementation ain’t, though. For the y-direction, it is immediately clear that either the screw, or the lower side of the T-piece can transfer any pressure force from the strings, but not both (dividing the force would be at random and fragile). If the bridge saddle rests on the bridge, the setscrew has slack, and if the setscrew absorbs the force, the bridge saddle has slack. Purely theoretically, we could consider of shift-fitting or pressure-fitting – but only those without any experience in production of mechanical elements will go there. No, that T-shaped saddle has slack, resting somewhere on something, depending on production tolerances (**Fig. 7.105**).

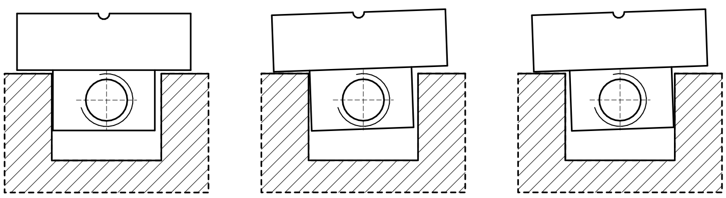


Fig. 7.105: Changes in position.

Trying to push a piece of paper in between the T-shaped bridge saddle and the bridge base is met with success, and proves that the two do not rest slack-free on each other. This test does not work everywhere, but at several places. In the worst case, this instability leads to torsion movements – then the string vibration is completely done for. Dear Mr. McCarty (rip), how was that supposed to work? String movements in parallel to the fretboard imply torsion excitation – anyone disagreeing? The sales speak for themselves? Ah – sorry, that explains everything. We can hope that the whole contraption somehow gets wedged or rusts shut (and for many guitars that will in fact happen) – a planned force-fit looks different, though.

For Fig. 7-100, the interface between bridge saddle and bridge base had been modeled with $\underline{Z}_2$, and Fig. 7.101 shows the effects of variations. That changes in stiffness and damping occur only in the high-frequency range might explain why this bridge in not entirely impractical. As long as the bridge-piece-T rests (or is in firm contact) somewhere, and as long as it is not subject to any torsion movement, any audible effects keep within reasonable limits. However, if any gaps resulting from manufacturing tolerances allow for a twisting motion, the bridge-T will wipe out string vibrations. This *"epoch-making bridge" "was not designed for solid body guitars like the Les Paul models [Berger / Perrius]"*, but for acoustic (!) arch-top guitars – which renders the whole thing even more problematic, because these guitars should be able to reproduce high-frequency partials as well, shouldn't they? Anyway, around 1954, this contraption-of-the-century found its way onto the Les Paul Custom, and from then on there was no holding back any more – in the true sense of the term.

The force introduced by the string to the bridge saddle (as far as it does not serve to move mass) is handed over via undefined paths to the bridge base that, true to its name, crosses the distance from one "shore" to the other. To the mechanical engineer, the arrangement is a **cantilever** supported on both ends. The lowest Eigen-frequency of this cantilever can be calculated using area moment of inertia, geometry of the cantilever, E-modulus and density; it turns out to be 1.6 kHz. Although the bridge has immobile support at both its ends (bearings), it can still vibrate in between; and if it receives excitation to do that, it will dampen the string vibration. Unfortunately, it does receive this excitation, and it is just that string delivering it that should be given an immobile bearing by the bridge. In order to not just theoretically calculate this friendliness towards vibration, measurements were taken with an ABR-1 bridge positioned on a stone table (**Fig. 7.106**). At 1.6 kHz, the conductance rises to almost 0.2 s/kg, reducing the degree of reflection for the E_2-string to below 60%. This means that more than 40% of the vibration energy is absorbed for each reflection! We should not universally condemn such a behavior because only the effect of absorption will enable the luthier to individually influence the string vibration; however, if this was supposed to emerge as McCarty-specific, then this absorption would have to be of a fixed value for all guitars of the same build. That, however, is not the case, since already a slight shift of the bridge (which on top of everything is adjustable in height, as well) changes its damping parameters.

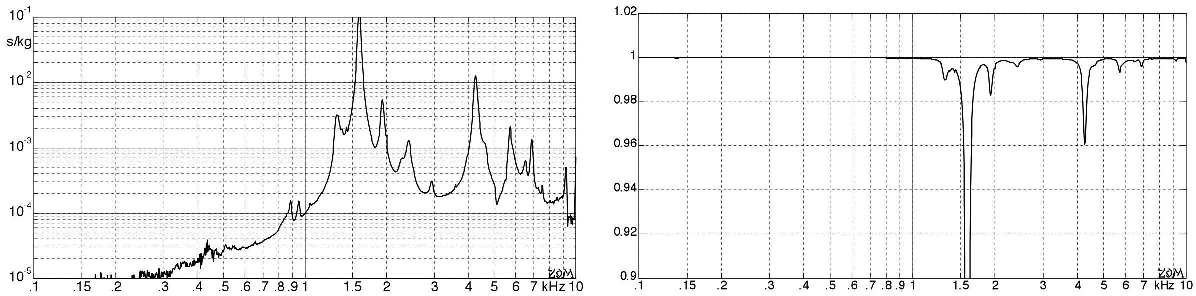


Fig. 7.106: Conductance (left) and reflection coefficient (power) of the ABR-1 positioned on the stone table.

The measurements related to Fig. 7.106 were done with an ABR-1 bridge that was positioned via two knurled nuts directly on a stone table. On the Les Paul, the two disc-shaped knurled nuts conduct the bridge-force to two threaded posts that protrude perpendicularly out of the guitar body. The mechanical input impedance ($\underline{Z}_3$ in Fig. 7.100♣) between bridge and knurled nut depends on the surface quality (burrs!), and on the angle between bridge and post; when adjusting the bridge height, the contact surface changes, and with it stiffness and damping, and thus also frequency and Q-factor of the resonance.

♣ Fig. 7.100 models the bridge as a discrete mass and does not (yet) consider any Eigen-modes.

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As an example for differences related to manufacturing tolerances, the decay times for partials were analyzed for a Gibson ES-335 (new strings, **Fig. 7.107**). This semi-hollowbody guitar dating from 1968 sports the bridge shown in Fig. 7.104, across which the strings run to a trapeze tailpiece. The guitar must not be blamed for showing a few minima in the decay times – a bit of individuality certainly is okay. That the decay times change as **the bridge** is **shifted** by one or two 10th's of a millimeter – that's owed to the adjustability. The decay curves will again change somewhat as one seeks to correct a slightly-off intonation with the **bridge-piece screws**. Guitar gurus, near and far, you who claim to hear with your golden ears the smallest detail in the wood-composition, you who even put your guitars in the freezer to get a few more cracks in the varnish so that the guitar body at last is "freed to vibrate" and the sound "blossoms", do see the signs: the one who, in "specialist" magazines, every month propagates bullshit, may finally drown in the same.

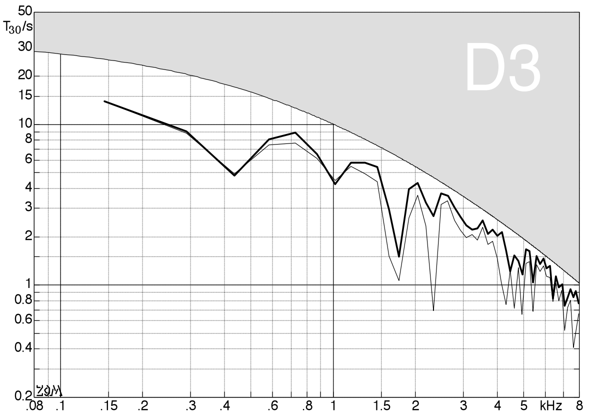

Fig. 7.107: Decay times of partials, ES-335; bridge shifted within the scope of manufacturing clearances. The grey area indicates the theoretical maximum T_{30}-decay due to internal & radiation damping (Chapter 7.7.2).

Since Gibson's ABR-1 bridge is height adjustable, it has some horizontal clearance, as well. Shifting the bridge within the scope of this bearing clearance changes bearing and damping parameters. Still, there was not much attention paid to this sensitive contact surface: in the Gibson bridge shown in **Fig. 7.108**, two burrs influence the surface between bridge and the knurled nut below it; these burrs co-determine the contact stiffness. To vindicate Gibson, it may be noted that not all bridges show such a dismal production quality. However, even a specimen bought for much money in 2010 had not ever come into any contact with a deburrer. That can only lead to the assumption that Gibson does not attribute much significance to this contact point. That, however, makes the little damping peaks that the guitar body itself generates finally loose all relevance. The holy wood, with all the entwined myths – can it be nothing but hype? Yes, it may and must be seen that way, because why would Gibson manufacture the most important link between string and the "holy grail" so sloppily, so wobbly, so unreliably, if the guitar body were important at all? What remains is the insight that while all those little peaks can be measured, they barely have any influence on the sound. That's irrespective of whether they result from the sloppily manufactured burr, or from the wood seasoned for decades. Goof rules.

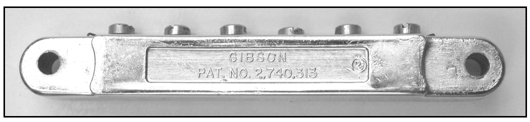

Fig. 7.108: Gibson ABR-1 bridge with burr.

The belief in the Holy Grail is deep-seated – deep enough that instructions for a conversion are found in G&B 6/2010 that are supposed to turn a "halfway" Holy Grail into a "real" one: a '**52 Goldtop** into a '**59 Les Paul**. Too bad, though, that due the rather special neck angle, the ABR-1 bridge does not fit. Therefore a band sander (**Fig. 7.109**) is called into action … which is a physically correct step if the focus is merely on the playability.

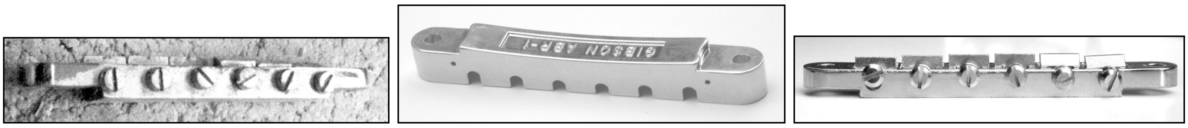

Fig. 7.109: ABR-1. Left the model from G&B 6/2010, center/right the copy pre/post milling.

Playability, however, is not the only aim of the conversion: *in the end the golden one is supposed to sound like a 1959 Les Paul*. The same sound – although its sanctum, the link between strings and wood, has been brutally abused with a belt sander? Let us take a look at the conductance of an original ABR-1 bridge (**Fig. 7.110**) – not the specimen analyzed in Fig. 7.110 but the one bought in 2010. Since professional tooling was available, the bridge was not "minimized" with a belt-sander, but via a high-tech milling machine. The rigorous thinning-out reduces the mass and in particular the stiffness such that the main resonance finally comes down from 1400 to 850 Hz. This gives rise to the question whether a guitar fitted with this bridge can ever sound like one fitted with a bridge developing its maximum genuine absorption at about 1500 Hz?

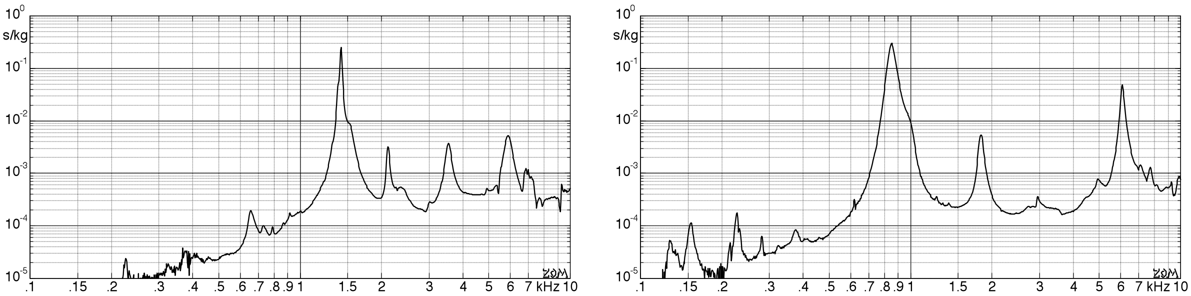

Fig. 7.110: conductance of the ABR-1 bridge; original condition (left), after milling (right). Stone table; knurled screws; bridge without bridge saddles; measuring point between the D- and G-guide-slots.

The alterations described in G&B were performed by a well-known and well-respected luthier having many years of experience under his belt, and therefore we are not willing to simply discard his evaluation ("*same sound*") as unqualified – there must be something to it. And so the only conclusion can be: if such big differences in the absorption have next to no effect on the subjectively perceived sound, then the body wood (with much lower conductance values) has even much less influence. It may be emphasized again and again by some that this Holy Grail *cannot be topped in view of the length of time it has had for being played-in (56 or 57 years)*, but the reasons for that must reside rather more in the metaphysical realm. Which is where a grail is best kept, anyway.

Fig. 7.110 documents the changes in conductance caused by the milling. It is obvious that the decay times of the partials will be influenced, as well, but proper proof is still required. Both variants of the bridge were therefore tested on a **Les Paul** (R9), with the decay times of the partials of the D- and G-string being analyzed for the original bridge and the milled bridge.

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Fig. 7.111 shows the corresponding results. Since the bridges are not positioned on a stone table anymore but reside, as intended, on a guitar, the resonance peaks measured in Fig. 7.110 shift a bit. Moreover, the manufacturing tolerances of the bridge saddles come into play now, and these are (benevolently speaking) of an abysmal quality. Three of the bridge saddles fall off if the retaining wire is removed while the other three are so stuck that they can hardly be moved at all via the adjustment screws. This was not an effect of the milling process but the original condition of the bridge. Whatever, after the measurements are concluded, this piece of junk will be discarded anyway. What remains as a result: the main resonance – having shifted to 850 Hz – will clearly cause shorter decay times of the partials in that frequency range for both strings … which apparently does not harm the rating "*same sound"*, though. This implies that the instructions to modify the guitar hold a contradiction: if the minimal influence that the "holy" wood has on the string vibrations is taken to be crucial, then the differences caused by the modifications in the bridge needs to be held as existential feat, and there should be no talk at all that here the '59-sound has been created (*simply put, this is the Holy Grail, G&B 8/2010*). If, on the other hand, the bridge resonances are taken to be of insignificant effect, then the microscopic effect of the wood should be assumed to be irrelevant. In that case, however, any plank from the DIY-store would have sufficed, too ...

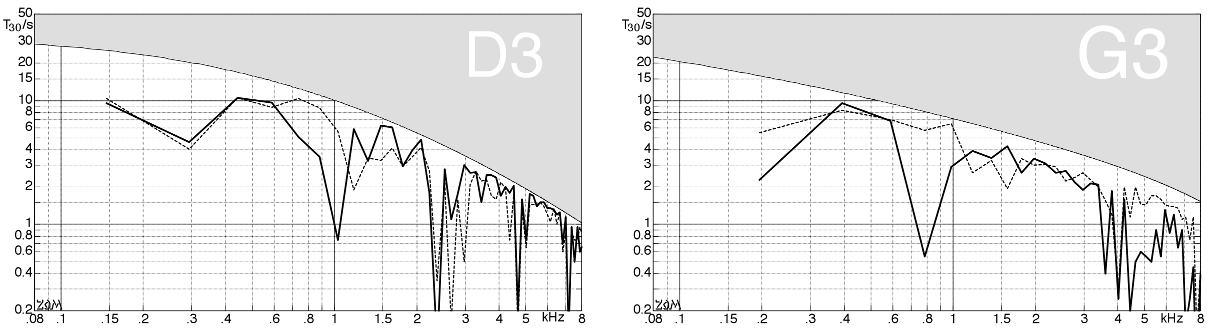


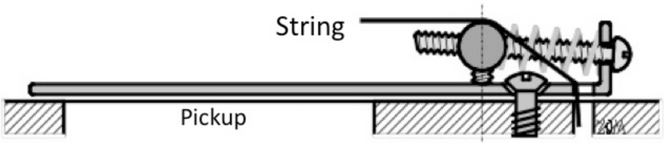
Fig. 7.111: Les Paul R9, decay times of the partials. Original bridge (---), milled bridge (——).
The grey area indicates the theoretical maximum T_{30}-decay due to internal & radiation damping (Chapter 7.7.2).

Of course, a recurring thought has been "it's all in the fingers", and so we can indeed just use the guitar according to its purpose: to be played. Yes, that is possible on most guitars, irrespective of where exactly the bridge is positioned.

After so much theory, how about a bit of some more "specialist press"? Here we go (all statements made by one and the same author): *Kluson machine heads are also very lightweight. The small mass can be easily excited to vibrate but it decays all the more quickly. Theoretically, that would mean that Kluson machine heads give less sustain [G&B 8/05]. Small changes in the height of the stop-tailpiece in part drastically change the sound (of the Les Paul) [G&B 7/05]. Machine heads (about $ 1200) and stop-tailpiece (about $ 2000) had only very little influence on the sound (of the Les Paul)[G&B 2/07]. Of course, build and material (of the stop-tailpiece) have an important influence on the vibration transmission to the body [G&B 7/05]. Hard to believe that simply swapping the machine heads (on the Les Paul) could lead to such (sound-) changes. [G&B 8/05]. Sometimes, I find it inappropriate how self-proclaimed equipment-missionaries roam about seeking to convert everyone to the true belief [G&B 8/07].*

7.10.2.2 Leo Fender's Telecaster

The Telecaster was Leo Fender's first "true" electric guitar. To start with, it was designated Esquire, then Broadcaster, and finally Telecaster [Duchossoir]. According to Fender's patent application US 2,573,254, the string length was to be individually adjustable – but that is only possible in pairs of two: two strings have to share a cylindrical bridge saddle (**Fig. 7.112**). Compared to the non-adjustable bridges customary until then, that definitely represented an improvement although it still was a compromise. Fender however already points to a further development: the bridge saddles are drilled through at an angle. Each of the three bridge saddles may be adjusted in height using two setscrews, and a long tensioning screw takes care of the intonation adjustment. A thick steel plate anchored with 4 large bolts in the guitar body serves as a base for the setscrews and the tensioning screws. The strings run across the bridge saddles through the guitar body to fastening bushings mounted from the rear of the body.



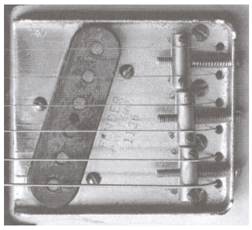


Fig. 7.112: The Telecaster bridge. [Duchossoir]

What has been said in Chapter 7.10.1 holds for the setscrews and tensioning screws – their transmission stiffness depends on contact surfaces and forces. In principle, this bridge does work. It may, however, develop an idiosyncrasy that helps this guitar to achieve a special status: the steel plate rests in an undefined manner on the guitar body, and its resonances (Eigen-modes) may re-act on the strings – not necessarily, but possibly. Using a hard nonmagnetic item to knock on the upward-bent flanks of the plate, we hear a clicking noise coming out of the amp/speaker. The **sheet metal** is not comprehensively damped by the body wood below it, but can resonate with its **natural frequencies** at a high Q-factor. Mechanical reactions from sheet metal to bridge saddles are possible, and – given steel as material – also inductive coupling to the bridge pickup. Generally, the sheet metal is electrically conductive and thus a place where **eddy currents** circling the pickup may roam (Chapter 9.5).

The necessity to make the string action **adjustable** was not only connected to the drive of all guitar players to make each new guitar "playable" according to one's own ideas. It was also unavoidable in view of the separation of guitar body and (bolt-on) neck into two individual production entities each subject to manufacturing tolerances. From Duchossior's close-up pictures it can be seen that these adjustment possibilities were indeed put to use, and that the bend-angles that the strings form as they run across the bridge saddles are specific for each individual guitar (they are string-specific in any case). However, this means that the vibration characteristics of the bridge are specific to each individual guitar, too.

Fig. 7.113 shows the decomposition of forces at the bridge saddle. The string-tension force Ψ is almost the same on both sides of the bearing cylinder (bridge saddle), and the frictional force may be neglected in a first approximation. The force F acting towards the lower left has two components. The setscrew just resting on the surface below can only take on the vertical component F_y; the horizontal component F_x is taken care of by the tension screw. Nevertheless, Fender's patent application shows a set screw mounted at an angle (Fig. 7.113)

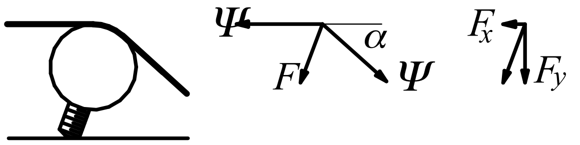


Fig. 7.113: String with bearing cylinder (left), force resulting from the string forces (center), decomposition of the resulting force in horizontal and vertical component (right).

We shouldn't expect too much here: *"Leo Fender was an ingenious, resourceful technician, but – as it is frequently reported – he had not even had formal training as an engineer, and he certainly was not a guitarist – couldn't even tune the instrument" [G&B Fender special edition]*. Duchossoir's citation is even more merciless: *"Leo had a knack of thinking slowly and consecutively – no flashes of genius – a merciless unstoppable slow degree of thinking [Tavares]."* At some point, the angled screws raised some eyebrows, and one day they stood upright (Fig. 7.112). More specifically: in the patent application [USPTO.gov], the angle between setscrew and tension screw amounts to 70°, in later bridges it is 90°. What is better?

The mechanical engineer would probably prefer the setscrew perpendicularly positioned on the base plate, because it can transmit only vertical forces in any case (horizontally, only small frictional forces remain). With the screw positioned at an angle, a bending moment results that loads cylinder and tension screw flexurally, while with a perpendicular setscrew there is merely a tensile force acting on the tension screw. What in fact prohibits sideways motion of the latter? This would be a motion within a borehole in which – according to the patent publication – the screw should be borne *"sufficiently loosely"*! An additional brace could make for more stability but the effect would probably not be very dramatic. Also, an axial force applied to a setscrew could possibly readjust the screw over time – therefore the perpendicularly oriented screw may offer slight advantages. These are, however, untried speculations for which no additional experiments were done. With

$$F = 2\Psi \cdot \sin(\alpha/2), \qquad F_x = \Psi \cdot (1 - \cos\alpha), \qquad F_y = \Psi \cdot \sin\alpha,$$

we can see the angle dependency of the forces; the bend-angle of the strings α amounts to about 25° to 50°. The tension screw has the sizeable length of 32 mm – apparently indeed necessary to allow for a sufficient adjustment range. With Ψ = 50 N (certainly possible for thin strings), F_x amounts to a minimum of 4.7 N, and F_y amounts to a minimum of 21 N[♣]. For heavy strings, F_x = 50 N and F_y = 100 N are possible, as well. That is quite a respectable degree of variability in the compression force, and correspondingly large will be the **differences** in the contact-stiffnesses and –impedances. Which tilting, rotating or wobbling motions the bridge saddle will be subjected to under real deployment conditions cannot be anticipated with a general consideration – the conditions vary too much. The offset-force acting on the setscrew presumably is so strong that this screw can a priori not be suspected as a "vibration killer". A longitudinal force of merely 4.7 N is scant, but then there are 2 strings pulling at one screw. Within the string, however, also longitudinal vibrations appear (dilatational waves) that could excite the bridge saddle to rotational vibrations. In that case, too, much slack between the screw and the bridge saddle would be counterproductive.

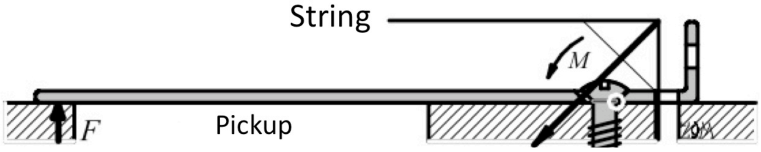


Fig. 7.114: Forces on the guitar body

The interface from the base plate to the guitar body is shown in **Fig. 7.114**. The sum of the two string forces generates a resulting force pointing towards the lower left, just missing the wood screw and thus resulting in a torque around the bearing point (circle). The main share of the retention force occurs at the screw; in order to compensate for the torque, a supplementary force F is necessary (here sketched in arbitrarily).

♣ A mass of 1 kg generates a weight force of 9.8 N (1 N = 1 Newton → 102 Gramm).

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Where exactly which forces act cannot be specified, because how the bridge rests on the body wood remains undefined: this depends i.a. on the curvature of both components and materials. The torque designated with *M* rises with increasing string diameter and increasing string height (distance between string and base plate). If there is (at *F* in Fig. 7.114) a tiny gap left of the pickup, half of the base plate is suspended in mid-air … opening un-dreamt of possibilities of vibration.

Also undefined is which of the four wood screws bears the main load – they just somehow share the retention forces. If the guitar body as a vibrating system were to be coupled in a defined manner to the bridge (or the bridge to the body), a completely different design would be required. No, this ain't no sound-design – it was simply a matter of bolting a base plate to a wooden board – over and done! As **Fig. 7.115** shows, the arrangement can in fact work pretty decently: here we see the decay times of the partials compared to the situation with a Stratocaster. Both guitars were measured with brand-new strings, although the diameters were not completely the same (Tele: 009 – 046, Strat 010 – 046). For the Tele, the decay is slightly faster, and it depends a bit more on the frequency. Before anyone starts to derive the general verdict that a Tele would have a shorter sustain than a Strat, let's be reminded that what we have here are individual results, measured merely with one single representative of its species♣.

Note: in Fig. 7.116, the grey area indicates the theoretical maximum T_{30}-decay due to internal & radiation damping (Chapter 7.7.2).

If we would want to extract **Telecaster-typical characteristics**, we would first have to define what a typical Telecaster in fact is: over the decades, Fender changed the headstock, the neck, the body, the pickups, the bridge – it was only the body shape that approximately remained the same: consequently, there is not "the" Telecaster. For most variants, the bridge does have the base plate of about 85x74 mm^2, but differences start already with the bearing-cylinders: thick, thin, made from brass, or from steel, with/without groove, with/without thread. From the 1970s on there is also a version with small or large Strat-like individual bridge saddles, or even a pure-bred Stratocaster bridge. Telecaster-typical remains apparently merely the body shape but that has next to no influence on the sound. Even if we limit ourselves to the single-coil-fitted original type, we find a multitude of different variants: 250-kΩ- or 1-MΩ-pot, bridge pickup impedances between 5.5 – 11 kΩ, (complete) solid body or (half the weight) Thinline body, bolt-on neck, tilt-neck, set neck [more info in Duchossoir]. If the pickup cover is the secret of the neck pickup, why then does Fender include a different pickup in the Thinline-Telecaster (2nd version), the Tele Plus, the Elite Telecaster, the Telecaster Deluxe and the Custom-II? Why are there also Lace and Seymour Duncan variants on top of the Fender version? Presumably, that is so that each guitarist can realize his/her personal idea of the Telecaster sound.

In http://www.tdpri.com/forum/telecaster-discussion-forum/77808-new-body-material-build-w-sound-clip.html, Terry Downs presents his new guitar, and lets the congregations of fans guess which material the body is made from. Everybody enthuses about the sound, and conjecture includes: oak, masonite, teak, cork, semi-hollow-body, synthetic counter top material, soy, hedge apple tree, and others – most guesses meant seriously. In fact, it was three medium density fiberboards that were bolted on top of each other – that's it. Result: *Sounds like a Tele* – what else.

♣ The multitude of limitations in the framework of university operations unfortunately does not make more comprehensive investigations possible.

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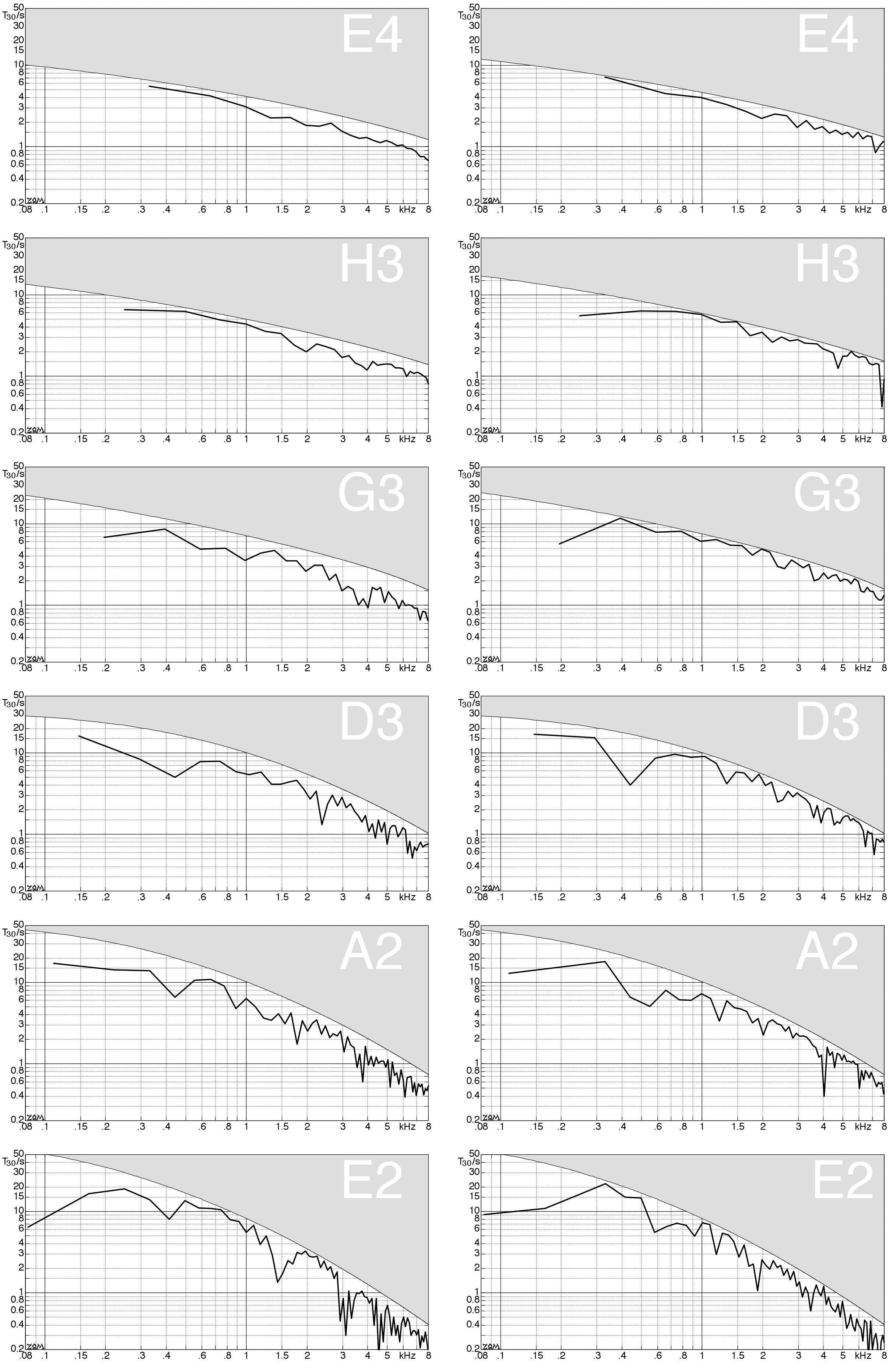

Fig. 7.115: Decay times of partials, Tele (009/046 set, left), Strat (010/046 set, right). “H3” = B(-string).