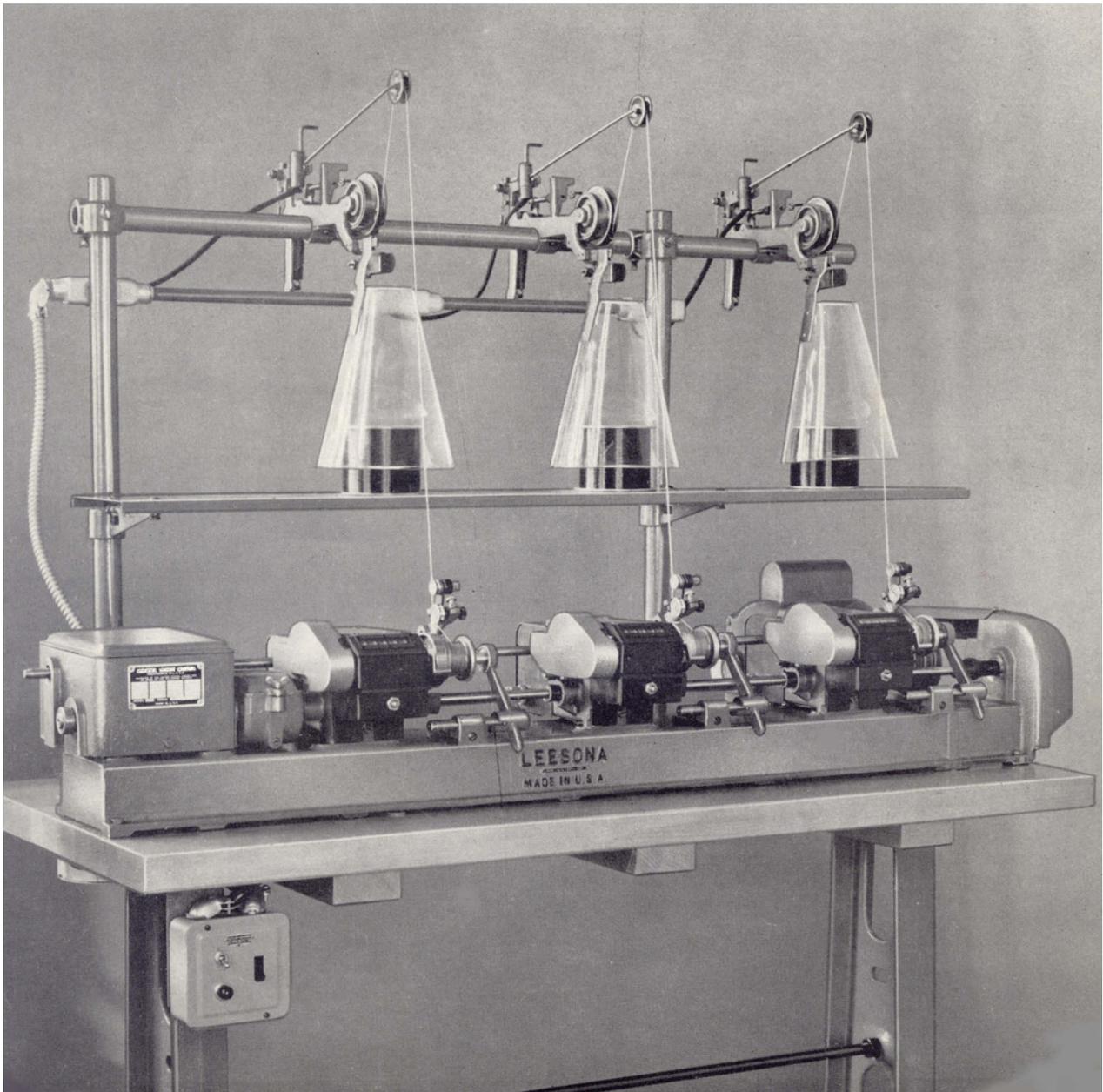


The Leesona Model #102 Coil Winding Machine and The Gibson® PAF Pickup

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The Leesona Model 102 & 102B Coil Winders were the workhorses of the coil winding industry. According to the Leesona serial number/shipment record book there were approximately 1661 units produced between 1935 to 1966*. That is a thirty one year run for the same piece of equipment. Like dozens of other models of coil winding machines at the time this machine would have quietly drifted into the sunset of obsolescence if it were not for the machine's connection to the Gibson Guitar Manufacturing Company. During a period from 1956 to about 1975 Gibson Guitars used a Leesona Model 102, along with several other coil winding machines, to wind their patent applied for humbucking pickups. The 102 was not the only machine used to wind PAF's and this is a very important fact.

Before continuing let me briefly lay out my background regarding guitar pickups. After some college I studied luthiery under the mentoring of Charles Fox the current owner operator of the American School of Luthiery. Upon graduation I started working at a very

busy guitar repair shop in Buffalo NY called Top Shelf Music. TSM was owned by one of the most knowledgeable people in the guitar business and was a warranty shop for Gibson and several others. Thousands of guitars went through Top Shelf and I worked on hundreds of PAF's. After several years of working with Scott at Top Shelf I moved on and started my own shop taking the Gibson warranty deal with me and gaining several other warranty gigs. I had that shop for about ten years before moving on into recording and eventually electro-magnetics but one love I had since my teens was winding pickups. That was what brought me into electro-magnetics. For sake of reference let it just be said that I have installed a LOT of pickups from many manufacturers and listen to them with a critical ear.

Magic vs. reality is what the lore of PAF pickups amounts to. PAF pickups were not a gift from the gods, they were a form follows function creation to preform a duty and nothing more. Over time they have proven themselves to be generally good sounding pickups. Does the machine they were wound on have anything to do with their overblown reputation? NO! There were at least four different model (make) winding machines used at the Gibson factory. Each machine laid down wire differently.

How did the mystic of PAF's even get started? In the late 1940's early 50's Instrument manufacturers were not looking to invent rock music. The demand for live music was changing and acoustic string instruments simply couldn't be heard on stage competing with louder wind instruments. Players were the first to try figuring out how to amplify the sound. The manufacturers followed. After some early efforts with varying degrees of success in 1956 Gibson released a pickup design that is still the de facto form for humbucking pickup manufacturer today. That pickup was the patent applied for or PAF humbucker. Honestly the Gibson humbuckers are excellent designs and to a point deserve the recognition they have accrued over time. In order to understand how PAF's achieved the mythical status they currently enjoy you just have to look at where they made the most impact and that would be during arguably the most creative time in recording history. During the golden age of recording, the 50's to the early 80's, some of the best music ever made was created using Gibson instruments that happen to have PAF pickups on them. Here's the thing: Tons of incredible music from that era was made using instruments that had pickups that currently have no real magical value. The pickups had ABSOLUTELY NOTHING to do with the greatness of the music. Today the only thing a vintage Leeson Coil Winding Machine will do that other newer machines can't do better is fool idiots into thinking that pickups wound a 102 machine will make them sound and play better!! Please understand that I make that statement as the current owner of the Leeson Coil Winding Co (electrical div.). It is marketing, marketing, marketing, and nothing more!

The instruments that used the early PAF pickups were generally made better than later models. Gibson's and Fender's from the 70's and 80's sucked compared to the previous decade. Fender sold out to CBS and Gibson became full of themselves. Gibson never got over being full of themselves. In the 60's most, if not all, of the best sounding Gibson examples used superb Honduras Mahogany wood for the body and neck. Honduras Mahogany at the time was absolutely incredible wood for guitars. It was brought into the US by the cargo shipload. Most people think it was used mainly for furniture and guitar building but they would be mistaken. The same properties that make HM perfect for guitars makes it perfect for other applications. During the middle of the 20th century a huge percentage of foundries in the US (and worldwide) were using Honduras Mahogany for mold patterns. Honduras Mahogany is light, easy to work, and very stable over time. Boatloads of MH were brought into the US then sold to pattern shops and turned into patterns for molds, many times used once and discarded. Imagine how much MH it took to

make a pattern for a ocean liner propeller! That is what has brought us to the current state of no longer having MH available for heirloom building. Honduras Mahogany is just as important to the sound of the PAF than the pickup itself, if not more so.

In the 60's there was still a remnant of the original American manufacturing ethic which was a cross between old world European master to apprentice craftsmanship and art in design. In that short period of time there was a second where profit wasn't the only object. A product with inherent style, build quality, and utility stands the test of time 99.9% of the time. Gibson guitars surely wanted to sell instruments however from a quality control point of view they didn't skimp. They did skimp in the 70's as did most American manufacturers but in the 60's you could buy a Gibson and the chance of getting a lemon was minimal.

Music made during the golden era of recording wasn't made by desperately trying to get one measure right and copy and pasting it 3000 times. Most often it was made by people whom could actually play their instruments. Any instrument will sound better when it's played by a competent player rather than a hack. When I had the guitar shop there were several players who would come in, grab a guitar, any guitar, plug into an amp, any amp, turn a few knobs and BAM good sound. That is the way it is. Years ago I wrote a little paper exploring this and the Vintage Myth**.

Let's discuss for a moment some of the technical aspects of coil winding. Coil winding machines from the 40's and 50's were manufactured during the electronic revolution. The mechanical winding controls of early machines evolved into electronic winding controls. In earlier machines the two most common ways of coordinating the traverse movement relative to the spindle rotation were gears and cams. Both gears and cams have "backlash" in their operation. In most forums it is referred to as slop or play but in mechanical terms it is referred to as backlash and it occurs when a geared system reverses direction. Because gear teeth work on a radius the teeth must have a bit a play between the tooth and the recess so the gear turns smoothly. Backlash happens when the gear teeth move from one side of the recess to the other side upon reversal. This looseness occurs at the point where the winding traverse switches direction so the wire might bunch up at the edges or it might pull away from the edges depending on the mood of the machine that day. You read that correctly. Old machines have personality and anyone familiar with winding on them will tell you so. Results vary day to day!!! Very minute adjustments on the machine can make a huge difference on how the coil winds. A properly setup Leeson 102 will wind a fairly tight coil but a George Stevens 115 has so much backlash the coils will actually fall out of the bobbin if you're not gentle. Ultimately the technical implications of the different winds is that the George Stevens machine will wind more air into the coil. Air is an insulator. Wire is a conductor. When you have two conductors with an insulator in between them you have a capacitor. Generally the more air you wind into a coil the higher the capacitive reactance the coil will have. Winding a coil with perfect side by side, layer over layer wire winding will produce a coil with better high end (less inherent capacitance) than a coil that is wound with more air in it (to a point). You can also get more wire on a straight wound coil. I wrote a little paper on that here*** with a radical pickup winding technique for extended range pickups.

The end of the 1950's brought a perfect storm of recording technology, guitar/amplification technology, civil unrest, creativity, and dare I say, drugs. The later also brought the demise of much of what was accomplished, I digress. The point is that it was a combination of many factors that has created the magical aura of the Neumann U-47, Pultec EQP-1A, Fairchild 670, and, the Gibson PAF. Granted they are all great pieces of gear and deserve the accolades for the role they played in the creation of our whole

notion of popular music. However, the idea that adding a PAF pickup to any guitar thinking you will instantly play and sound like Jimmy Page is like putting Ferrari wheels on a Prius and going off to Le Mans. Pickup manufacturers would like you to think so.

The truth is that old winding machines were finicky. The distance of the wire guide or nozzle to the coil, wire tension, gearing, cam wear and even humidity will change the way a machine will wind a coil. The winding performance between the different machines used at the Gibson factory was significant and that point can't be stressed enough. Not all of the PAF's were wound the same or on the same machine so the concern for the "need" for a Leeson 102 to recreate them boils down to marketing foolishness and nothing more. Vintage Windings currently holds all of the technical drawings for the 102 and the remaining inventory of parts so we have a monetary interest in perpetuating the myth. The nonsense has to stop some time.

It must also be remembered that the coil is only one part of the electro magnetic action of a pickup. Like transformers pickups use metal to help support the inductive process. Transformers use magnetic metals that don't hold magnetism for long periods of time and pickups use magnetic metals that do hold their magnetic charge over time. The type of alloy and, almost as importantly, the annealing process used, along with direction of anneal and magnetic charging all affect the performance of the resulting magnet and therefore it's sound in a pickup. Current imported Asian metals are no where near as pure as the metals the US was producing in the 40's and 50's. Buying off the shelf magnets that were annealed by an unknown process with impure alloys will not produce a vintage PAF no matter what machine the coils were wound on. For more information regarding small scale lab smelting of magnetic alloys please see the Western Electric papers elsewhere on the VintageWindings site.

There are far too many pickup companies manufacturing or trying to remanufacture what has already been done. It is time to innovate and it is time for musicians to move on to the next sound. There is surely a market for the rewinding of original pickups in need of repair, however, electromagnetic pickups can be made in an infinite number of configurations. It's time to start inventing again. The time wasted re-inventing what has already been done is time not spent inventing something that hasn't. Oh yeah, don't worry about what machine you have. Just figure out how to really use it. cp

*The 102B began being shipped in 1956, however upgraded 102 machines were shipped in 1954 & 55. Remaining standard 102 machines continued to be shipped until the stock was exhausted.

** [http://www.vintagewindings.com/tech_swag/The Vintage Audio Myth.pdf](http://www.vintagewindings.com/tech_swag/The_Vintage_Audio_Myth.pdf)

*** http://www.vintagewindings.com/tech_swag/Wideband-Guitar-Pickups.pdf

If you still don't believe a word I said and absolutely need a 102:

Original shipment information for all 102 and 102B machines is available for purchase.

e-mail info@VintageWindings.com