Tattoo Machines and their Secrets

On more than one occasion, while talking "shop talk" with other artists, the topic of machines always comes up. We have heard artists talking about machines built by other machine builders and have heard them comment, "It's a good machine" or "Those machines are work horses"...the question we had was, "what do you *think makes it a good machine?", "Name some qualities that machine has, which make that machine a good machine." Many artists DO NOT know what makes that machine a "good" machine, they also DO NOT know what to do to make that machine a **better** machine. The fact is that many artists learn to put color in, they learn to shade and outline but never know about the function of the main tool of their trade. We have heard stories about artists throwing a machine away because it didn't run...when it could have been a simple repair job! Tattoo machines are investments, they are your money makers, you should protect your investments. If we compare the tattoo machine to a car, there are several parallels that can be drawn between the two. A car can run hot, a machine can run hot as well...an un-tuned machine will sound like and run like a car which is not running on all cylinders...grounding problems will prevent a car from starting or a machine from running... And just like a car, a low grade clunker can be "hot rodded out" to make it run great. The electromagnetic machine was based originally on a schematic for a door-bell...so, how complicated can this machine be?*

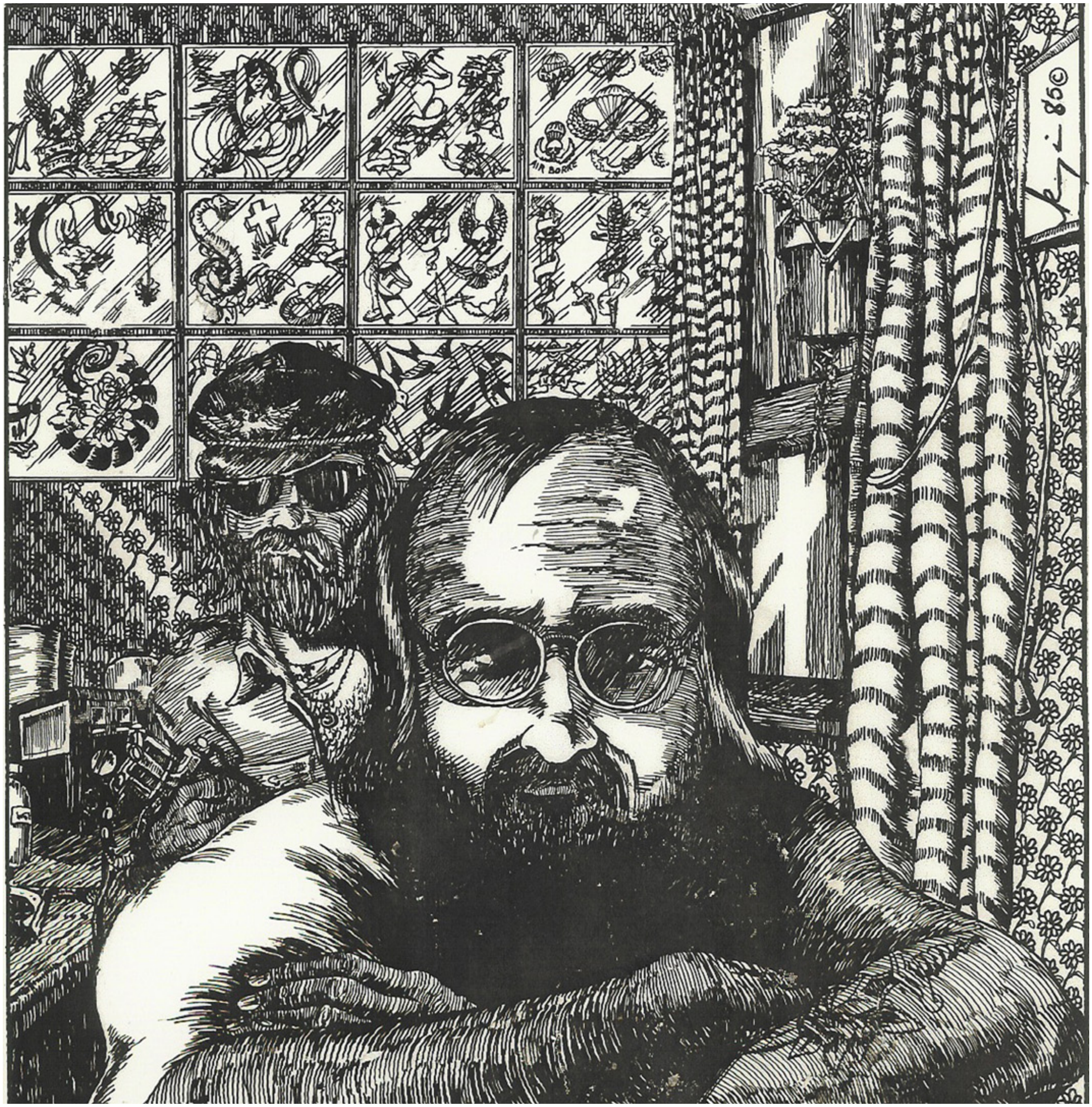


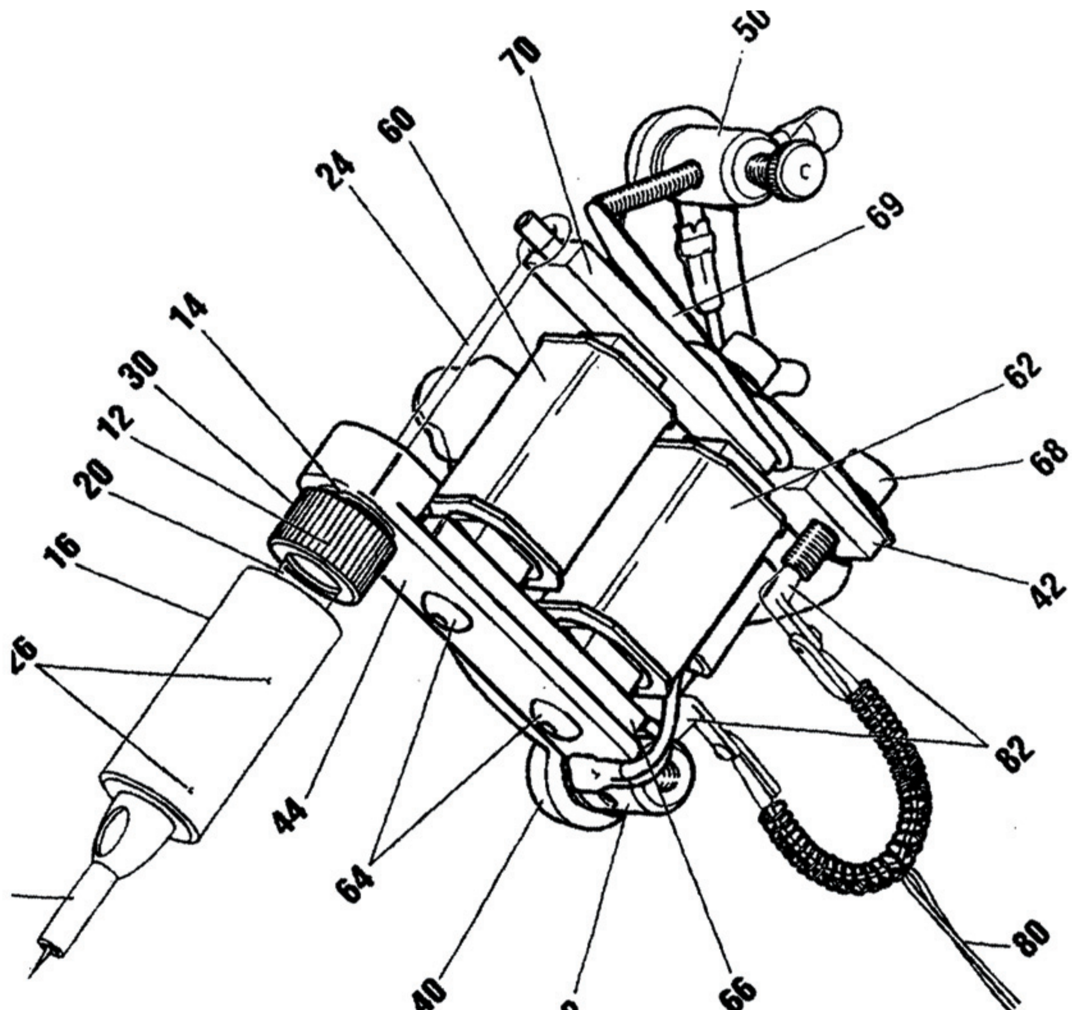
Illustration by Terry Kaegin

We are in a new era of technically, artistically and professionally advanced tattooing. Tattooing's "old school" secret society has been overtaken by artistic youngsters from all walks of life. Myths surrounding the tattoo machine are running more rampant than they have ever been, the proof is seen in the immitation, copycat machines being sold by artists and suppliers who don't *really* understand their function. Credibility from nothing. The machine is simple and it's methods are scientific.

It's time to debunk these myths and superstitions.

Tattoo Machines and their Secrets

Godoy



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Ink illustrations: **Jeremy Riley, Reverend/Doctor Terry Kaegin**

Illustration (p. 26) of invention by Bill Baker / Eikon Device

Photos: **Godoys, Jeremy Riley, Casey Altorf**

Technical help: **Dave Hollander**

Legal Department**- Devon Ryning** (USA attorney) & **Dean Palmer** (Canada)

godoymachines@hotmail.com

www.tattoolz.com

This book is intended for tattoo artists of all skill levels to learn what they don't already know about the tattoo machine and improve upon what they do know. Starting from the most fundamental, basic instruction (part names) and moving on to function, building, assembly, tuning and trouble shooting, all written in layman's terms, no mind boggling jargan.

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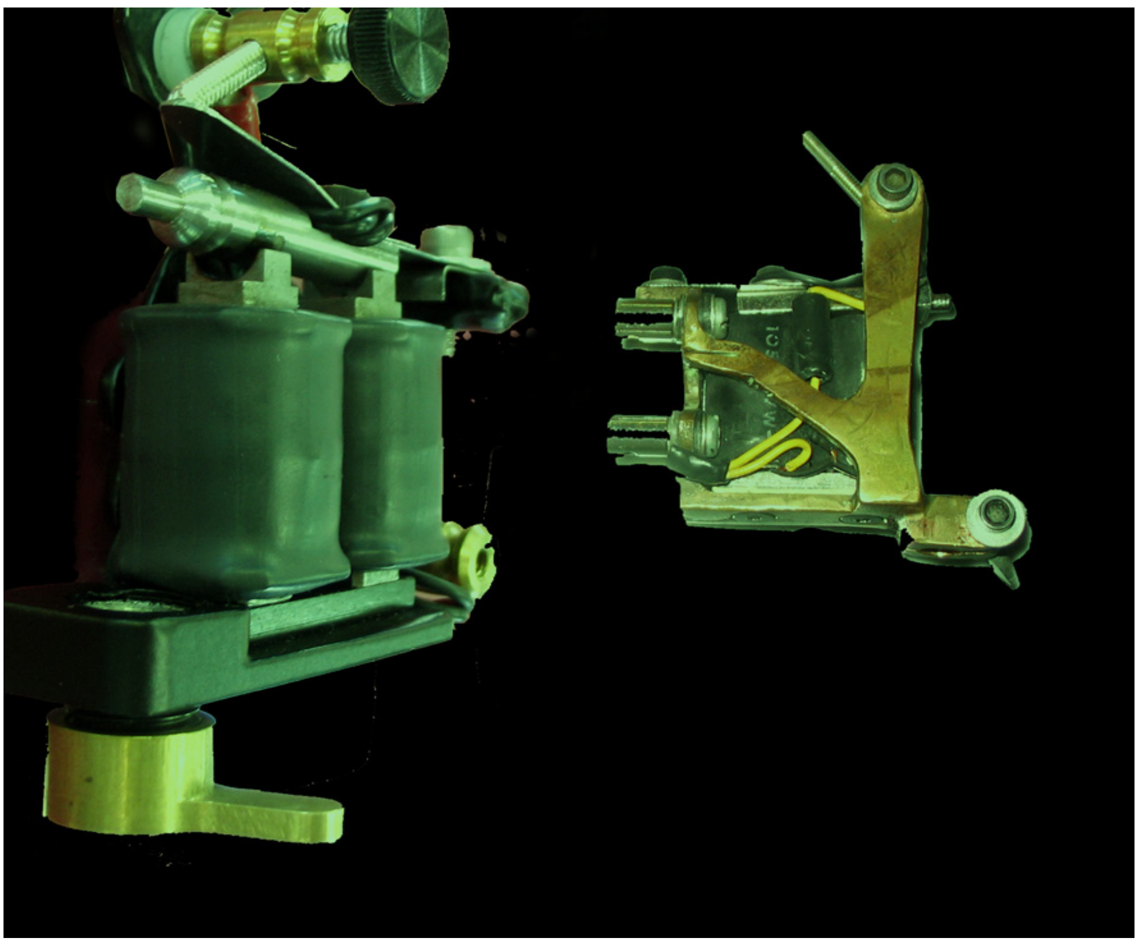
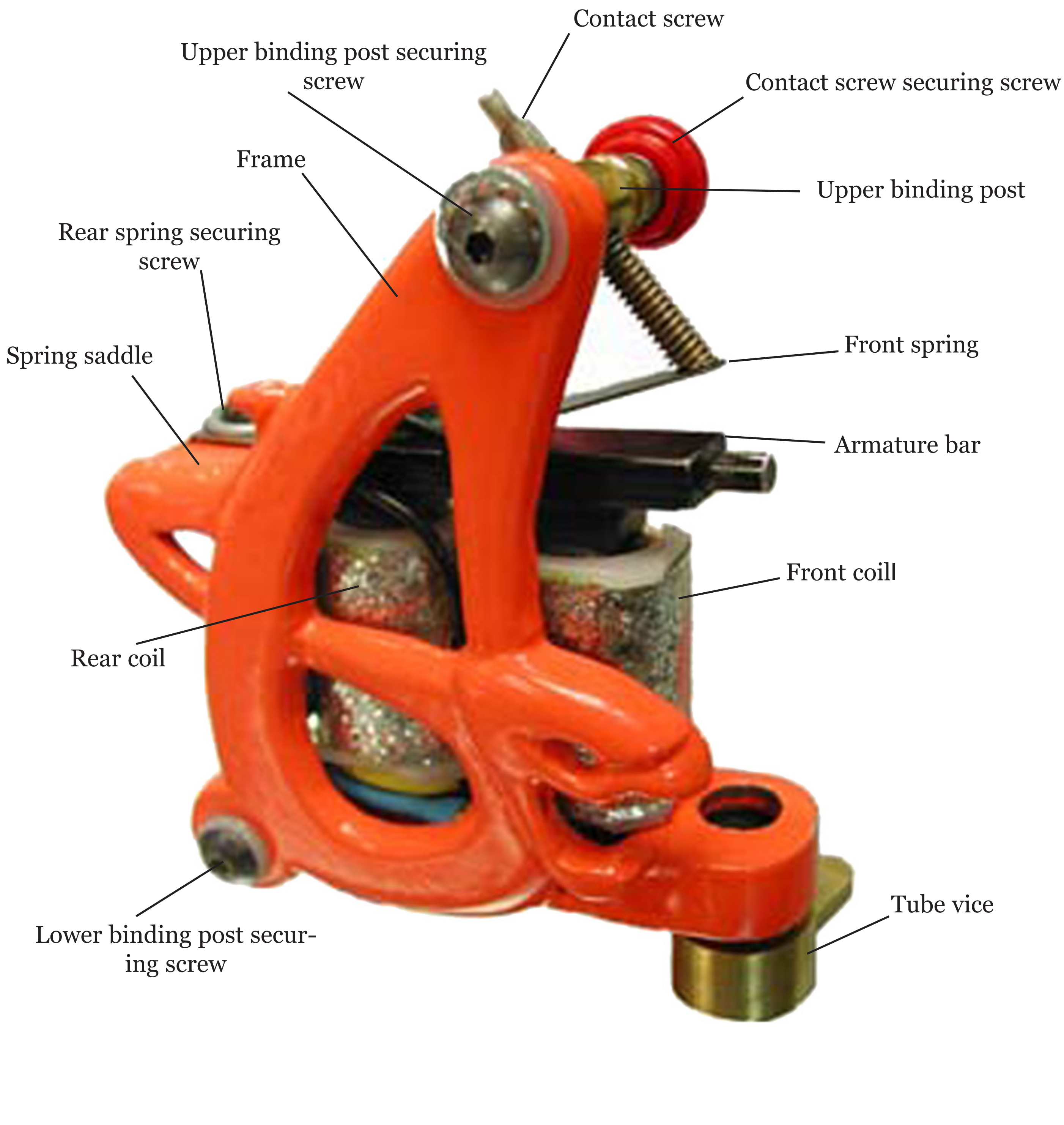
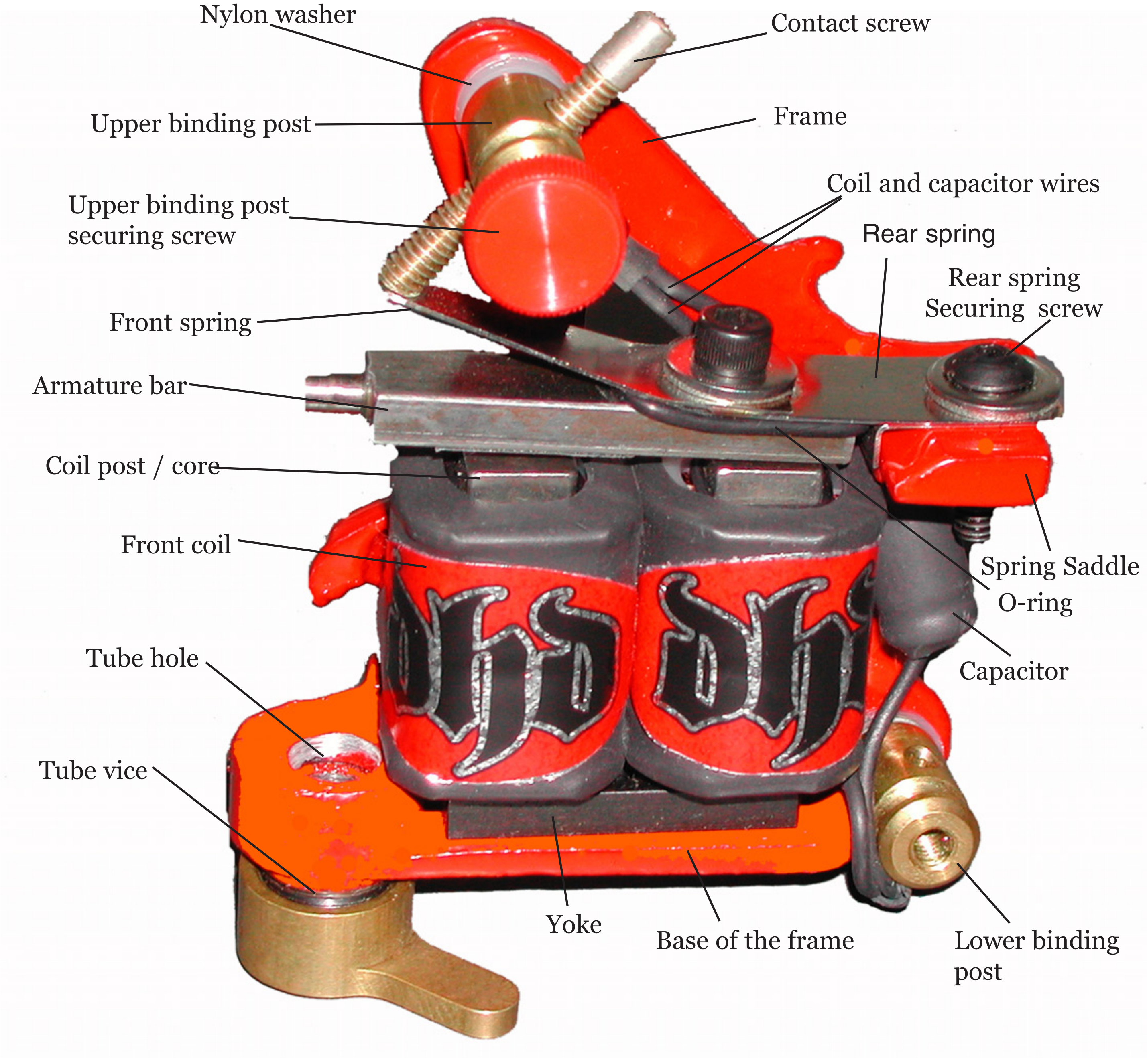


Machine evolution:
A1920's Jonesey machine (right) and a 2005 D.H.D. "Bullet" machine (left) (patent pending).

Machine Parts Diagram 1



Machine Parts Diagram 2



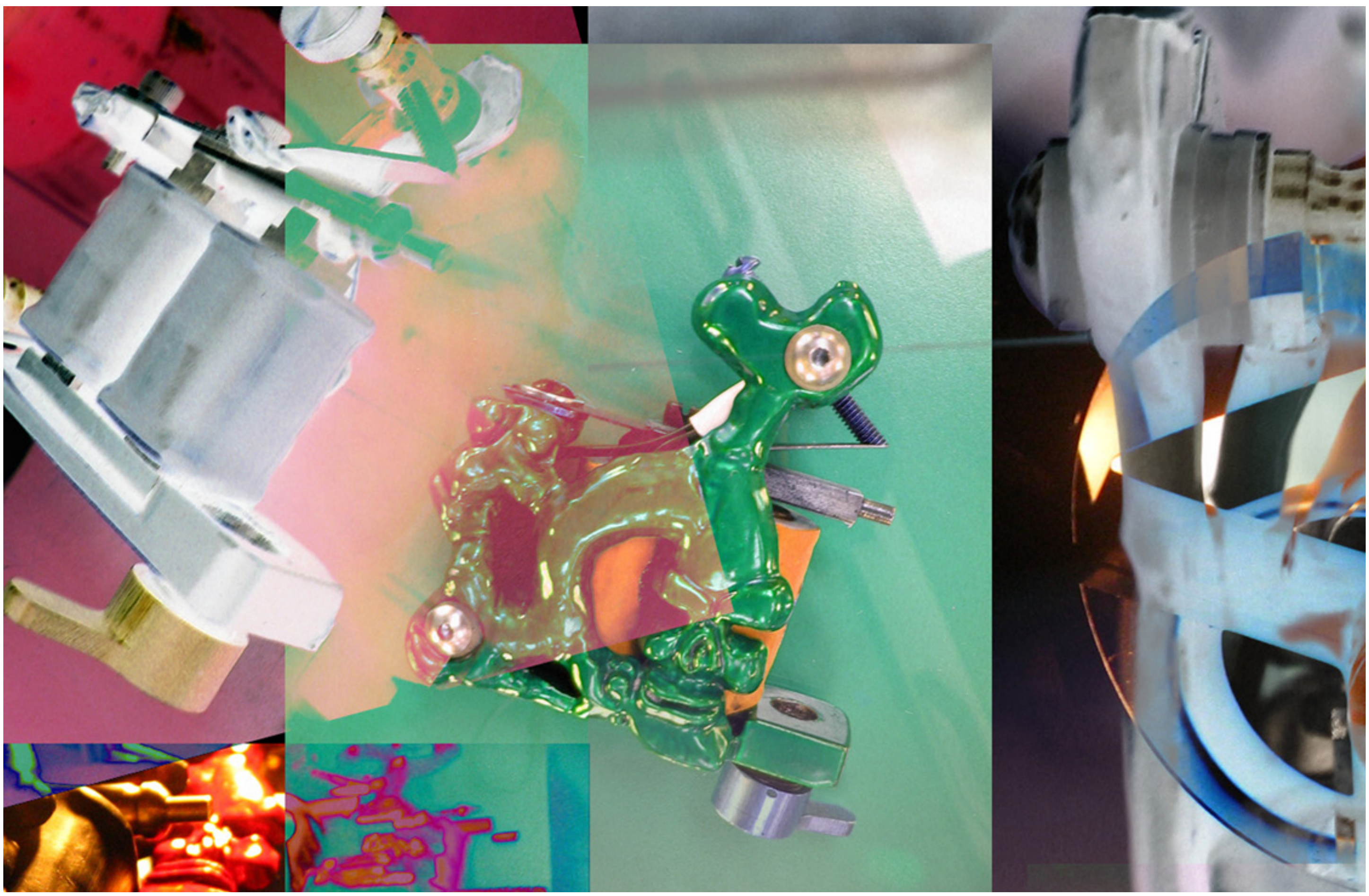
The insulated parts can be seen very clearly in this photo. Take note, all the wires, capacitor, terminals and even the coils are insulated.

Contents / Chapter Break Down

by Jeremy Riley

OBJECTIVES

A tuned machine, is a machine which exhibits smoothness, consistency and versatility in its performance, no matter the use (lining, shading...). To be able to tune or repair a tattoo machine and to make that machine do exactly what you want it to do and NOT have to change your style to accommodate the way the machine runs is essential. Most of the time machines do not arrive pre-tuned and ready to tattoo. Some artists prefer different qualities in their machines and will have no choice but to tune and modify the new or old machine to their own needs. This must be done with knowledge of the machine's function, not haphazardly...this is science and physics, not magic. There is a reason for everything. Maintaining consistent performance standards by trouble shooting, tuning, repairing and servicing the machine itself is what will be covered in this publication. The power supply, foot switch and clip cord be covered briefly.
All these things, combined with the artist's technique are what make a perfect result which will not only be seen in the finished tattoo but during the tattooing process as well.



IF ANY SENTENCES or PARAGRAPHS DO NOT MAKE SENSE TO YOU UPON FIRST READING, READ THEM AGAIN UNTIL THE INFORMATION DOES MAKE SENSE TO YOU.

1

The Machine's Frame

"...he comes well prepared...squared off, 8 corners, 90 degree angles, flat top...snake eyes, block head..."
-Devo

Having a solid base to secure the machine's components is the basic function of the **tattoo machine frame**.
The rigidity of the tattoo machine frame is the most important quality of a frame, so the material used in it's construction must be considered. There are many materials that fit the rigidity requirements besides metals. Plastics, composites, even wood are acceptable. There are other reasons that the material used in frame construction should be considered beside rigidity.

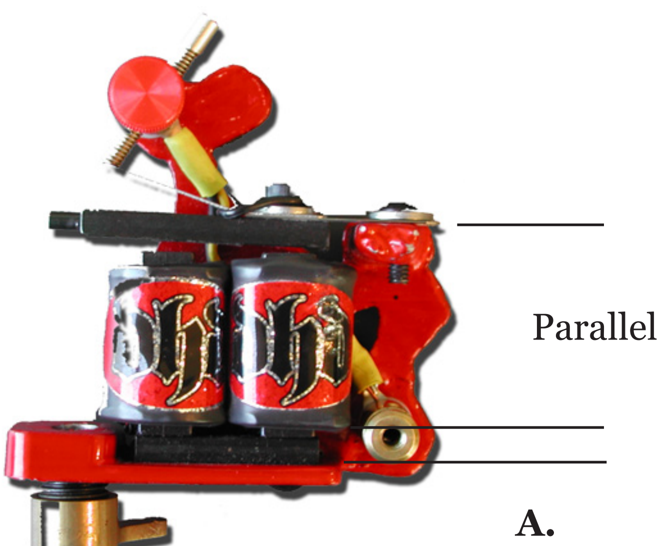
The material the frame is made out of will determine wether or not there is a need to use a yoke. A yoke is a piece of ferromagnetic material, without windings that connects 2 or more magnet cores. In order to make the coils work as a "team", the coils must be connected to each other by a shared base made out of magnetic material, preferably the same material the coil's core's and armature bar are made from, because these are all part of the magnetic system. A steel or iron frame will serve this purpose but any frame made from any non magnetic material (brass, aluminum, plastics, wood...) will need a yoke. A frame can be cast, machined, punched out of steel and bent into shape, or screwed together in parts.
The material the machine frame is made out of combined with the thickness of the frame will affect the way the machine's vibrations will feel in the artist's hand. But weight has to be considered also. There are machine frames made from iron and steel, brass, silicon bronze, aluminum, and plastics, there have been some made of wood. Any material will absorb vibration. The thicker the frame, wether it is machined on a CNC machine, cut out of a steel bracket, punched out and bent or cast at a foundry, the more vibration will be absorbed.

Myth: "Aluminum machines are chattery".

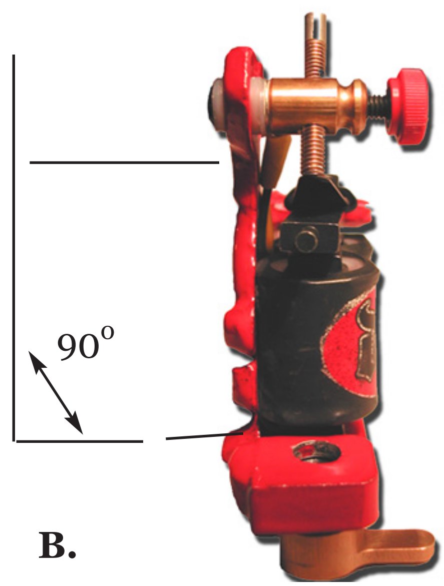
A very well known artist & "machine expert" in the tattooing community told us this once, "Aluminum machines are chattery". We had some aluminum machines set up and proved him wrong.
Aluminum is an excellent metal. It is light, and rigid. It can come in a variety of strengths, some aluminum is heat treated aircraft grade t-5 or t-6...other types of aluminum may be a bit more bendable. Some grades are more brittle, for example t-6 can be more brittle than t-5 and may break or crack if the fully assembled machine falls from a desk. Never the less, this material, is light and rigid. It is easier to machine than steel or iron, it feels softer than brass or silicon bronze when sawing, drilling or tapping, it is more heavy duty than any plastic and in the right thickness, it will absorb vibration as well as any brass machine frame. The myth that an aluminum frame makes for a chattery tattoo machine is not true. When powder coated, more vibration is absorbed.
The final most important quality of a good machine frame, is the drilling specifications. A frame with non adjustable drillings for binding posts, coils, and spring saddles are strongly recommended, so that parts do not have the potential to slide or shift during

machine operation. The distance from the spring saddle to the tube vice drilling is also crucial. The frame is the foundation of the machine. The proper function of the machine's moving parts will be dependant on these drillings. On an un-drilled machine frame, always drill the coil holes first and base the placement of the other drillings (spring saddle, tube vice and binding posts-*in that order*) around the coil holes. Taking into consideration the length of the armature bar / spring assembly.

The frame's "lines" when viewed frontally, should always be at a perfect right angle. This means that the upright part of the frame which accommodates the upper binding post should make a perfect 90 degree angle with the base of the frame which accommodates the coils. If the upright part of the frame is NOT on a perfect right angle, there will be a need for shims or shortening of the binding post, depending on the angle. It is easier to straighten any flaws in the frame *before* any assembly of parts tothe frame. This can be done with a rubber mallet and a vice. Be very careful when straightening aluminum, especially if you are using impact from a rubber mallet to straighten any part of an aluminum frame, aluminum should be handled with extra care, it only bends once...usually. The spring saddle should be parallel to the base of the frame(A), any frame which is punched out from sheet metal and bent into shape, should always be examined carefully for parallelism of the spring saddle to the base of the frame and examined for a 90 degree angle between the upright support (B) and the base of the frame.



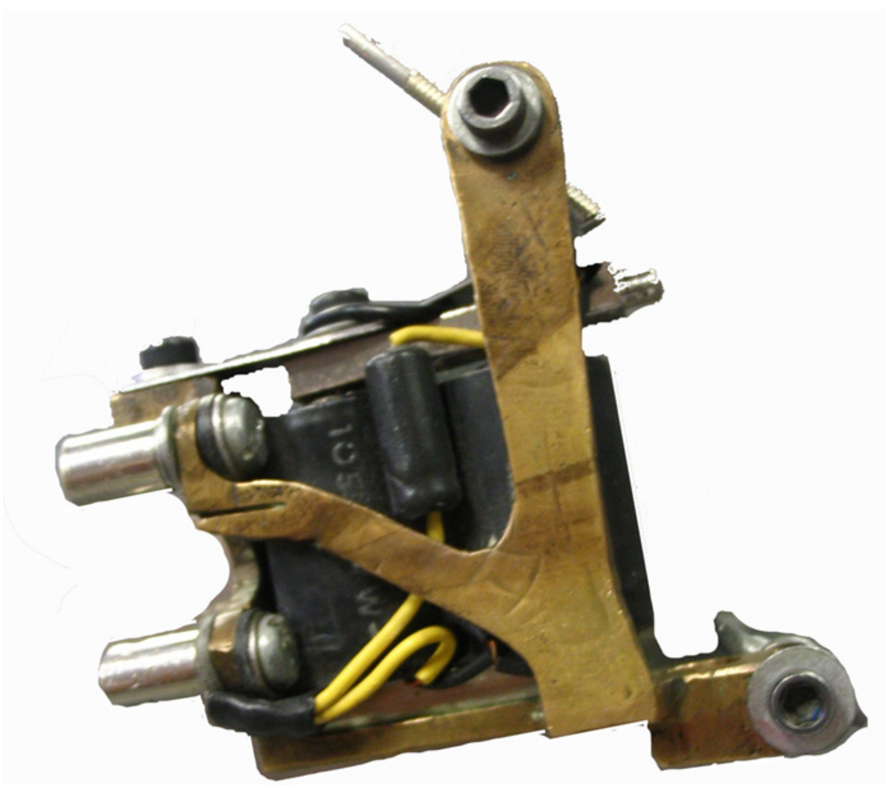
A.



B.

These illustrations show important lines and angles which a frame NEEDS to comply with in order to house the components properly.

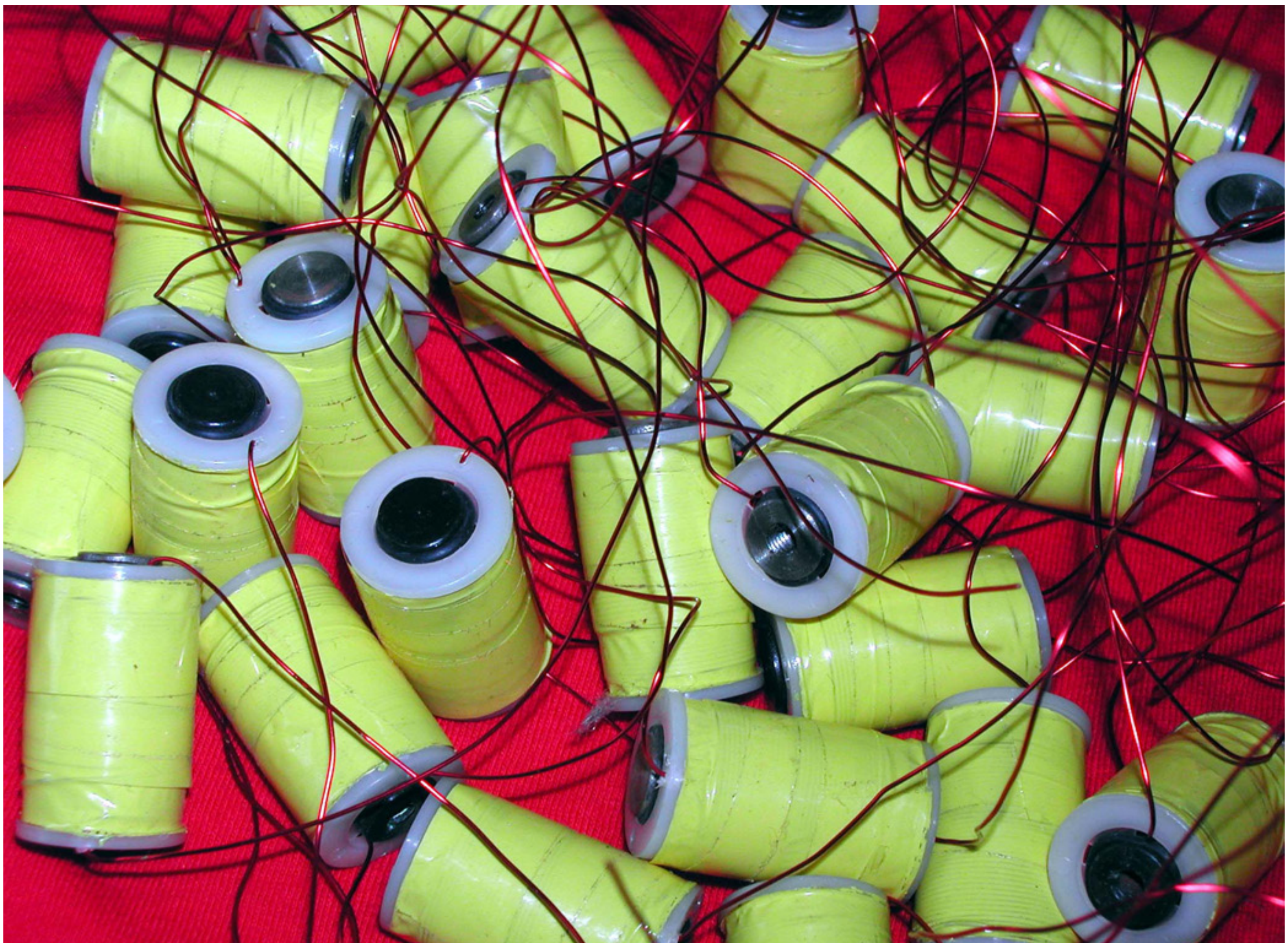
An original **“Jonesey”** frame showing “pits” from sand casting. These imperfections don’t matter, it’s the drilling / frame specifications (distances, angles) and tuning which count. The Jonesey is an example of a well designed, “cast”, machine frame.



The same originial Jonesey frame assembled with more modern parts, showing scars from a hack saw. This particular Jonesey was made from silicon bronze, it is a rare one. Because of the non-magnetic material it’s made from, it is necessary to use a yoke on this frame, as a magnetic base for the coils to rest on.

2

The Coils



"They will generate as much electric as they can..."
-999

An electromagnetic tattoo machine is assembled with a pair of **electromagnetic coils** and a **reciprocating armature bar**. This is a what visually and functionally characterizes the electromagnetic tattoo machine and separates it operationally from a rotary machine, or a pneumatic machine. We all know that the coils are the main machine part responsible for attracting the armature bar which holds the needle bar with it's attached needle groupings, and forces the "down ward motion" which make the needles penetrate the skin. Inexperienced artists often blame the coils for a machine not functioning or running properly. So some myths and assumptions about coils must be addressed.

Lets talk about the function of the Coil, starting with electrical current.

Current is made up of electrons. *Electrons* are invisible atomic particles. *Voltage* is the force that causes current, in the form of electrons, to move through wires. Electrically charged particles move through material, they can move through water as well. Electrons are the most common moving charges. In our use, the coil uses copper wire. Copper is an excellent conductive metal because copper atoms contain very loose electrons. Even though this is true of all metals, copper is the preferred type of wire for our intended use.
In a copper wire, the energy due to room temperature is enough to make any of these electrons float around inside the metal. When connected to a power supply, electrons are pushed, they will move through the wire in a continuous loop of charge, like water through a garden hose. When electricity moves through a wire it creates an electromagnetic force. When running an electric current through a machine coil with a steel or iron core, a magnetic field is generated. A final note, the closer the wire is wound together, the better the quality of the magnetic field. Look at some of these "machine" builders coils...check the closeness of the winds.

Coil Terminology

First, before we proceed to the next topic, the term "wrap" used as "8 wrap" or "10 wrap" referring to the wire winds on a coil is incorrect, each time the wire completes a turn around the coil post, it is referred to as a "wind" or a "turn". The *winds* added up from the lower retaining washer/cap to the top washer/cap is called a *layer*. An 8 layer coil (D.H.D. round coils) may have 296 *turns* or *winds* around the post. So the correct terminology is "8 layers" or "10 layers" NOT "8 wrap" or "10 wrap".
There are few simple ingredients which make up a coil's construction:

- an iron or steel post
- insulation tape
- nylon, neoprene or plastic retaining washers
- magnetic copper wire

The construction of a coil bobbin consists of (starting at the center): a machined or milled iron core–recommended steel is 1018 or 1025, not stainless, this core is then wrapped with a layer or insulation tape, followed by windings of magnetic copper wire to the desired number of layers, which are held in place with a nylon, plastic or neoprene retaining washer inserted into grooves which are machined distally (on each end) on the core for the purpose of accommodating the said washer(s), and finally, the coil is finished with an insulating material wrapped around the "bobbin" of wound wire (sticker, insulation tape, heat shrink...). This is a simple construction.

Let's address some myths about coils.

Myth: "Coils burn out."

Not true, the construction of a "coil" will not permit a coil to "burn out" or "go bad". One way a coil will become useless is if the wire wound around the post is broken. This will interrupt current flow and the machine will not run. Another way is for any part of uninsulated wire to make contact with the frame, or the yoke (grounding). This is not to say that a grounding problem would be solely linked to the coil wire itself, it is common for inexperienced artists to not insulate the screws which secure the binding posts (see binding post assembly illustration p. 53).
The construction of a coil consists of (starting at the center): a machined or milled steel or iron core–recommended steel is 1018 or 1025, not stainless, this core is then wrapped with a layer or insulation tape, followed by windings of magnetic copper wire to the desired number of layers, which are held in place with a nylon, plastic or neoprene retaining washer inserted into grooves which are machined distally (on each end) on the core for the purpose of accommodating the said washer(s), and finally, the coil is finished with an insulating material wrapped around the "bobbin" of wound wire (sticker, insulation tape, heat shrink...). This basic construction cannot "burn out" and will not be damaged by heavy use.

Myth: "12 layers are better than 10, 10 layers are better than 8, 8 layers are better than 6."

Not so...The more layers of wire wound around a steel/iron post, and the thicker the wire, the longer the current takes to flow through, from the lower binding post around one coil, around the second coil and ending at the terminal at upper binding post. Remember, the longer the wire, the more resistance the current will encounter in it's movement through the wire, and the more heat will be produced. The wire gauge and length are the key factors here...the thicker the wire, the more current will flow through but the slower it will flow. Is it really better? Not necessarily, there are variables which can be changed: spring thickness and tension, frame specifications, armature bar weight and capacitance measurements to compensate for and even improve what a coil's performance may lack and may even make the magnetic field of a coil with less layers, function similar to a coil assembly with more wire layers, just by changing the wire gauge to a thicker gauge. But no matter how many layers of wire, the electromagnetic coil will still do what it was designed to do: allow current to pass through the wires wound around it's steel or iron posts causing a magnetic field which pulls down the armature bar, moving *it* and it's components (needle bar, needles...).

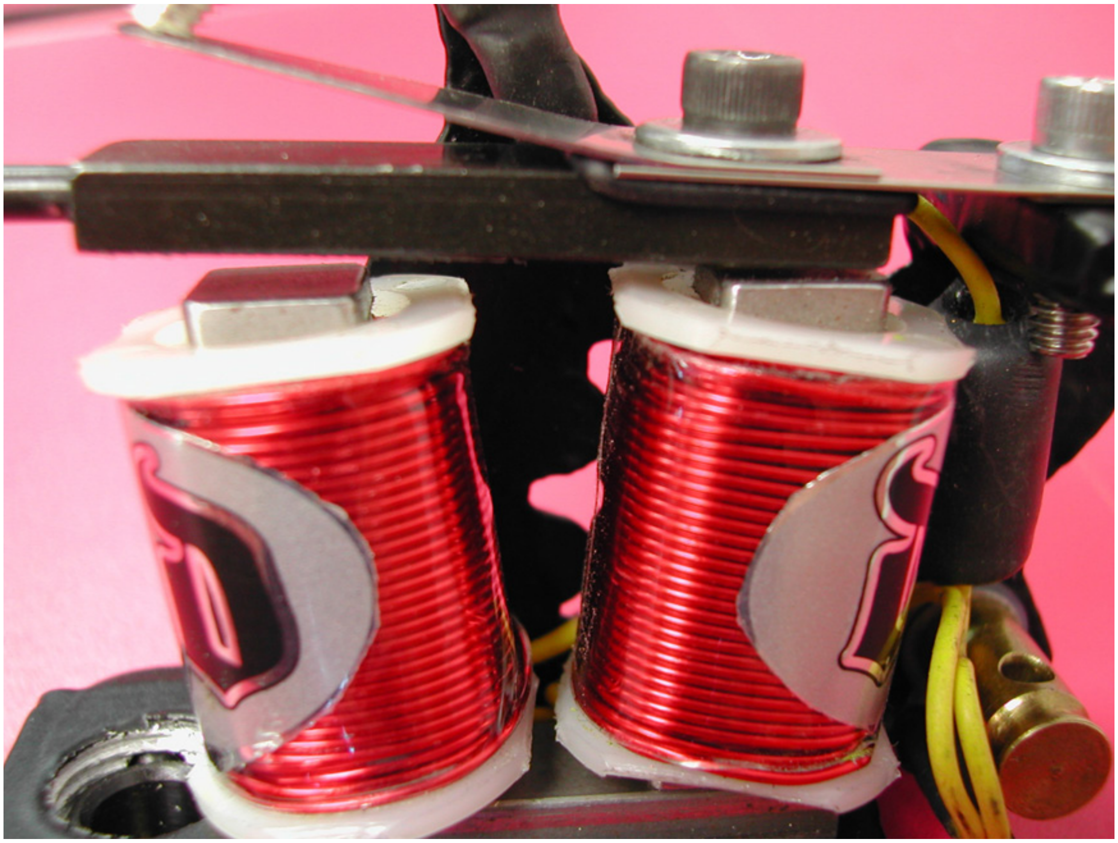
Myth: "Coils must always be used in Pairs"

Not so, there have been machines made using only one coil. The weight of all components being moved by this one coil must be such that this one and only coil can move them with minor effort in order to make this one coil machine run well.

Wire gauges

The thickness of any wire is called it's "gauge". These thicknesses / gauges, are measured in numbers. The tattoo industry standard gauge for magnetic copper wire wound around coils is AWG 24.

Wire gauge measurements / numbers, are opposite to the measurements of spring gauges in the way that the *thinner* the wire, the *larger* the number and the *thicker* the wire, the *smaller* the number. The measurements of the magnetic copper wire are preceded by: AWG, this abbreviation stands for "American Wire Gauge". The standard industry coil bobbin is wound in AWG 24. Thicknesses of wire will affect current flow. Thin wire (AWG 25, 26...) allows current to pass faster with less resistance, the thicker wire (AWG 23,22,21), though it allows more current to pass through, it actually causes more of a resistance because there are a greater number of electrons present in the thicker gauges of wire. Regardless of wire gauge, the closer the winds are together the better the magnetic field will be. An inconsitently hand wired coil bobbin will not be as efficient magnetically as a tightly wound coil bobbin. If winding your own coils, do it right, wind them tight!



These “V-twin” coils (patent pending) are wound in 6 layers of AWG 21 wire.

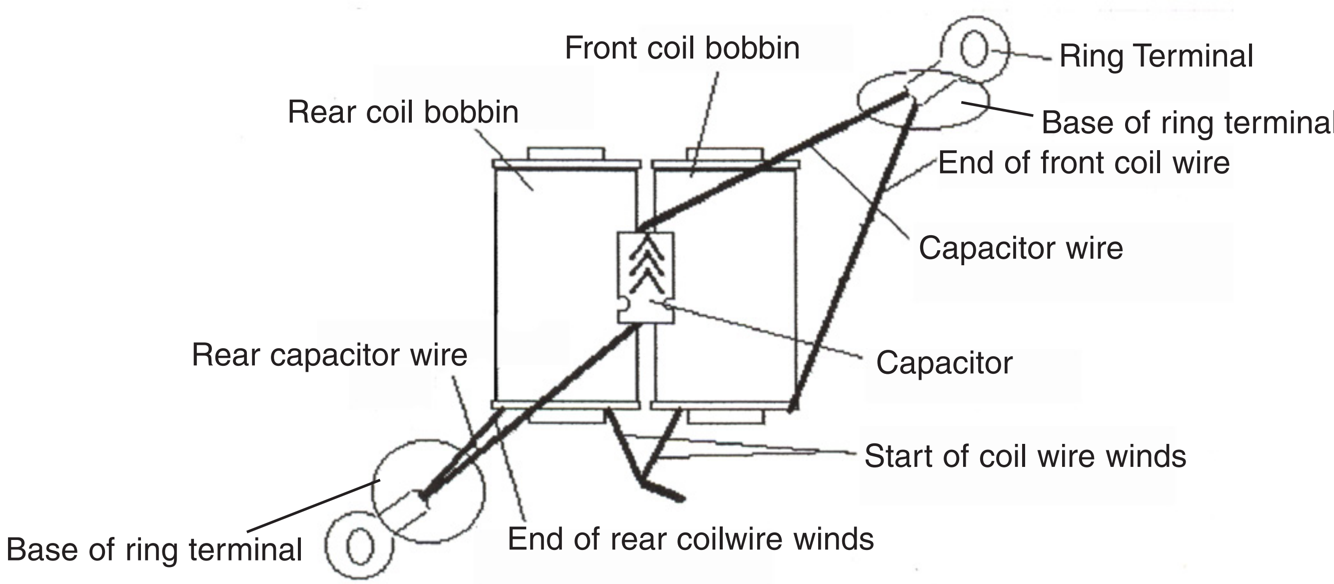
Most of the magnetic copper wire manufactured is sold pre-insulated so if the wire is being wound around a **round** coil, it is not always necessary to apply a layer of insulation tape to the coil post...but, it depends on the thickness of the insulation material covering the wire. The main reason to apply the layer of tape is to be sure that no grounding will occur by any exposed wire directly touching the coil post or any other metal part on the machine. Remember, we want the current to pass through the wire, NOT through the frame, the steel / iron coil posts or the yoke, so make sure any exposed wire is insulated! Any coil core which has angles in it, square, rectangular, octagonal, should have a layer of insulation tape around the bobbin core to prevent any possibility of sharp edges or angles from cutting through or wearing down the wire’s own insulation and causing a grounding problem. Grounding in a tattoo machine is caused when an un-insulated exposed wire or terminal directly touches any other metal part of the machine components other than the terminals attached to the upper and lower binding posts.

Coil Assembly (Assembling coils)

Every coil has a starting and stopping point where the wire wound around the bobbin starts it’s winds and ends–a hole is drilled or punched into the retaining washer next to the center of the coil core/post and it starts it’s winds usually from the bottom or base of the coil post, to the top retaining washer and back down repeatedly until the number of layers desired is reached. The end of the wire commonly ends on the outside of the same retaining washer where the winds are started and exits through a hole drilled near the outside diameter. It is not wrong to have a coil wire end and exit through the top retaining washer. We have made coils of odd numbered layers-5, 7, 9 which start winds at the “bottom” of the post and exit at the top retaining washer. This made the distance from the top of the coil to the upper binding post shorter which cosmetically, created one less wire to try and hide or tuck away and made for quick assembly of the coils to the frame / binding posts, it also gave the machine a front coil with an odd number of layers and a rear coil with an even number of layers. Functionally, the difference was slightly noticeable. Our theory was that a frontal coil with more winds and another layer would make for a stronger magnetic pull and add versatility to the machine’s function.

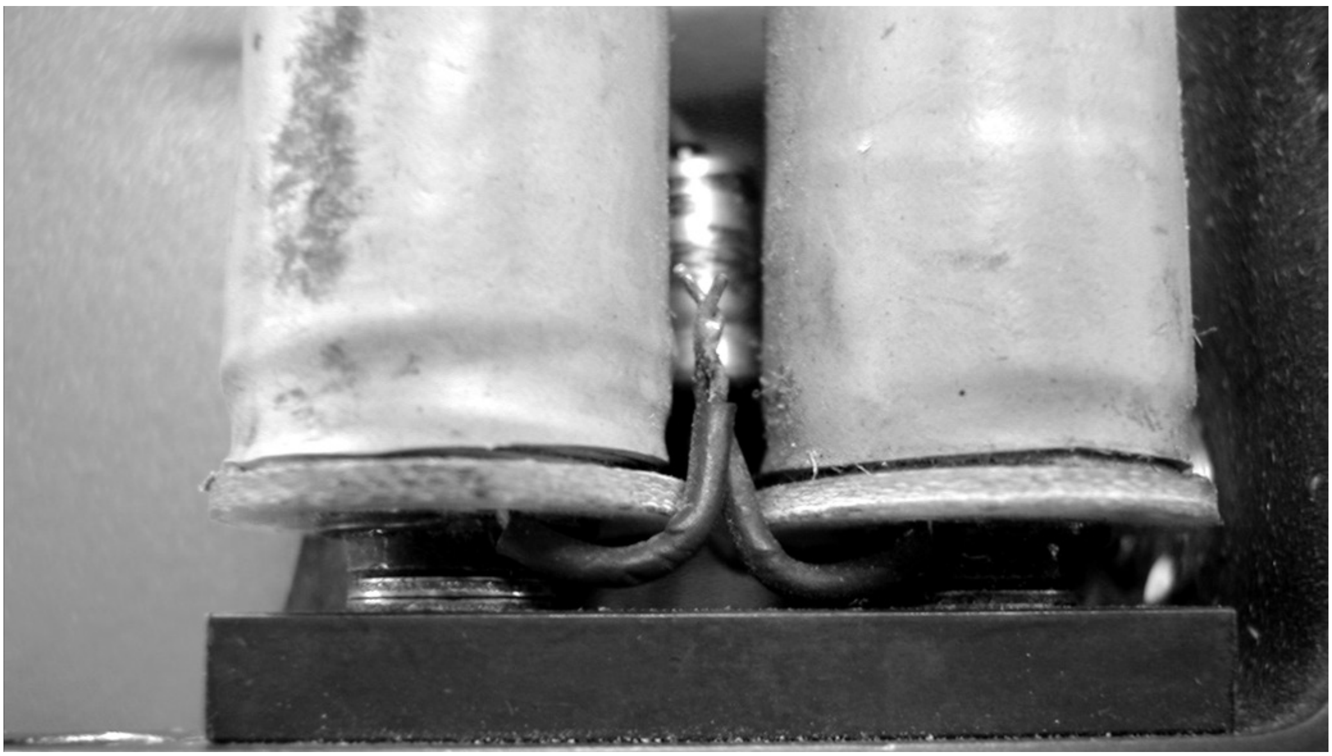
To connect the coils to each other

The inside wires (or starting wires at the inner base of bobbin) from each coil must connect to each other, the outside wires (or end wires) will connect to ring terminals which will be attached to the upper and lower binding posts. The sizes of these ring terminals are #8 or #10 (see p. 39, “Understanding screw threads”). We recommend that no solder be used when connecting coils to each other. This makes for easy separation of the coils if separating them from each other becomes necessary. It is also not necessary to solder the outer wires to the terminals if the terminals used are the type that can be pinched to secure the wire to the (although unsoldering a wire from a terminal is easy). These are called *solderless ring terminals*. They Can be pinched with pliers. All *exposed wire must be insulated* and it is not a bad idea to insulate part of the terminals to prevent potential grounding on the machine’s frame.



Coil assembly wiring diagram

Wire ends connecting to terminals, or to other wires, should have the red insulating material removed before attaching them to the terminal. Simply scrape this material off with a pair of scissors or a small file, be careful when using any blade as the wire may accidentally be cut off.
If a wire breaks, at the bottom of the coil at or under the retaining washer, the coil can be repaired by partial removal of the retaining washer and careful unwinding of the broken wire to the desired length. This must be done with care so as not to accidentally cut any part of the wire winds. This can be a tedious process, so be patient, take your time. Think of it as brain surgery. DHD coils are manufactured for easy disassembly in case such an emergency arises.



This is a perfect example of a pair of coils, carelessly joined together with solder, leaving the bare wire exposed. If you look carefully, you can see the exposed capacitor behind the exposed wires. Capacitors are also capable of causing a grounding problem so it is strongly adviseable to heat shrink the capacitor as well. The coils should have been more presentably heat shrunk. This is a perfect example of careless work, imagine if you dropped your car off for repair and the car looked like this when you picked it up!

Please, to more fully understand the function of the coil and it's magnetic field and it's application in the act of tattooing, read the power supply section on page 62.

3

The Springs

"See saw up and down, around and around we go..."

-The Jam

2 steel **springs** (in our application), when bent, serve 2 main functions: **1**) They create a resistance to the 'downward' pull that the coils exert on the armature bar, by pulling the armature bar in the opposite 'upward' direction (rear spring) & **2**) Control the speed (front spring) and force the armature assembly will bounce back (after making contact with the contact screw) to the coil (with the aid of the coil's magnetic pull). Springs usually are used in pairs; a rear spring and a front spring. Though a "one piece" spring may be used (p. 51), the spring "pair" combination produces greater variability and versatility in the intended uses of the machine and each (spring) has it's own job to do. Machines usually use a pair of springs, a front and a rear spring. These springs are usually made from "close grain high carbon spring steel" or "strapping steel". An excellent example of a high cuality spring steel is found in automotive "feeler gauges".

This is a set of feeler gauges ranging from thick to paper thin. These are generally used for gapping spark plugs, another example of spring steel can be found in the steel "straps" used to hold 2x4's together, usually in shipping. The strapping steel has a 'blue' look to it, the steel these straps are made from are treated. This treatment affects the rigidity of the material. Generally, springs made from this 'blue' steel, feel harder and have less flex than a "feeler gauge" spring of the same gauge. Simply put- a blue .018 gauge spring usually will feel stiffer than a feeler gauge non-treated .018 spring. If you have this type of spring as your only option, experiment with shapes that improve flexibility, if the spring is too stiff (see "Spring width and shape" section p. 25). Be sure you test the flexibility of the material before using it as a spring for your machine. Hold a piece between both hands, about 1" between your thumbs and place your pointing fingers on the ends of the material and bow it, see if it springs back. If it doesn't spring back and stays bent, it is not worth using as it may crack, or not have the resistance needed for a smooth running versatile machine. Using low quality springs can cause the machine to sound and run exactly the same way it would if there were electrical power-surges going through it.

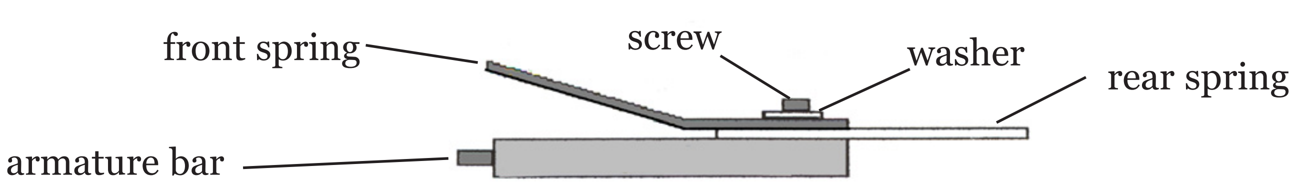
Understanding spring gauges

The smaller the (standard) number on the spring stock, the "thinner" and more flexible the stock, the larger the number, the "thicker" and less flexible the spring stock. A machine will have to work harder to move a harder (thicker) spring (.019, .020, .021) because the flexibility is limited, this can also happen when there is too much tension on the rear spring. Generally, spring gauges used are inch measurements, the number .018 has an equivalent metric measurement of .457. A .017 spring has a metric equivalent of .432, so in metric, it is the same, the greater the number, the thicker the spring gauge.
An .018 in front used in combination with a .017 in back may be ideal for the proposed function of your machine. Maybe the drilling specifications on a particular frame may require the stiffness of a .019 rear spring and a .018 in the front. The tension of the rear spring will dictate the amount of compression on the front spring which, in effect control the speed of armature bar/needle bar movement and force of needle penetration... that is, if the front spring is a thin enough gauge to have some flex, and it should have very little. If it doesn't, it may be too thick of a gauge, we recommend to stay around .017 and .018 for a front spring (see Spring Tension test p. 60).
Remember, the power supply controls the force at which the needles will penetrate (not the speed) when encountering resistance from the skin. When doing a black and gray piece, a machine may run at a lower setting (on power supply) on the customer with softer skin (to achieve a smooth perfect gray) and may need to run at a little higher setting on someone with tougher skin, in order to achieve the same "smoothness" of shading. The tension of any spring is affected by it's thickness / gauge and will directly influence the quality of penetration and resistance the needle grouping will encounter, controlled of course by the regulated power supply. The goal is to regulate tension, (bend), gauge of the springs, in conjunction with the pull from the coils magnetic field, which is controled by the power supply's dial.

You can make these springs yourselves or buy them already cut. To make springs, see the "Cutting Springs" section, **Chapter 4** - p. 29.

Spring / Armature bar assembly

The assembly of a spring / armature bar set up is as follows— bottom to top: armature bar, rear spring, front spring, washer, screw.
TIP-any washer used directly on top of a spring should have any sharp edges gently filed off, this sharp edge can increase the risk of a spring breaking in the particular area the sharp edge pushes into the spring material, the movement of the armature bar and the flex of the spring material, will speed up the breaking process.



Recommended gauges

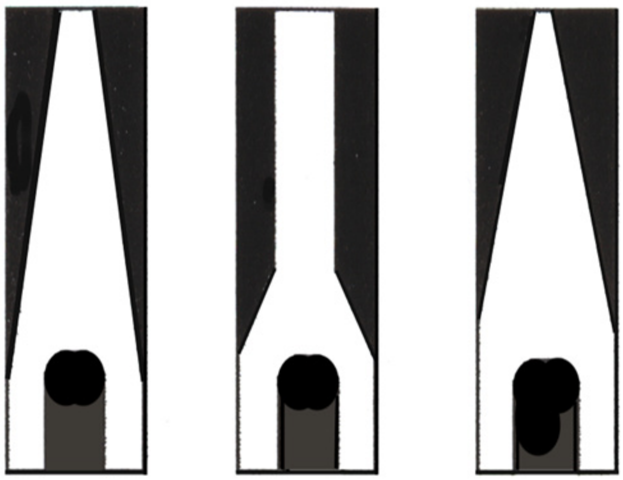
Gauges of spring steel needed for proper function will vary according to the specifications of the tattoo machine and weight of the armature bar / components associated with the armature bar. Generally, we recommend a .017 or an .018 front spring and a .018 rear spring combination...though different gauges may be used to compensate for differences in frame design and drilling specifications, or weight of the armature bar. The flex of the .018 spring (usually) has the standard ideal flex / stiffness for a perfectly versatile and well tuned machine. Though, on occasion, an .018 may be a little stiff for a rear spring if the spring saddle is very close to the back of the armature bar, where a .017 gauge spring may be the ideal gauge to use. Generally, springs used will remain between .017 and .019 for the rear spring and .017 and .018 for the front spring.

Spring width and shape

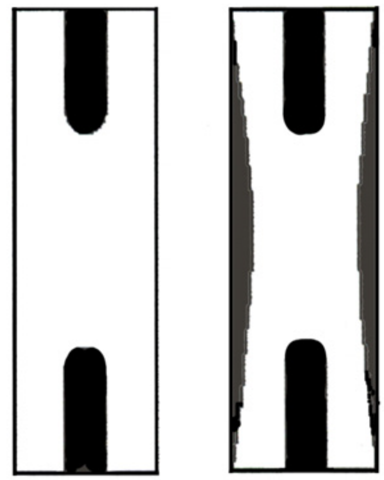
***A question:** You have 2 pieces of spring steel stock, both are identical in thickness and in width, but one is longer, which one will be harder to bend? The short one will be "stiffer" and have less flexibility when bent by holding each end, the longer one will be more flexible. This principle is important because in the tattoo machine application**, tension on the springs is created by bending or un-bending the springs, or shortening them**. If the distance between the spring saddle and the front of the armature bar is too great, and the gauge of "rear" spring stock is not thick enough there will not be enough tension / leverage to move the armature bar at a force acceptable for proper needle penetration in to the skin, no matter how big of a bend you put in the rear spring; remember the rear spring has to deal with the following: armature bar weight (including it's assembly components), needle bar weight, grommet weight, rubber band tension, how many needles must be forced into the skin and the skin type. A thicker spring gauge may be considered if needle penetration is not adequate.

***A second question**: You have 2 pieces of spring stock, both are identical in thickness and in length, but one is thinner in width, which one will be more flexible? Easy.
Using this principle, solve this problem: You have a rectangular piece of spring stock which needs more flexibility. What could you do to this rectangular piece of stock to increase flexibility? Change it's shape-cut, file, hole punch...removal of stock on each side of the spring will increase flexibility and reduce tension, as will removing stock from the center (See illustrations on the next page).

This seems so simple yet a big percentage of artists cannot diagnose this problem and would not know how to fix it. Do not be afraid to experiment with different shapes and thickness of your spring stock. The springs are possibly the most important ingredient in the function of a smooth and versatile machine.



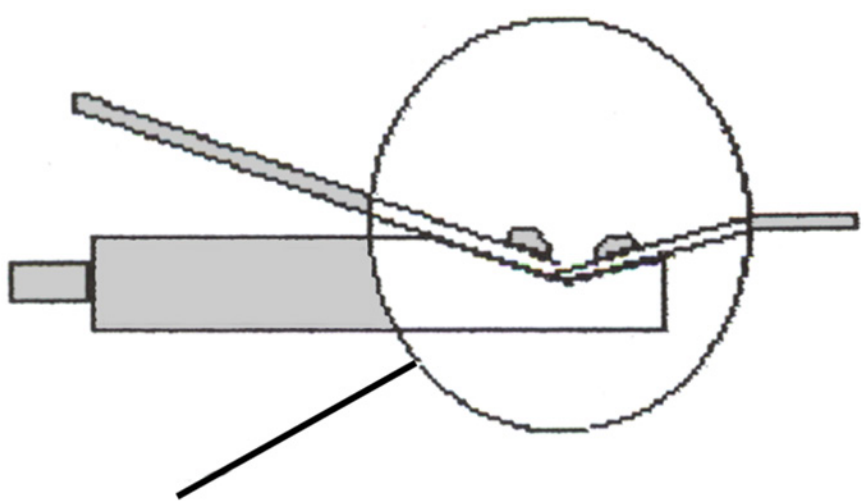
Ideas for front spring shapes.



Ideas for rear spring shapes.

Spring Tension

Some artists say that bending springs may shorten the life span of the spring and cause it to break sooner. We have all seen the armature bars with angles milled into them to accommodate an unbent front spring. The same could be done to the spring saddle to accommodate an unbent rear spring. The theory stating that "bends in the spring will shorten the material's life" may be true but we have no choice unless we use angled spring saddles and angled armature bars. If you don't use those bars, you must regulate the tension on both springs by bending or unbending them. Another point to bring up regarding these armature bars with angles milled into them, even though they are a novel idea and very inventive (invented by Bill Baker of Eikon Device in Toronto, Canada), it's important to state that these require 2 screws and or 2 washers to secure the springs to them...this adds weight to what the rear spring already has to carry and may require a thicker rear spring gauge to move them correctly, so keep this in mind if this your choice of armature bar, use the correct spring gauge!

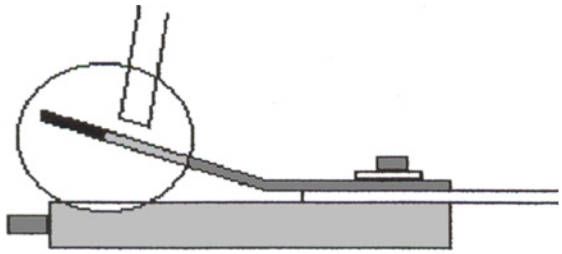


Angled armature bar. Note the extra weight the rear spring has to deal with, an extra screw and washer added to it's already existing burden.

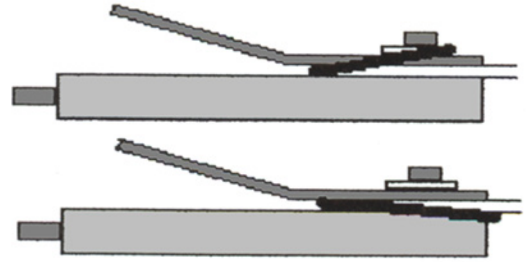
Remember, the tension on the rear spring will decide the compression of the front spring, and that the front spring will compress according to it's gauge, the thinner the front spring, the more flex it will have. This directly affects the application of the tattoo. The gauge of the front spring is just as important as the gauge of the rear spring. The front spring partially influences the movement of the armature bar which directly affects the needle bar's force of movement. So a thicker stiffer spring may work well for lining with larger groupings as it causes more counter resistance than a softer, thinner spring would, but it can also determine the abuse the skin may have to endure if there is not enough flex to deal with the resistance the skin will produce against the penetration of the needle groupings. A stiffer front spring will also limit the versatility of the machine's function to a strictly coloring machine or a power liner but will also make the machine have to run at a higher setting on the power supply and may even cause the machine to heat up. The technique to gray shade consistently and smoothly by turning the dial on the power supply "down" will not work properly if the springs are too stiff, and if there is too much tension on the rear spring. We believe that each machine should have the capability to outline, shade and color with the particular grouping being used, including a single needle. This enables the artist to excecute small tattoos with the same detail as a larger tattoo, provided that he/she has the skill to use small needle groupings.

This brings up another problem. Being familiar with the armature bar and it's assembly, answer this question: You have a .016 or a .017 spring in front (these gauges are used as an example based on the understanding that the .018 gauge spring is the "ideal" standard spring to use) you can use the machine just fine with a 5 or 7 magnum for black and gray shading or lining with a single needle and a tight 3, but cannot use a larger liner grouping to line with it or color solidly with it, what would be the cause?
The resistance of the needles penetrating the skin causes the thin .016 or .017 front spring to flex thus allowing the needle bar / grouping to "back off" from the skin upon contact, and not allow the needles to penetrate the skin deeply enough to inject the color solidly. You will need that front spring to be stiffer and don't have and .018 to change to, what can you do?... using the principles described above. Shortening the front spring by cutting it and move your contact back is one way (be sure to set your stroke and tune the machine after cutting the spring and moving the contact screw back) , why? Because a wider, shorter spring stock will be less flexible in terms of leverage—front to back--tip of the spring to the back where it is secured to the armature bar.

What else could you do? **O-rings** come in a variety of thicknesses and diameters. When placed under the front spring and over the armature bar assembly screw or under the front spring and behind the back of the armature bar, the 'pull back' on the front spring can increase tension. A thicker o-ring will move the point of flexibility closer to the tip of the spring thus shortening the available spring stock and increasing tension (lessening flexibility) on that front spring. Though ideally, the spring should be changed to a thicker gauge and an O-ring added. O-rings provide a shock absorber under the spring and make for a smooth running machine-careful with the thickness of the O-ring.



Cutting back the front spring and moving the contact screw back.



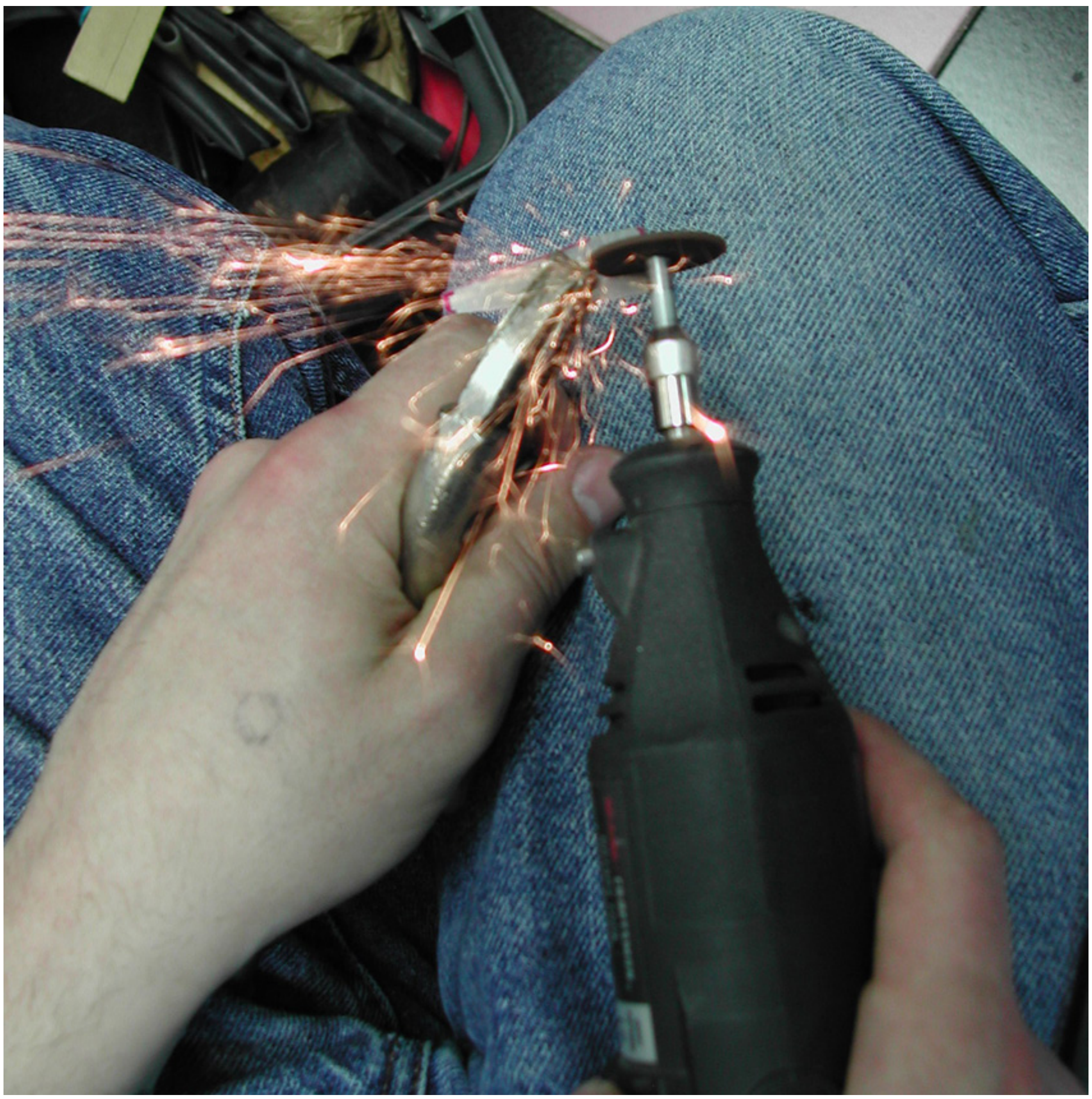
O-ring placement.

When modifying a thicker spring gauge by slimming it down (removing stock in order to increase flexibility and lessen tension) the flexibility of the .018 gauge spring *usually* has the ideal flex to move and support the weight of the armature bar, it's assembly components (screw, washer, front spring, o-ring, grommet/tape/paper towel, needle bar, needles) as well as resistance from the rubber band and the resistance from the penetration of the needle grouping into the skin-suntanned or tougher skin will affect counter resistance on the front and rear springs as well. The front spring deals mostly with the resistance from the penetration of needles into the skin, more so than the rear spring, though the rear spring is also affected. ...why is your machine heating up? Maybe you should check the gauge and tension of rear spring. Or maybe your rubber band is too tight. Similar to an overheating car, a machine can heat up if it's struggling to move the armature bar due to increased resistance (too stiff of a spring, too much rubber band tension and weight of the components (armature bar assembly). A machine heating up may be a symptom of another cause as well...carbon build up on the contact screw interferes with the flow of current and makes the machine work harder. It can also build up on the clips on the clip cord, so watch for it and remove it if necessary. From constant use, the metal clips will develop wear in the form of grooves worn into them, these can be filed down to smooth these out but eventually, the clip cord clips should be replaced. A clip cord is easy to build and maintain, as is the footswitch.

These grooves can allow for a build up of carbon and should be cleaned periodicaly with a fine sand paper, wire brush, steel wool or a small file.

4

Cutting Springs



"I said do you feel it when you cut me...well alright..."
-The Stooges

Springs can be purchased from almost any tattoo supplier in the thickness you may need, to the tune of $5.00-$10.00 dollars a pair.
A 12” length of feeler gauge stock runs between $1.00-$2.00. It can be ordered through specialized hardware stores. Starrett is a good brand. 3-4 pairs of springs can be cut out of one 12” length, and not only is it economical, the spring shapes and widths are yours to control and modify until you find the perfect shape for the function. You will also learn a lot by cutting these yourself, if you are willing to take the time and be patient.

Tools needed for cutting springs:

- spring stock 12” length
- ruler
- sharpie marker
- tin snips / metal shears
- hole punch is preferred, but not necessary
- Dremmel with cutting disc (the larger disc 1.25” diameter)
- large flat file
- vice grips
- needle nose pliers
- safety glasses

Anyone who tattoos knows and recognizes the basic shapes of the rear and front spring. The front spring is commonly triangular with a “u” shaped slot cut at the back of the triangle, where this spring connects with the armature bar / spring assembly securing screw and washer. The rear spring, basically, we know as a rectangular shape with “u” shaped slots cut into each end of the rectangle. One slot sits against the spring saddle securing screw and washer and the other end is attached to the armature bar assembly / spring assembly securing screw.

To cut a front spring

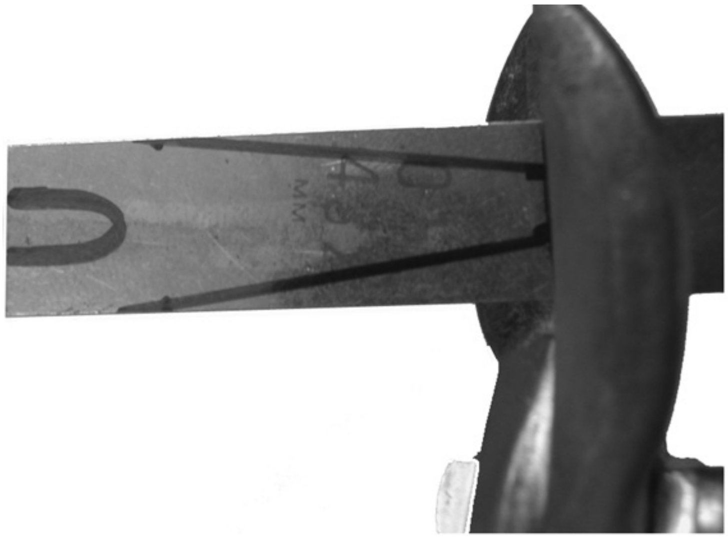
1) Mark the length of the spring on the spring stock with a sharpie or permanent marker.

2) Cut the stock to length with a pair of tin snips or sheet metal shears. By holding the spring stock with a pair of vice grips.

Mark the triangular shape of the front spring on the cut piece of spring stock with a sharpie or permanent marker. It is better to make the spring stock a little wider and have to remove stock to improve flexibility if necessary than to start with a spring that is too skinny and flexible.

3) Mark the width and depth of the slot which accommodate the size screw you will be using to secure the springs to the armature bar assembly. Normally an 8-32 hex head screw, so it must accomodate a #8 hole (see understanding screw threads p. 39 .

4) With the piece of stock secured in the vice grips, punch out the ending of the slot with the hole punch. Make sure the hole will accommodate the size screw you intend to use to secure the spring to the armature bar assembly.



Spring stock marked for cutting a front spring.

Keep those safety glasses on...before you cut into the stock, secure the spring with the vice grips. The closer you clamp the vice grips to the hole or proposed cutting marks, on the stock, the stiffer the stock will be and the easier the cutting disc will go through with out the stock flopping around. With the dremmel cutting disc, cut into the stock, following the line from the back of the spring all the way to the hole you have punched. If you DO NOT have a hole punch, cut all the way to the proposed ending of the slot. The piece that is left in the slot, between the dremmel cuts, will break out easily with a pair of needle nose pliers. Smooth the jagged edges of the break with the cutting disc or small round file. This slot is important to have. It makes it possible to change the flexibility of the spring by simply sliding the spring forward or backward. If you do not have a dremmel, but do have a hole punch, cut from the end of the spring to the hole with the tin snips.

Secure the small piece of spring stock in the vice grips at the back of the piece of stock and cut, with the tin snips or sheet metal shears from the front of the spring toward the back, making sure to leave enough room for the snips to cut all the way to the proposed end of the cut without interference from the vice grips. Do the same on the other side. Wear safety glasses! The pieces of stock which are being cut off, will be extremely sharp at one end and can fly once the cut is complete. You should have a triangular shaped piece of spring stock with a flat space at the tip and a flat section on each side, length wise. These flat spaces should be the same length as the length of the screw slot. Smooth and round any burrs or sharp edges with the file.

This spring is ready for bending. Always leave a space equal to 1/2 the diameter of the securing washer before the start of the bend. The bend should NEVER end up *under* the washer / securing screw which holds the spring to the armature bar. The bend should ALWAYS be on or in front of the edge of the washer. A bend under the washer will affect the flex of the spring. It will make for an inconsistent performance which can be heard and felt when tattooing.

To bend the front spring

1) Mark the proposed bend with a sharpie or permanent marker, just in front of where the washer will sit once secured to the armature bar / spring assembly.

2) Hold the thicker back of the spring with the vice grips, put the flat edge of the needle nose running perfectly with the bend line you have drawn and bend the spring. DO NOT be too concerned with the angle you have made just yet, there is room for adjustment. The adjustments are normally made upon complete machine assembly and before tuning.

See examples of spring shapes (p.25). Remember that the springs you have cut, can be re-shaped in order to improve flexibility if necessary.

To cut the rear spring

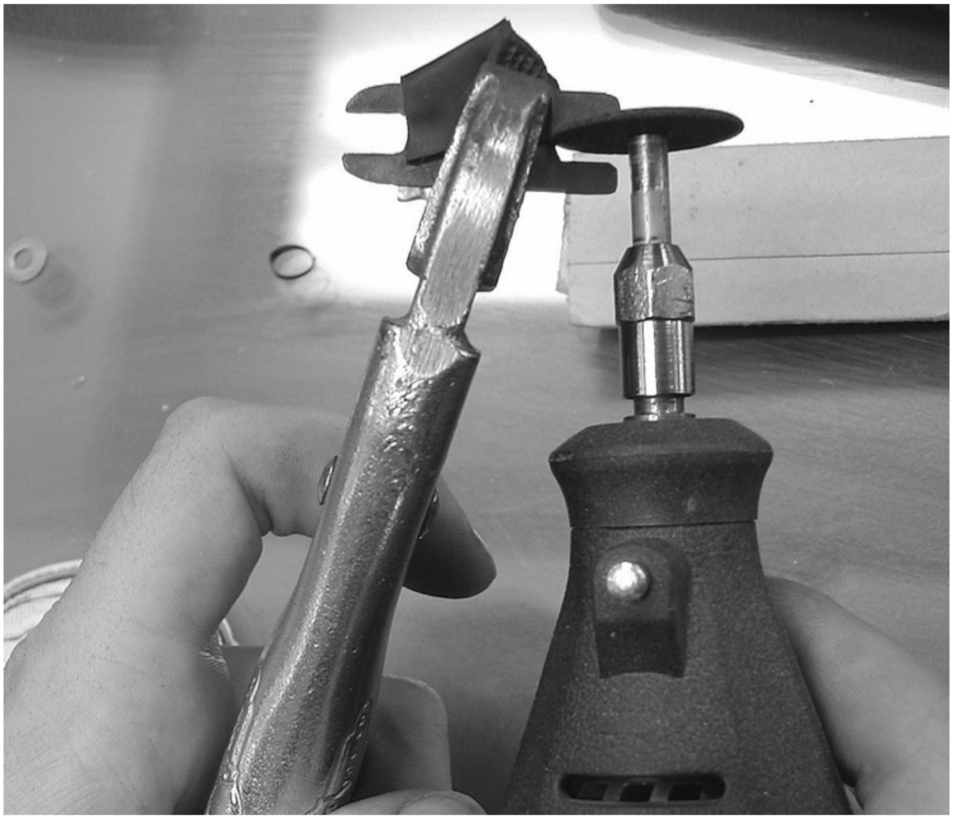
1) Mark the proposed length of the rear spring stock with a sharpie or permanent marker.

2) Cut the stock to length with a pair of tin snips or sheet metal shears. By holding the spring stock with a pair of vice grips.

3) Mark the width and depth of the slots which will accommodate the size screws you will be using to secure the springs to the armature bar assembly and to the spring saddle on the frame. Normally an 8-32 hex head screw.

4) With the piece of stock secured in the vice grips, punch out the ending of the slots with the hole punch. Make sure the holes will accommodate the size screws you intend to use to secure the spring to the armature bar assembly and to the spring saddle on the frame.
Before you cut into the stock, secure the spring with the vice grips. With the Dremmel cutting disc, cut into the stock, following the line from the back of the spring all the way to the hole you have punched. Do this on each side for each slot. If you do not have a dremmel, but do have a hole punch, cut from the end of the spring to the hole with the tin snips. NEVER use the tin snips only without a hole punch. Tin snips and sheet metal shears will, almost always, leave a small crack running diagonally from the end of the cut, into the spring stock, this will usually result in a break in the spring during operation of the machine.

If you DO NOT have a hole punch, cut all the way to the proposed ending of each slot with the Dremmel. The piece that is left in the slot, between the Dremmel cuts, will break out easily with a pair of needle nose pliers. Smooth the jagged edges of the break with the cutting disc or small round file.



Using a dremmel to cut from the rear of the spring to the hole which was punched out by the hole punch. This makes a smoother cut which is less stressful on the integrity of the spring stock.

This rear spring is now ready for bending. Always leave a space equal to 1/2 the diameter of the securing washer, in front of the rear slot before you start the bend. The bend should NEVER end up under the washer / securing screw which holds the rear spring to the spring saddle. The bend should always be on or in front of the edge of the washer. A bend under the washer will affect the flex of the spring. It will make for an inconsistent performance which can be heard and felt when tattooing. The bend in the rear spring should be made a half of a washer's diameter in front of the rear slot on either spring (front or rear).

To bend the rear spring:

1) Mark the proposed bend with a sharpie or permanent marker, just in front of where the washer will sit once secured to the spring saddle.

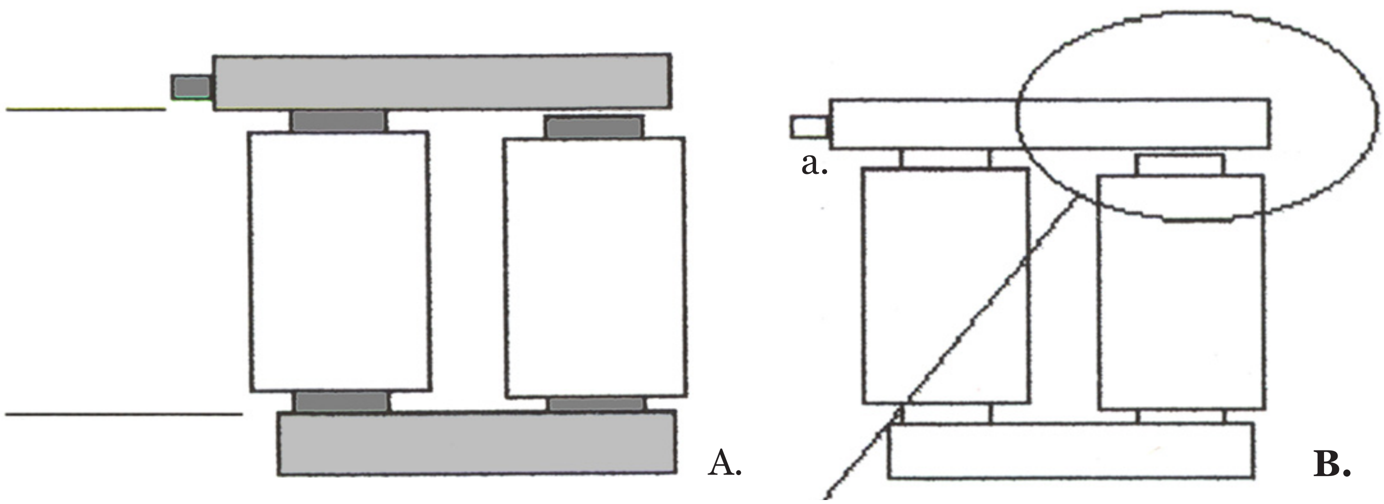
2) Hold the spring with the vice grips, put the flat edge of the needle nose running perfectly with the bend line you have drawn and bend the spring. DO NOT be too concerned with the angle you have made just yet, there is room for adjustment.

The adjustments are normally made upon complete machine assembly and done before fine tuning. See examples of spring shapes (p. 26). Remember that the springs you have cut, can be re-shaped in order to improve flexibility if necessary and can be bent some more to increase tension or un-bent to eliminate tension. To assemble the pair of springs to the armature bar, see "**Assembling the armature bar / spring assembly**" in the "**Assembly of the Machine from Basic Frame to Finish**" section (p. 52).

Armature bar

The armature bar is what holds the needle bar. It is connected to the tattoo machine frame by it's attachment to the rear spring, which is attached to the spring saddle on the frame. Simply put, it's movement is regulated by the magnetism of the coils and the tension of the springs. It's length and general size is important to it's rate of movement. It's material must be magnetic, iron or steel. Preferably the same material as the coil posts and yoke, as these are all part of the magnetic system.

The armature bar should cover both coil posts completely, remembering to leave the smallest possible space between the rear coil post and the armature bar (See Illustration B). The armature bar should **always** be parallel to the yoke or machine base when the armature bar is pressed firmly against the top of the front coil post (see illustration A).

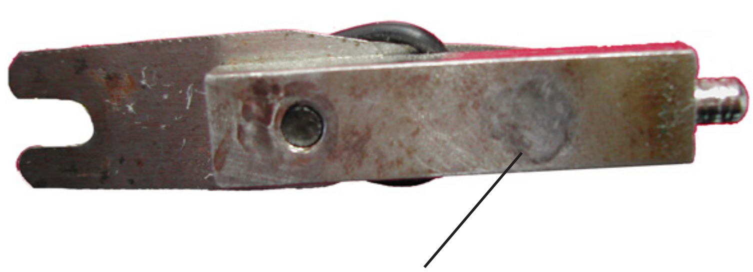


The armature bar should never protrude too far past the vertical line of the rear coil **post**, if this is the case, it should be trimmed off with a hack saw and filed.

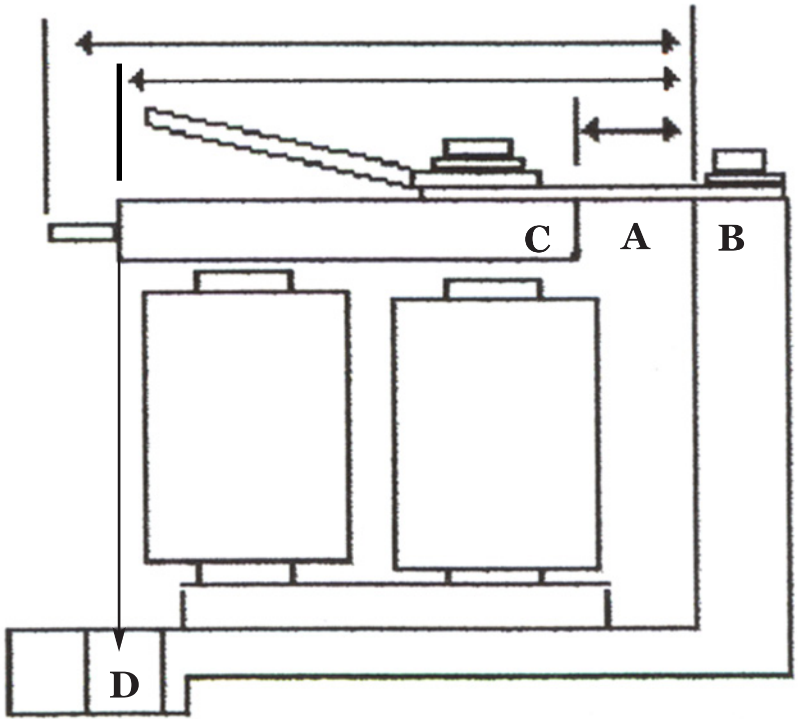
The nub (a) on the armature bar should have the needle bar running directly through the center of the inside diameter of the tube, or slightly behind center, (toward the front coil) making allowances for a rubber grommet, foam tape or piece of paper towel, (whichever you choose to use to make a secure fit for the needle bar loop), as it will push the needle bar loop forward slightly. The distance from the spring saddle to the front of the armature bar should be taken into careful consideration, as should the space between the spring saddle and the rear of the armature bar. This, as stated before, determines what spring gauge, width and length should be used.

The longer the distance, the stiffer (thicker) the rear spring should be. Any spring has a weight tolerance it can support and move correctly, testing these spring gauges is what should be done in order to find the perfect spring gauge for that particular machine's specs. It's not a bad idea to start with a .018 (.457 metric) and move up or down in gauge from there. Don't forget that springs can also be shaped to improve flexibility if you are starting with a stiffer spring, generally .019 and higher is considered "stiffer". This information is explained in more detail later on in the book in the "Spring Tension Test/Ball System" chapter page 59 .

An armature bar making contact with the front coil post is directly responsible for the sound a machine will produce. A small piece of 3M Trans- pore tape will not only act as a muffler and make the machine will sound smooth, but it will also protect the armature bar from wear. Remember, over time, the friction will cause a groove to be worn into the armature bar itself in the shape of th front coil. This friction will also cause the tape to get thin and wear out, this tape should be changed periodically. Also, when changing the tape, the surface of the coil may be covered in adhesive from the previous Trans-pore tape "muffler", this can be wiped off with some WD-40 and a paper towel. A groove worn in the armature bar, from the front coil post, will act as a guide and keep the armature bar wanting to hit in exactly the same place, this is no good, especially if the armature bar is mis aligned to begin with...but the armature bar can be flipped over and re aligned so that the smooth side can be used to make contact with the coil, it will be like using a brand new armature bar. Armature bar weight can be a factor as well. An armature bar can have holes drilled in it or ca be cut to lessen it's weight, to accommodate the movement and flex of a softer spring.



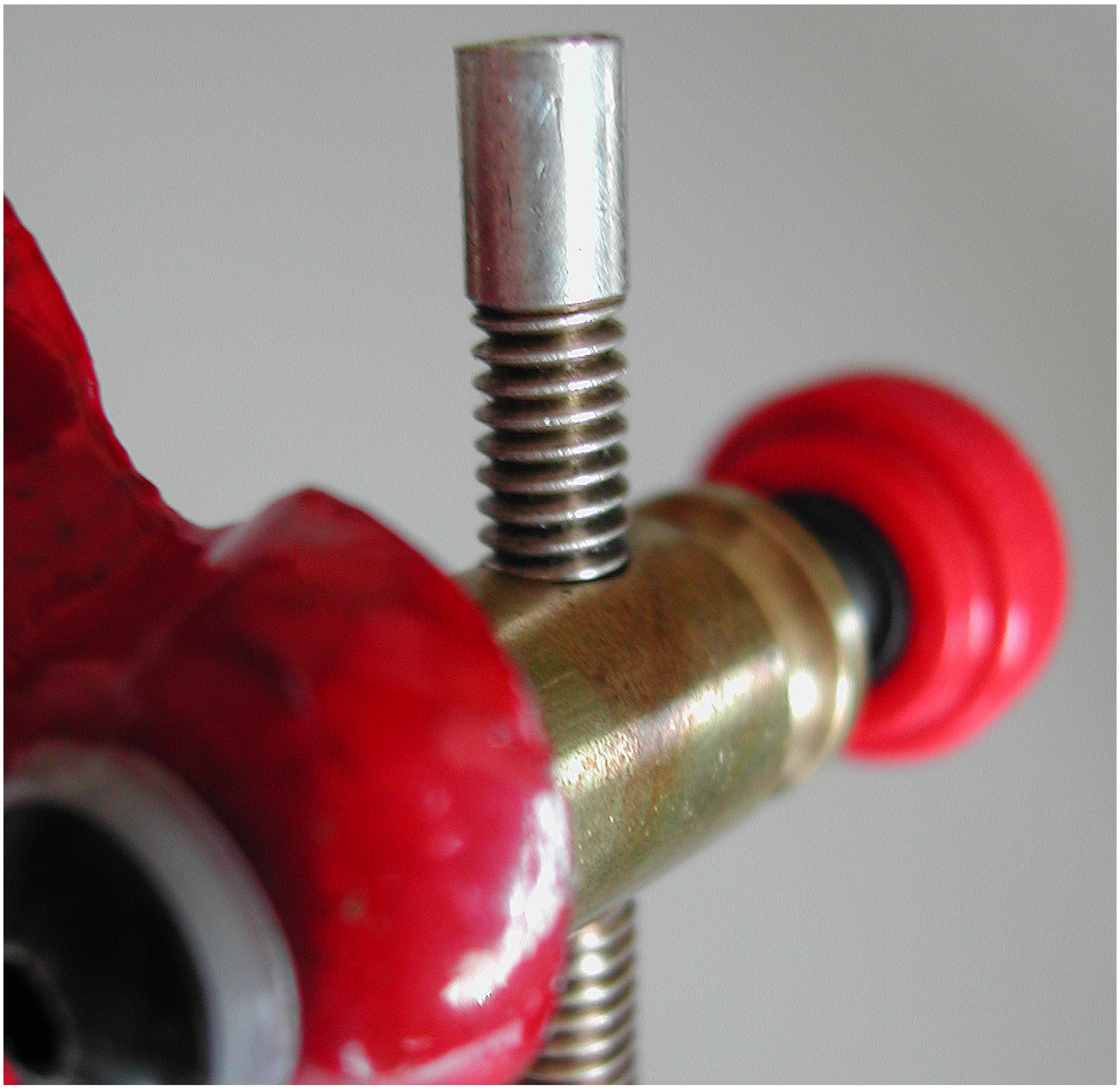
Notice the armature bar "scar" from front coil friction.



These distances will vary from machine to machine and are crucial to the proper function of the machine. Just by the illustration, one can see that the weight of the armature bar / front spring assembly is totally dependant on the strength, gauge and tension of the rear spring (A), and once assembled, even more weight will be added to the equation, and once the machine is running, even more force will be exerted on the rear spring. The farther away the rear of the armature bar (C) is from the spring saddle (B), the thicker the <u>rear</u> spring gauge should be, the longer the armature bar or the longer the distance to the tube vice hole (D) from the spring saddle (B), the thicker the gauge of the <u>rear</u> spring should be. You will know if the spring(s) should be thicker because the needles will not "hit" with enough force to color solidly and will usually make an inconsistent line. Several companies will sell springs already assembled on their machines without specifying the gauge so it's important to understand these frame distances and the applicable spring gauges. Some spring sets these companies sell in their unassembled machine kits, or on their completely assembled machines, may be too thin of a gauge but more <u>commonly</u>, will be too thick, usually .020. An .018 gauge rear spring seems to be standard for quality performance but assert the distance between the back of the armature bar and the close edge of the spring saddle and use the appropriate spring gauge, .018 may be too thick. A .017 or a .018 back spring can usually used with an .018 as a front spring, so base any spring changes around the use of a pair of .018 gauge springs. See "Spring tension test" (p. 60), "Ball system" (p. 61) for a more in depth understanding of these springs "in use".

5

The Contact Screw



" Lie back and dream of me, red death to set you free we'll turn the screws to make you die..."
-Motorhead

The contact screw runs through the upper binding post. It makes contact with the front spring. The point where this contact screw makes contact on the front spring will change a machine's performance. It is an important co-factor in the setting and adjusting of the distance the armature bar will travel (the stroke), by, among other things, acting as a limiter for the front spring, so it must be tightened or loosened in conjunction with the tension on the spring(s)-(see "Spring Tension Test, Ball System" p. 59, 60, 61). Once again, *the bend in the rear spring will control the distance the armature bar / front spring assembly will potentially travel this is called the "stroke". The gauge of the front spring will dictate at what rate of speed the armature bar assembly will travel (bounce) when moving from the coil to the contact screw, in direct relation to the tension applied to the rear spring. Tightening the contact screw will lessen the distance the armature bar will travel and increase the speed of it's movement*. Changing the angle of contact will also make a difference. Pivoting the contact screw to make contact farther back on the front spring will reduce the distance the armature bar will travel even more–shortening the stroke, increasing the tension put on the front spring resulting in a non functional machine. Let's explain. Tightening the contact screw or moving the contact screw's point of contact back without adjusting the spring tension will retard the function of the machine in the same way:

Shortening the stroke- this lessens the distance the needles will protrude from the tip of the tube, and in effect may limit potential needle penetration...solid color requires slightly more needle penetration at greater force than shading...but the stoke should be the same in either application.

Another result of a compromised stroke by tightening the contact screw is the versatility and performance of the machine. A machine that can shade smoothly, needs flex in the front spring. When the screw is tightened, it pushes down on the front spring, decreasing the flex margin the spring already has and increasing the upward tension against the contact screw. A machine with this much tension would *not* be able to shade smoothly or consistently.

Shortening the front spring and moving the contact screw's contact point farther back on the front will do the same– reduce stroke and cause too much tension for the new stroke change.

Let's review. The loss of distance (tightening the contact screw or adding more of an upward bend in the front spring) will also limit the stroke and reduce the potential needle penetration. It is crucial that potential needle depth is not sacrificed. The less needle that penetrates, the lighter the color will be, the lighter the line will be (unless using a single needle). Loosening will do the opposite, again, the potential needle penetration is affected.

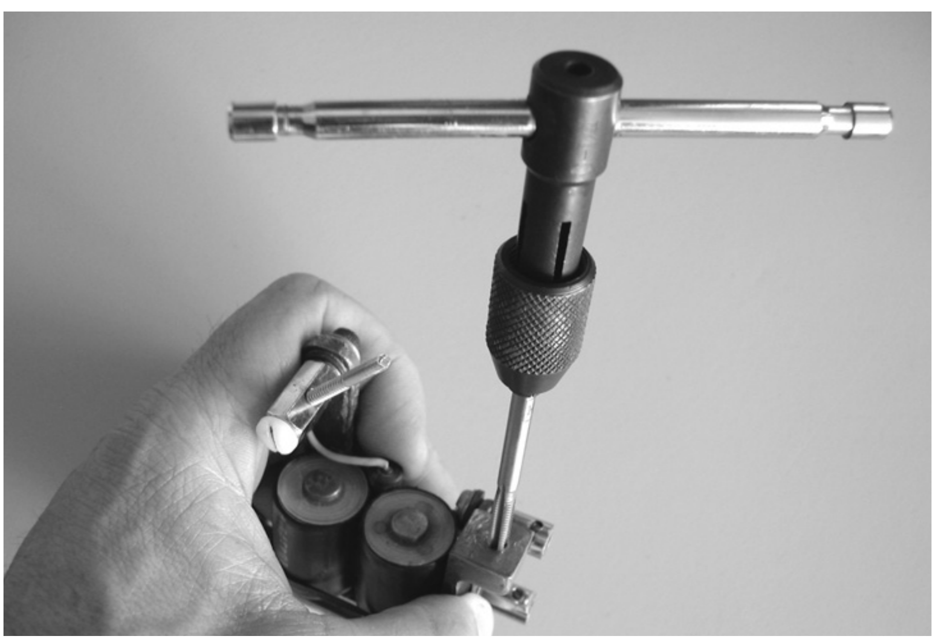
A larger stroke will require more tension on the rear spring to compensate for the distance the armature bar will travel (See illustration p. 52).

Material

Silver is recommended first and foremost–sterling is excellent. Brass or even copper are fine. Steel or even stainless steel will work but are <u>not</u> recommended. When operating, a machine undergoes friction in several areas, the most obvious is where the contact screw connects with the tip of the front spring. A groove in the front spring may appear over time in the specific area that the front spring connects with the contact screw; this is normal wear and tear but the time it takes to develop varies according to the material the contact screw is made from. A steel screw will burn hotter and holes in the front spring will appear sooner. It is important to monitor spring wear and replace when necessary. This is the reason we recommend silver first, followed by brass, copper, steel and stainless steel. Silver does not wear a hole in the front spring at as fast of a rate as the other metals do.

Understanding Screw Threads

Contact screws as well as securing screws may be metric but are commonly standard. 8-32 is the most frequently used screw in the tattoo machine assembly. It can be found on: binding post screws, coil securing screws, contact screws, armature bar / spring assembly screws, spring saddle screws and tube vice screws. This does not mean that any other screw type cannot be used. Let's talk about the number 8-32. This number does NOT mean 8/32" of an inch, it is not a measurement on a ruler. In these numbers used to describe screws, for example 6-32, 10-24 and 8-32, the first number indicates the size of the screw's diameter, or inside diameter of it's corresponding washer so a #6 screw will fit a #6 washer...the second number is the number of threads per inch this particular screw has. So, on a 10-24 screw- the screw is a #10 which has 24 threads per inch on it.

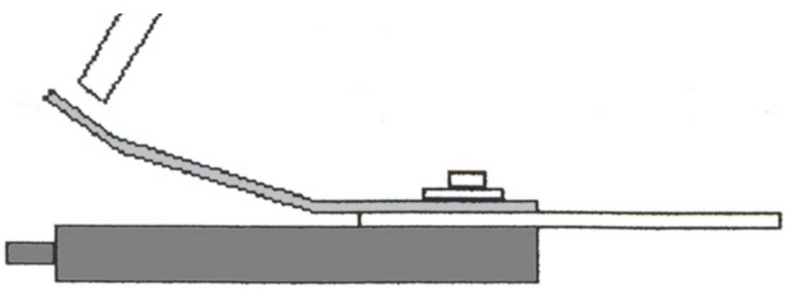


Re-Tapping a stripped #8 hole with an 8-32 tap. A tool which is very easy to use.

Tap and dye sets are available to rethread screws and to “tap” (re thread the hole). It is common for inexperienced artists to put a metric screw in a standard hole and vice versa and stripping out the already existing threads on a frame or binding post. That’s why an understanding of these numbers is <u>important.</u> This is a simple task, these tools are worth the investment.

Contact

The more surface contact, the better the function, the longer the life of the front spring the better the performance of the machine. This may be achieved by filing the contact screw or bending the spring until maximum surface contact between the flat section of the screw and the front spring is achieved, this may involve and extra bend inthe front spring.

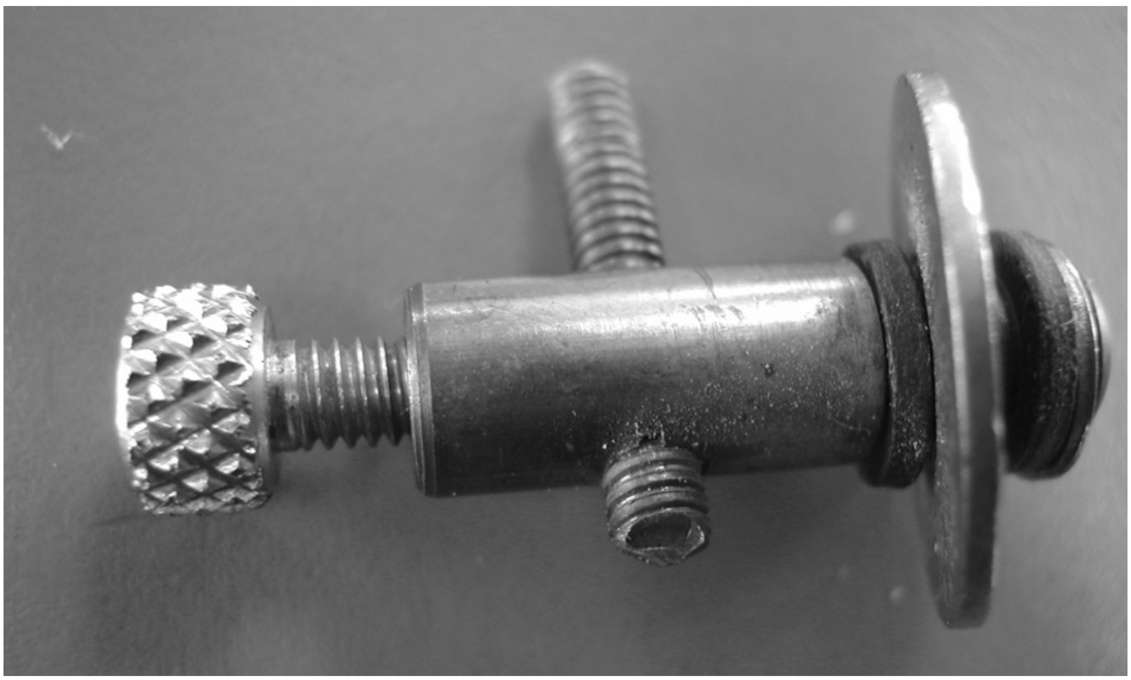


Contact screw maintenance

Carbon build-up is common on the flat surface of the contact screw, so occasionally filing or lightly sanding the tip of the contact screw to remove the carbon build-up is recommended, but only remove the carbon build up, do not remove screw stock. Too much stock removed will result in having to re-tune the machine.

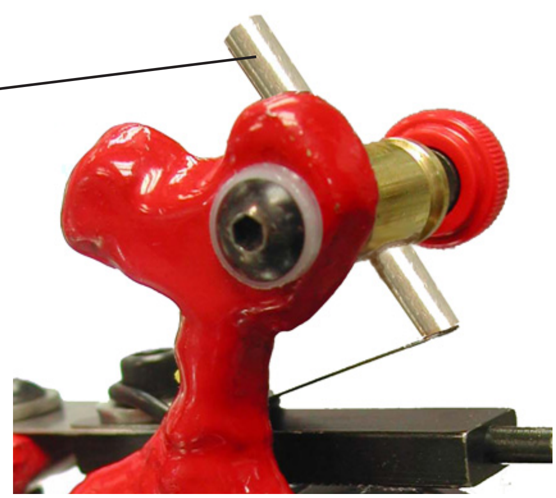
Securing the Contact screw

The contact screw is located on the upper binding post. The most highly recommended material for this screw is silver. Silver is a soft metal and can be bent easily or have the threads damaged easily. A securing screw is commonly used to secure the contact screw in place once the machine is tuned. It is extremely important NOT to damage the contact screw because it will limit future tuning of the machine. If the securing screw is metal, a small acrylic ball or a piece of an o-ring can be used in between the end of the securing screw and the threads of the contact screw. If the threads are damaged on the contact screw, it will not be able to turn when adjusting or fine tuning the machine. Also recommended are nylon or plastic screws for use as securing screws.



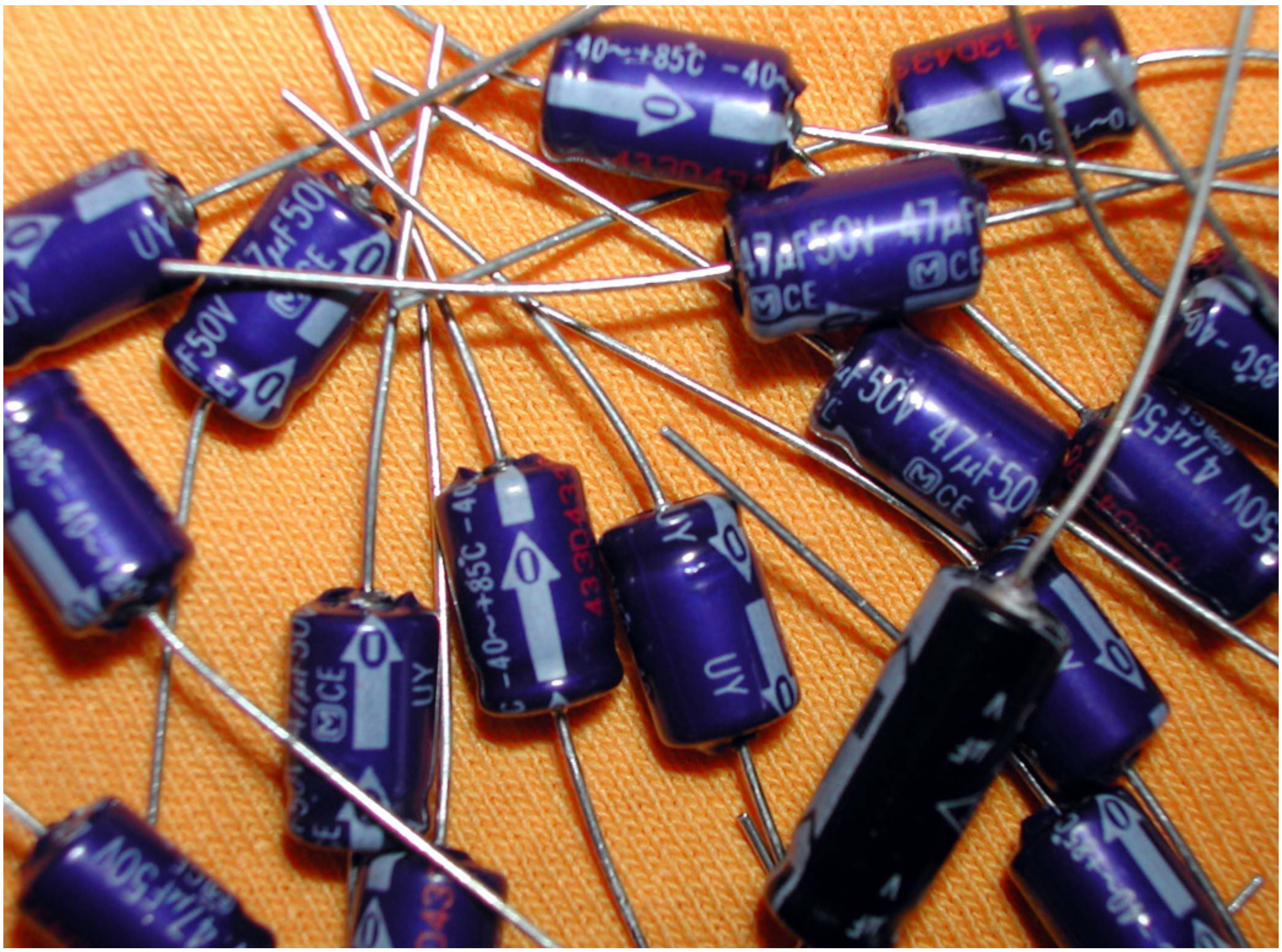
Another perfect example of careless maintenance. The contact screw is pitted at the surface contact area with alot of carbon built up inside that pit. The threads are becoming stripped due to the lack of thread protection inside the binding post, In this case, the securing screw was being tightened directly against the threads of the contact screw without any thread protection in between them.

It is not necessary to use a **screw** as a 'contact screw', a simple cylindrical rod made from brass or any other recommended metal can be used, provided that it fits snuggly into the drilled hole in the upper binding post. These rods can be purchased in brass at any hardware or hobby shop. A thread protector, is not necessary, (but recommended to absorb vibration) so any metal screw can be used because there are no threads to ruin.



6

The Capacitor



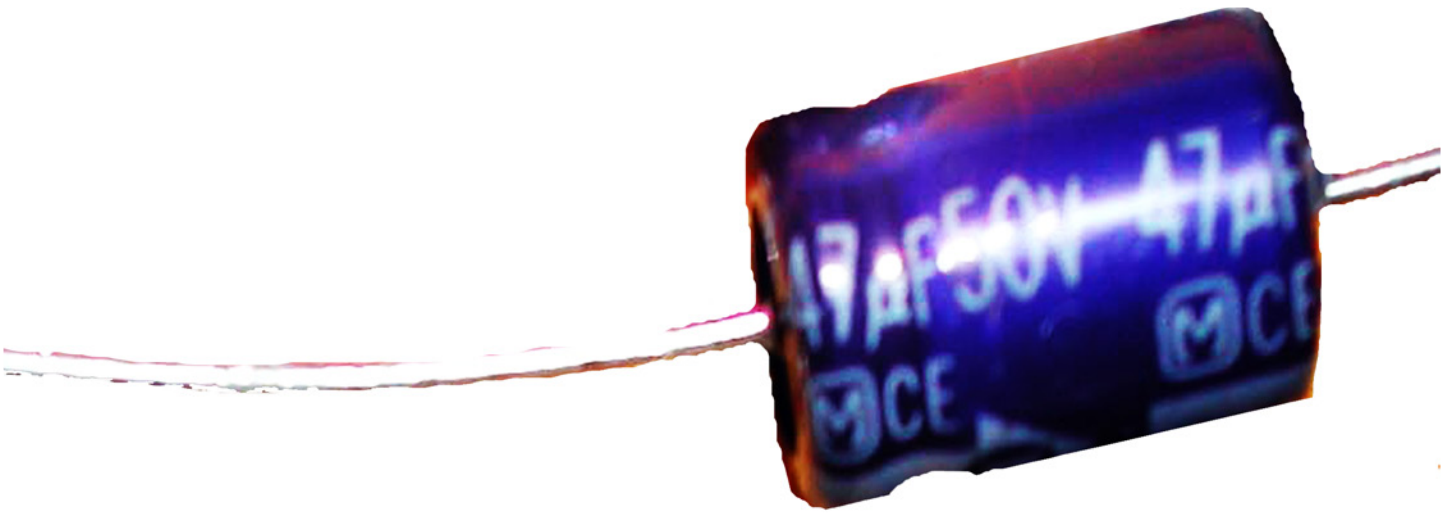
"Electricity runs through my blood like dogs,
man if you could see it..."
-Generation X

A capacitor is defined as: "2 conducting surfaces separated from each other by insulating material such as air, oil, paper, glass or ceramic. Capacitors are capable of storing electrical energy. In some cases, a capacitor will block direct current and allow alternating or *pulsating* current to pass." This is our use. An electrolytic axial capacitor visually consists of a cylinder with a wire protruding from each end, like a fire cracker with a fuse on each end. A capacitor allows current to enter and pass through it, it does not "fill" up but will receive more charge with increasing potential until breakdown occurs. So, current passes through the capacitor, when it reaches it's limit, the micro farad (uf) / Volts limit which is indicated on the side of the capacitor, that amount of electricity flows through a wire located on the opposite side of the capacitor cylinder. The capacitor's "capacitance" is measured in micro farads the symbol is uf. **Capacitance** is defined as: " The quantity of electric charge which can be received by a system of insulated conductors from a potential source of given value". It is important to note these numbers as the capacitor used can influence the movement of the armature bar. A smaller capacitor, will make the machine run a bit faster because it will release the charge quicker. The smaller capacitors which enable a machine to run at a faster rate 47uf 35v or 47uf 25v, are recommended for use in an outlining machine used for groupings of 1 to 3 needles, which require quicker movement to apply a consistently clean line. IMPORTANT: **The speed of the armature bar's travel is NOT controlled by the power supply**, this is to say that when turning the dial on the power supply up or down, the speed of the armature bar's movement will not be affected. The power supply controls the strength of the coil's magnetic field in effect, controling the force at which the needles will penetrate.
Capacitors serve as regulators for the current passing through the electrical circuit of the machine's coil assembly. The current is 'smoothed out' and controlled.

Q: Can I assemble and run a machine without a capacitor?

A machine may be assembled without a capacitor but will run very "rough" and hot, resulting in a general inconsistent performance, and hole being burned all the way through the front spring. A large blue spark will appear between the contact screw and the front spring when a capacitor is not being used...this symptom is also an indication, if you **are** using a capacitor on your machine, that your capacitor needs to be replaced immediately. Other symptoms include inconsistent power surges or a decrease in power.
Recommended capacitance measurements for tattoo machine application are: 47uf 35v, 47uf 63v, 100uf 35v, 100uf 25v, 22uf 63v... Voltage should be no greater than 63v, it is not necessary. Along with the volts and micro farad measurements printed on the side of the capacitor, you will notice and arrow. To attach the capacitor to the machine when replacing it, the arrow must be pointing from the bottom of the machine to the top, in other words, the wires should run as follows: "lower" wire (under the bottom of the arrow) attaches to the same terminal as the rear coil wire on the lower binding post, the "upper" capacitor wire (above the arrow) should attach to the same terminal as the

“front” coil’s wire is connected to and this termnal should touch the “upper” binding post. The capacitor wires can be attached to their own terminals and be assembled separately. This makes for easy removal and installation of the capacitor. The bottom of the capacitor arrow is commonly found next to the indentation on the capacitor cylinder. If there is no arrow printed on the side, the indentation is the “bottom” of the capacitor and it’s corresponding wire will attach to the terminal at the lower binding post. Though this dent is recognized as “positive”, this does not matter since there is no positive or negative on the machine, it is the direction that the current flows which must be addressed here so the arrow on the capacitor must point in the direction that the current moves-from the clip cord or RCA jack through the coils and the capacitor and ending on the terminal(s) connected to the upper binding post.

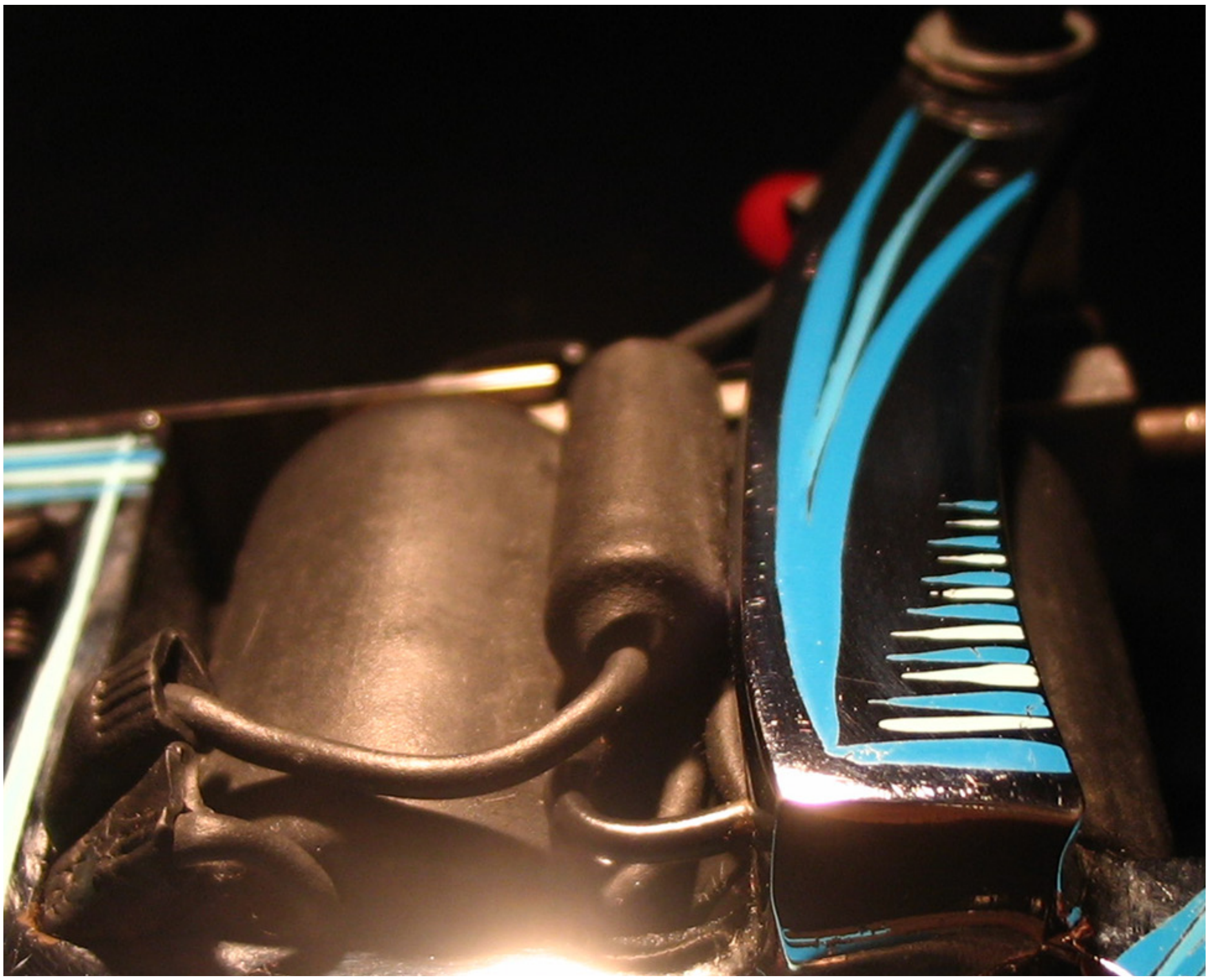


Remember to observe polarity symbols. If polarity is reversed, or if the working voltage or temperature ratings are exceeded, the capacitor may be damaged or could explode. In capacitors, the capacitance can vary according to temperature, this means that sometimes heat can cause breakdown of a capacitor’s performance, so a machine which is struggling to do it’s job, will run hot and this will cause the capacitor to break down.

Polarity is defined as: “An electrical condition determining the **direction** in which current tends to flow. Applied to direct current sources (DC); also to components when connected in DC circuits.” This is our use. It is also defined as: “the quality of having 2 opposite charges, positive and negative”. A capacitor has an arrow on the side indicating the direction the current should flow through it. This is important to us because there are no positive or negative on our machines, the current flows in a specific direction. This can be noted in the rotary machines. A clip cord connected to a rotary and then activated with the footswitch, will cause the rotary motor to turn in one direction, if the clip is flipped over, it will rotate in the opposite direction.

7

The importance of insulation!



"...my insulation's gone...you make me overload..."
-Ace Freheley

For a machine to function properly, or just to function at all, it is mandatory to understand the importance of insulation. The flow of the current through the machine's wires must be restricted to the wires only, and anything that comes in direct contact with the wires or wire terminals-- the upper and lower binding posts for example, need direct contact with the terminals. Exposed wires should never touch the frame or coil post, this will only ground the flow of current and produce a non operational machine, until the grounding problem is corrected.

What should be insulated?

Starting from the most basic parts:

Coil Posts

Coil Posts should be insulated to prevent copper wire from making contact with them. A piece of insulation tape is recommended to surround the post only where the wire will be wound, between the upper and lower plastic / nylon / neoprene retaining washers. Even though the copper wire used to wind the coil bobbins usually is insulated, the insulation is usually thin and may easily be stripped off, exposing the wire inside.

Coil Wires

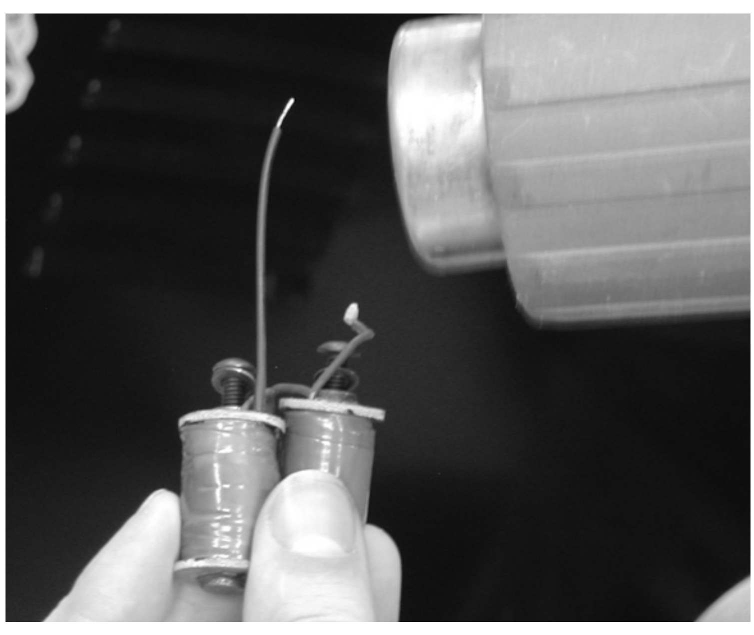
The wires exiting the coil assembly must be insulated with a heat shrink before they are connected one coil to the other and wires to terminals. Because of the proximity of the wires exiting the bottom of the coil bobbins, to the yoke or base of the frame, it is important to make sure the wires are totally insulated all the way to the plastic retaining washers on the coil, from which they exit. Remember to leave a space of un-insulated wire for connection to the terminals.

Capacitor wires

The capacitor wires which exit the top and the bottom of the cylindrical capacitor should be insulated as well. The capacitor will sit very close to the frame once installed and may run the risk of one of it's wires making contact with the frame. Insulating the capacitor itself is also recommended as on occasion, the capacitor may not already be equipped with adequate insulation and may also cause grounding problems if it makes direct contact with the frame. Heat shrinks come in a series of colors and sizes to match the thicknesses of the wires and capacitor and can be used for aesthetic purposes as well as functionality. Remember to leave a space of un-insulated wire for connection to the terminals.

A properly insulated capacitor with insulatedtermials.

A properly insulated coil assembly.



Using a heat gun to heat shrink wires produces smooth results.

Terminals

The *terminals* attached to the capacitor and coil wires will still conduct current so it is important to insulate the lower part of the terminal, leaving exposed enough of the ring on the terminal to accommodate the binding post so it connects directly and completely to the said terminal.

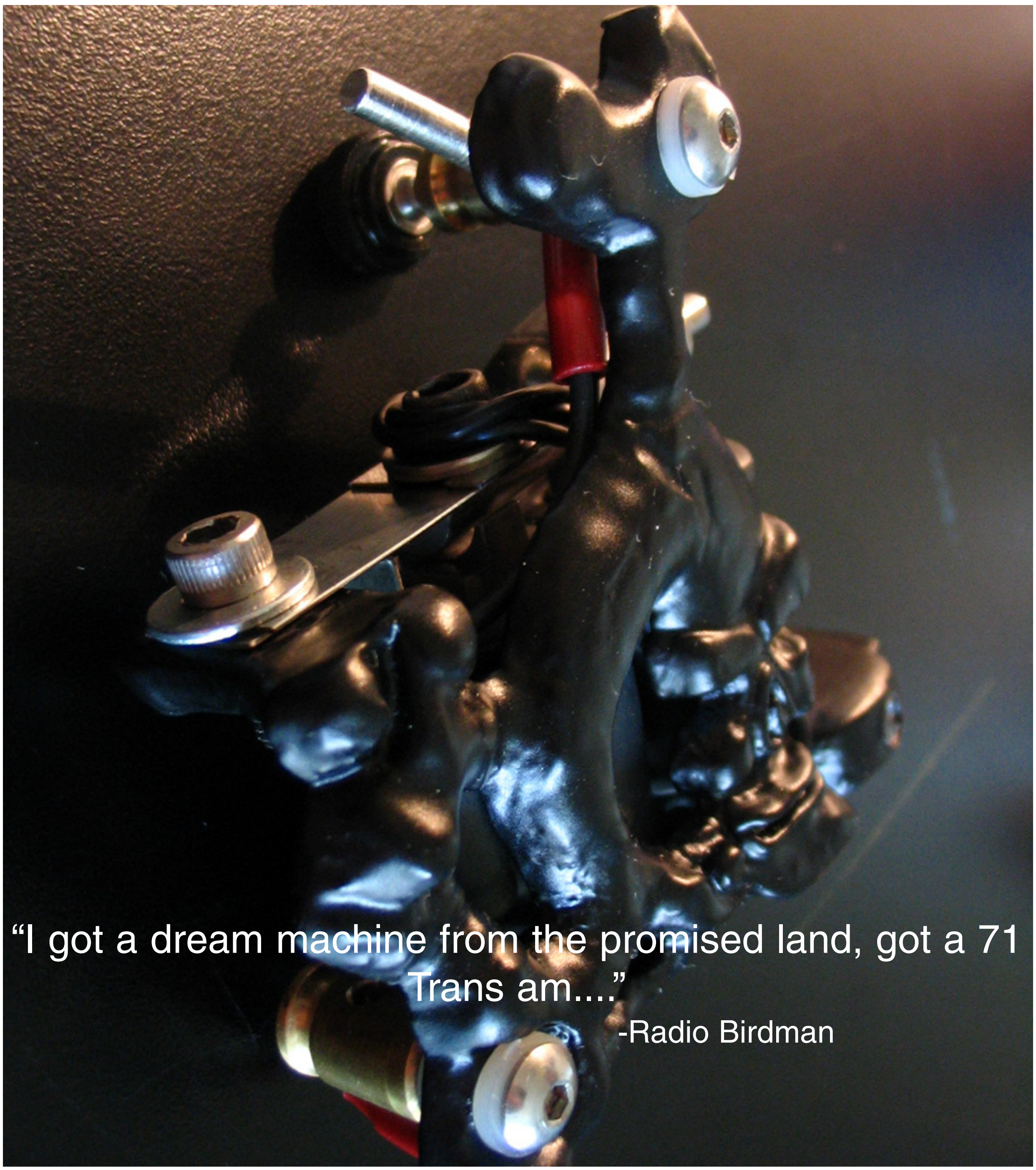
Screws

The only screws which should not touch the machine frame are the screws which connect the binding posts to the frames. These should be insulated by using plastic or nylon t-washers, or flat plastic / nylon washers OR a piece of electrical or insulation tape (if you do not have t-washers) around the threads so no part of that screw will make contact with the machine frame. The coil securing screws are the only screws which **can** touch the frame.

A perfectly insulated machine...this one will not have grounding problems.

8

Assembly of the Machine from Basic Frame to Finish



First, there are 3 main component assemblies which must be assembled prior to their attachment to the machine frame. These include the Coil assembly, the armature bar / spring assembly and the 2 binding post assemblies. Below are: lists of parts needed for each assembly, instructions and illustrations on assembly procedures.

Assembly of the coils / Capacitor

Parts / tools needed for coil assembly:

- ✠ 2 coils
- ✠ heat gun / heat shrink
- ✠ 2 solderless ring terminals
- ✠ 2 flat tab terminals (optional)
- ✠ 1 axial capacitor (see suggested capacitance measurements in capacitor section)
- ✠ 2 coil securing screws 8-32 1/2” – 3/4” in length (prefer button head style)
- ✠ soldering iron/flux (optional)

1) Scrape the red insulation off of the ends of the wires to be joined to any terminals or to other wires. Do this to both the coil wires and the capacitor wires.

2) Heat shrink exposed wire, leaving ends of wires to be joined to terminals or to other wires un-insulated. Do this to both the capacitor and the coil wires.

3) Heat shrink capacitor cylinder and / or coil bobbins.

If you are putting the capacitor on separately, this is the time to solder the capacitor’s wire ends to the flat tab terminals NOT solderless ring terminals.

If you are putting the capacitor and the coil wires together on the same terminals, attach both, the capacitor wire end and the coil wire end to the same “solderless ring terminal” by pinching the wires into the receiving the of the terminal, this means one coil wire end and one capacitor wire end per terminal. Making sure that the arrow on the capacitor cylinder is pointing from the lower wires (which attach to the lower binding post) to the upper binding post.

Slide a piece of heat shrink on to of the terminals, DO NOT put any on the ring area, this area must touch the binding post directly and completely. Just insulate the receiving end of the terminal where the wires are inserted and slightly overlap the heat shrink on to the wire(s).

Assembling the armature bar / spring assembly

This part of the operation should be done after the springs have been cut and bent, making sure that the distances are perfect from the frame's spring saddle to the nub on the armature bar, where the needle bar sits, making sure the needle bar would run perfectly vertically through the tube vice hole in the frame, or slightly behind center (when looking at the machine from the side).

1) Put a piece of Trans-pore tape under the armature bar, where it would make contact with the front coil.

2) Put the 8-32 Allen screw through the #8 washer and then screw the 8-32 allen screw with washer, into the threaded hole at the back of the armature bar. Place the rear spring slot on to the armature bar followed by the front spring slot (directly on top of the rear spring). When using a larger screw, for example 10-24, make sure you use the accompanying washer, a #10 washer.

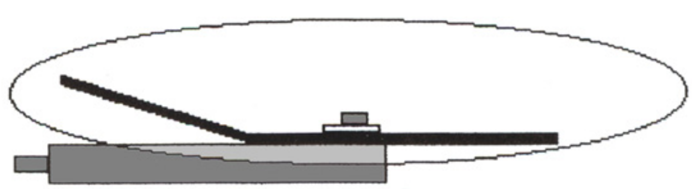
3) Snuggly tighten the screw / washer on to the springs, they should be able to move when pushing on them. This is the time to align the springs.

4) Place o-ring under the front spring and over the Allen screw which holds
the springs in place. There are 2 ways to place the o-rings. There are 2 ways to place the o-rings (See illustration).

An imaginary straight line should run from the tip of the front spring through the center of the Allen screw and through the center of the rear spring, from front to back of the armature bar / spring assembly. You may add an o-ring.

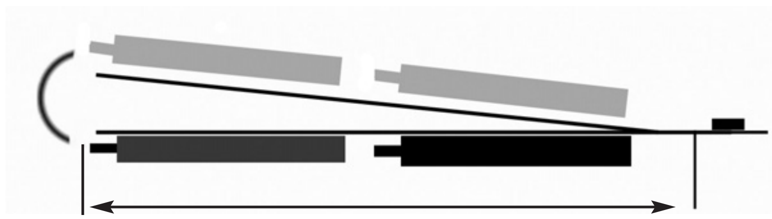
Once aligned, secure the springs by tightening screw / washer, so that the springs DO NOT move and cannot shift during machine operation.

Placement of O-rings.



Assembly of a one piece spring system.

This illustration depicts how the stroke can change as the armature bar is placed away from the rear spring saddle to accommodate a large distance from the spring saddle to the tube vice hole. The greater the distance from the spring saddle to the tip of the armature bar, the less strength the rear spring will have to move this displaced weight at an acceptable rate and force, so a spring stiff enough to bare the tension required to move the weight of the displaced armature bar and all it's components is required.



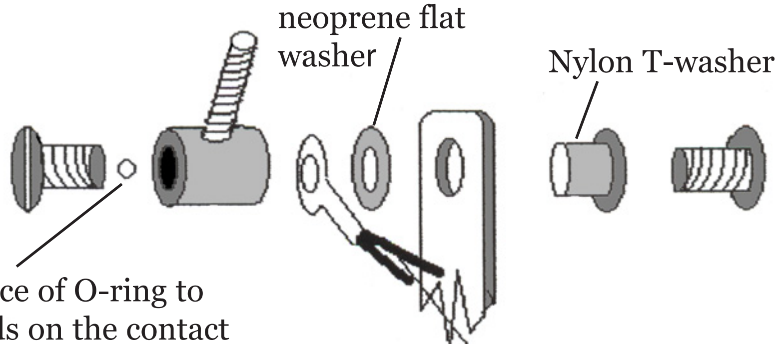
Assembly of binding posts

Parts needed for **upper binding post** assembly:

- binding post
- contact screw
- acrylic ball or piece of o-ring (acrylic ball or piece of o-ring must be used to protect the threads on the contact screw.)
- contact screw securing screw-can be plastic or nylon, if metal is the choice, a nylon or plastic flat washers-used insulate frame from the binding post and to shim the binding post if necessary.
- nylon or plastic t-washers- to keep threads on binding post securing screw from touching the machine frame. See illustration.

Assembly order from coontact screw securing screw to the frame (left to right) and the final screw:

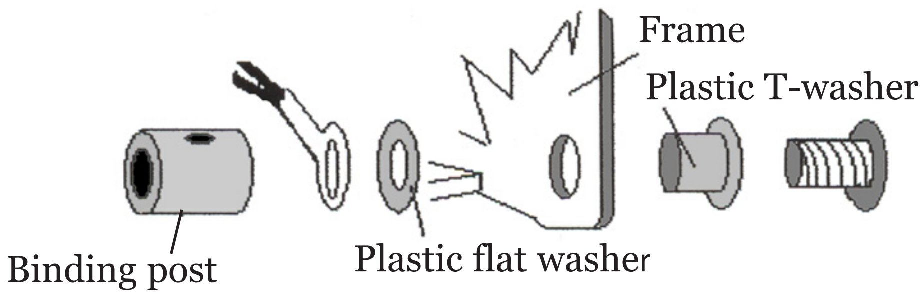
Securing screw, acrylic ball or piece of o-ring, contact screw/binding post, coil / capacitor terminal, plastic washer, machine frame, plastic "t-washer" (or tape, plastic flat washer), securing screw. This binding post assembly is now ready to be secured to the frame.



Parts needed for **Lower binding post** assembly:

- binding post
- securing screw 8-32 3/8" (Phillips, button head, Allen head)
- plastic, nylon or neoprene #8 flat washers
- plastic or nylon t-washers See illustration.

Assemble the similar parts in the same order as in the directions for assembling and attaching the upper binding post to the frame.



Once you have the coils assembled, the armature bar / spring assembly and the binding posts ready, it is time to put all these components on to the machine frame.

We are only just getting started!

Assembling the machine

This is the recommended order for machine assembly. There are details in this section which may be overlooked, it is important to re-read anything which you may not understand.

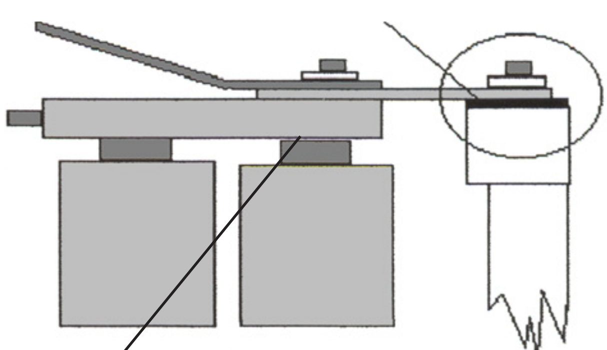
1) Attach **coils** (and yoke, depending what material the frame is made from) to the machine by tightening the coil securing screws snuggly.
Remember, these screws are the only attachment screws which DO NOT need to be insulated.

2) Place the **armature bar / spring assembly** onto the spring saddle, tighten the spring securing screw, making sure that there is no vertical play in the rear spring. It should sit solidly on the saddle.

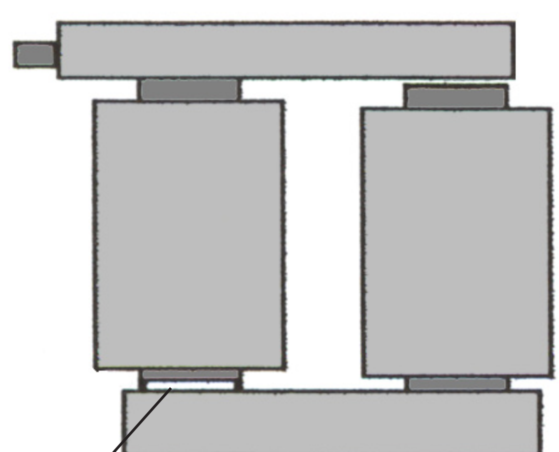
3) Pull down the armature bar assembly by the nub on which the needle bar sits (see illustration next page). Check for parallelism- this means that *the armature bar is parallel to the yoke or the base of the frame when the armature bar is making full contact with the front coil*. The armature bar should NEVER touch the rear coil, **there should always be a very small space between the armature bar and the rear coil**, the smaller the better.

Any parallelism issues should be handled NOW before moving on.This means-- SHIMS. Shims may be made from washers, or better yet, feeler gauges. As we mentioned earlier, a hole punch and some tin snips can make any feeler gauge into a shim. The large selection of feeler gauges in a set can produce a variety of more precise shims than any washer selection ever could. And because you are making them yourself, shape and size of these shims is changeable.

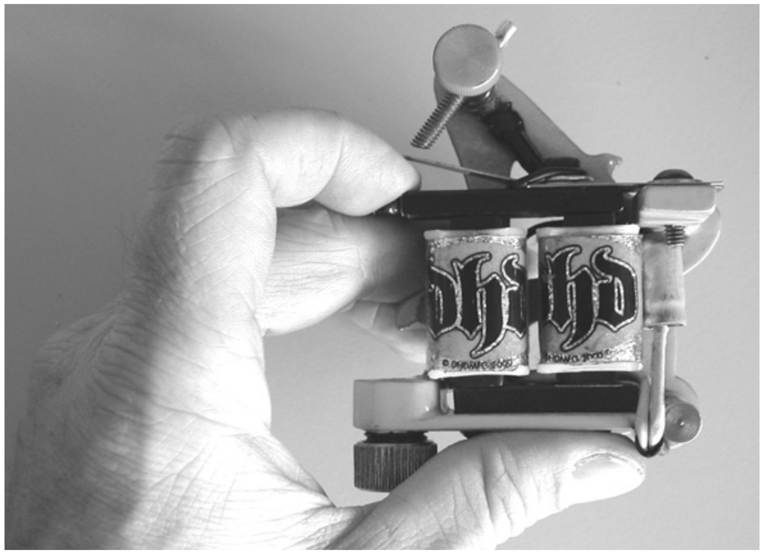
Shim the rear spring (with a squared off shim), when necessary to achieve parallelism on the armature bar coil contact.



Small space.



Shim the coils when necessary, to achieve parallelism between the armature bar and yoke or frame.



When moving the armature bar assembly manually, ALWAYS pull it down by the armature bar. NEVER by the front spring because this will change the tension on that spring.

Shims may be necessary under the front coil to make the armature bar parallel. It may be necessary to shim the rear coil if the small space is too big. This space should be paper thin. Shimming the spring saddle slightly to raise the armature bar / spring assembly may help to make the armature bar parallel to the yoke or the base of the frame. A round washer should NOT be used for this purpose.This shim should be flat on one side (p. 54), the shim must sit perfectly flat to the inner edge of the spring saddle closest to the rear coil. Once you have achieved parallelism, you may move on. Filing off the top of the rear coil to make a paper thin space is also recommended only if it is absolutely necessary.

Attach the **lower binding** post to the frame and to the coil / capacitor assembly by doing the following.

Place securing screw through plastic t-washer, put screw and t-washer through the hole drilled into the lower rear of the frame, place plastic, nylon or neoprene washer onto the protruding screw, place terminal on to the plastic washer and over the protruding securing screw, attach the binding post. The binding post should be tightened snuggly.

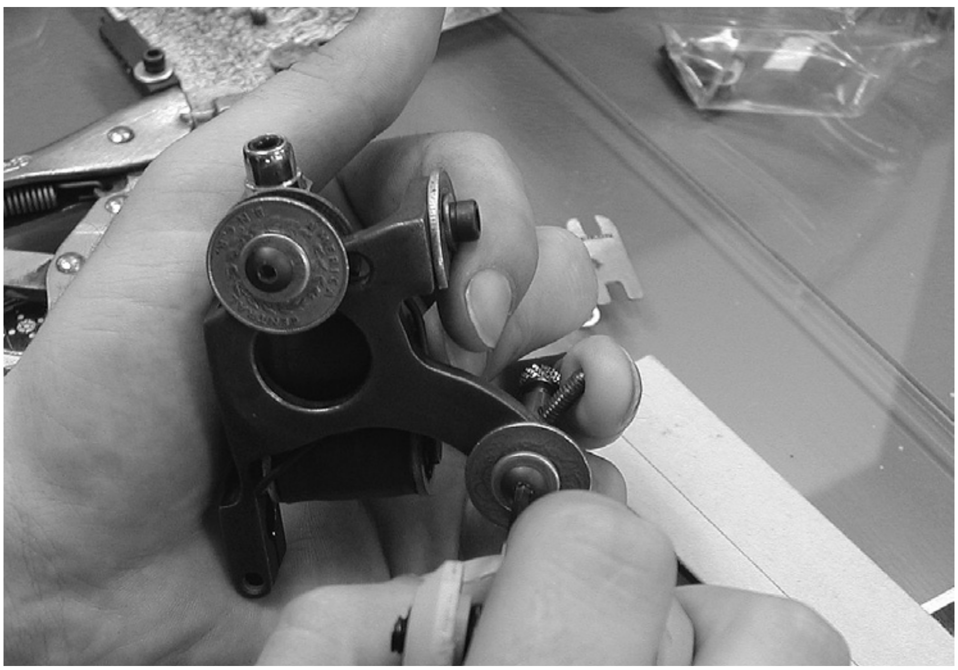
Remember to check for any grounding after attaching and tightening the rear binding post. No exposed wire should touch the frame or the yoke .

Attach the **upper binding post** by following the same procedure indicated in "attach the lower binding post..." The contact screw should be in place as should the acrylic ball or piece of o-ring to protect the contact screw's threads, as well as the contact screw's securing screw.

Check “vertical lines” by placing a needle bar onto the nub on the armature bar. You may connect a needle and tube set up.This is to verify that the needle bar is running down the center of the tube, or just slightly behind the center point.

Look at the machine from the front. The needle bar must run down the center of the tube. Imagine a straight line from the contact screw down through the tube and out the tip of the tube (p. 67 & 68 photos). This means that if the contact screw is slightly off, to the left or to the right, the binding post must be shimmed with plastic, nylon or neoprene washers **between the frame and the terminal NOT between the terminal and the binding post**.

Find the spot on the front spring where the contact screw will make contact, a good place to start is on the front spring, directly above where the needle bar holding nub meets the rectangular armature bar. When tightening the binding post securing screw, hold the contact screw in place with one of your fingers so that it doesn't pivot away from your selected contact area on the front spring (see illustration).



Hold the contact screw securely with one of your fingers when tightening the binding post. This prevents the contact screw from moving back on the spring.

Set the stroke. This means open or close the contact screw to the distance you would like the armature bar to travel in conjunction with the bend in the rear spring. Pull down on the armature bar and let it up til it makes contact with the contact screw. Set the space between the contact screw and the front spring. This should be done without the needle / tube set up. The following pages will help you to fine tune the stroke setting and to understand compensation between the contact screw, the flex of the front spring and the tension of the rear spring. Don't worry, it will become clear, read the next few pages and have your machine handy.

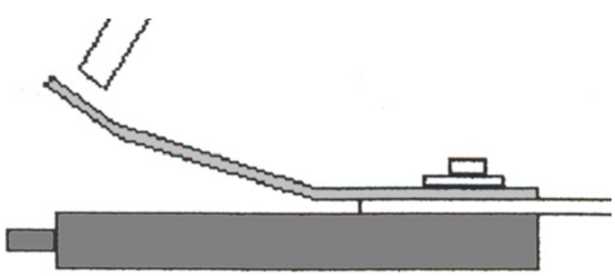
Do the **spring tension test** (p.60) to establish the following:

- Stroke.
- Test for adequate spring tension on both springs (flex on front spring and tension on the rear spring).
- Where is the best place for the contact screw to make contact with the front spring.

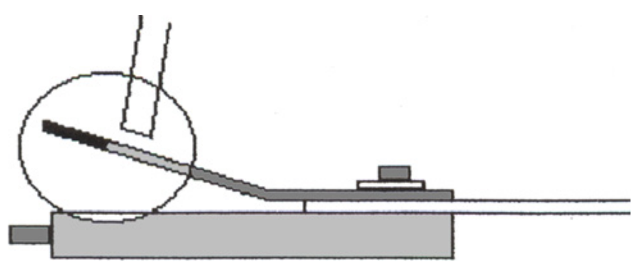
You may have to add tension or take away tension on the rear spring. Remember, pull down on the armature bar, release the downward pull slowly until the front spring stops on the contact screw. The armature bar should continue to travel very slightly. This ensures that there is a flex on the front spring which will handle the amount of resistance the skin will provide but it also shows that the rear spring tension is capable of supporting the weight of a needle bar, needles, grommet or paper towel, O-ring, rubber band tension, friction of the needles rubbing against the back of the tip and finally, the resistance the skin will provide. Generally, if the machine exhibits these qualities, once plugged in, the fine tuning should be minimal.

Once the area of contact is established on the front spring, and the spring tension seems acceptable, trim off the excess spring stock in front of the contact screw. This "tightens up" the performance of the machine and eliminates any extra un-necessary additional vibration which will come from the excess spring stock in front of the contact screw. This should be done with an o-ring already in place. O-rings smooth out vibration, minimize sound and slightly increase tension. We recommend o-rings for this reason. O-rings come in different diameters and thicknesses so choose wisely.

With the Dremmel, or a good file, cut an angle on the tip of the contact screw making sure that it is identical to the angle of the front spring so that the flat spot on the contact screw makes a 100% connection with the angle of the front spring. A secondary bend on the front spring may also be used. (see illustrations).



An extra bend in front spring to match the angle cut into the end of the contact screw, will ensure solid contact between the two.

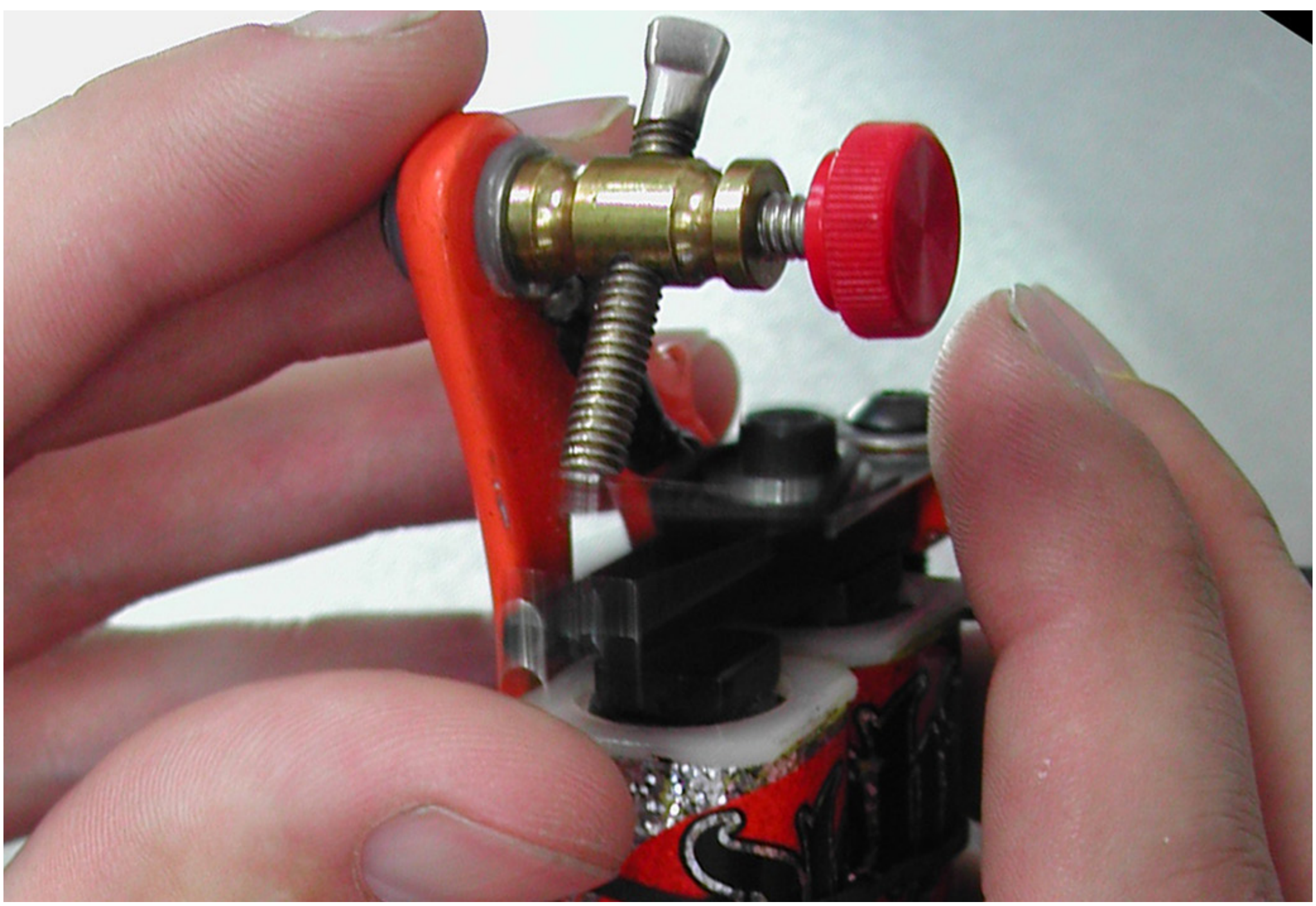


An angle cut into the tip of the contact screw matches the angle bent into the front spring so there is solid contact between the two.

Plug the machine in and run it without the needle bar / tube assembly connected, turning the dial on the power supply slowly up and down. Follow the **"ball system"** (p.61) to re-check the spring tension and to make sure the machine can shade as well as color. The balls should not get closer in the turned down black and gray mode. Feel the movement of the armature bar with the soft finger print on the thumb (see Illustration below). The balls getting closer to each other when turning down the dial on the power supply means, there is too much tension on the rear spring whereas the balls staying the same distance apart means there is versatility in function. When touching the armature bar while running the machine and the armature bar comes to a complete stop (at a "coloring" setting), means that there is excessive tension on the rear spring.

Contact from the contact screw on the front spring is important. The stroke should not be compromised. Bend rear spring to create tension or or un-bend the spring to take away tension, do this in conjunction with opening or closing the contact screw until the spring's flex is correct. It is all about compensation.

Once the machine runs smoothly, double check the tuning with the needle bar / tube set up on the machine. It should exhibit the same qualities. It will have to be running a little higher on the power supply dial but it should exhibit the exact same qualities described in detail in the "**ball system**" section as well as in the "**spring tension test**" section on page 59.



9

Spring Tension Test Ball System

"Take my word, I got a method that'll make me king..."
-The Dictators

<u>Spring tension test</u>-push down the armature bar, release the tension slowly until the front spring makes contact with the contact screw and stops, the armature bar should continue to move *very slightly* before it stops. The front spring should flex, the armature bar should move about 1/32 -to just under 1/16 of an inch. Any more than this and you may have too much tension on that rear spring. This is assuming that you have a front spring of the right gauge. A stiffer front spring may do the same thing when more tension is put on the rear spring but remember that the skin is soft and a front spring has to have some flex to it. Start with a pair of .018 springs and go from there.

This is a rough tension check, always test the machine again when it is fully assembled *with* a needle bar, tube and rubber band. The slight upward movement means that when the machine is fully assembled with a tube, needle bar, rubber band, grommet / paper towel, that the back spring will have enough tension to move the armature bar / front spring assembly smoothly toward the upper binding post so that the front spring will still be able to make contact with the contact screw, despite encountering resistance from the rubber band and resistance from the skin.

The slight flex of the front spring is what allows variability and versatility in the machine's function--to be turned down to shade consistently smooth grays and turned up more for solid coloring or heavy lining without beating up the skin.

Too much tension on the rear spring will produce:

- Limited variability in machine performance.
- The machine will have to work harder to move that stiff of a rear spring.
- The skin may take a lot of abuse.
- Holes burnt into the front spring will be more common.

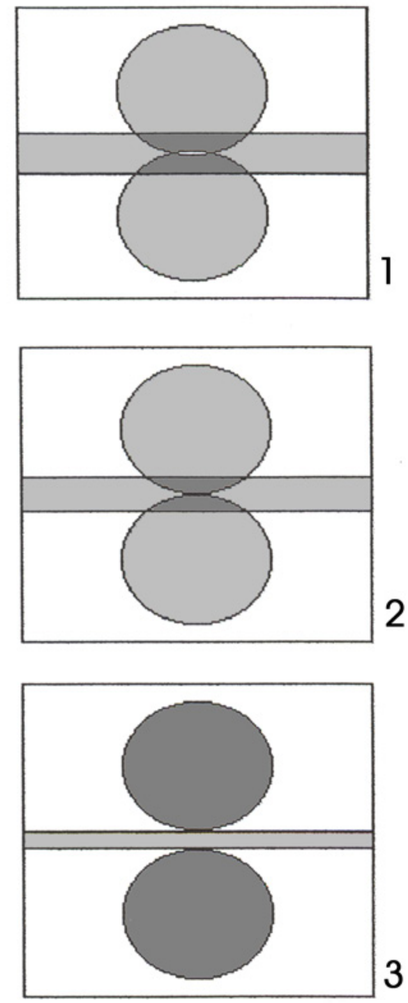
Read the above sentence in bold print again and again until you understand it. Try this system along with the "ball system" chart (p. 61).

When running the machine and viewing it from the side (coil side), if the front spring makes a slight football shape, there is way too much tension on the rear spring.

“Ball system”

The term “Ball system” is used in reference to the appearance of the needle bar nub to look like a bouncing ball, when seen from the front and the machine is operating (p. 59). We are using the distance from the centers of these moving balls as general guide lines for stroke distances and how they apply to each machine use. These are our recommendation. A machine used as a liner should have these balls bounce closer together than a shader would, and closer than a machine used to line with larger needle groupings. This is because the needles will hit the skin at closer proximity, (this is important) so that while moving the hand quickly to line, the line is consistant and solid. No matter the distance the balls travel, these should never get closer to eachother when the power supply is running at lower setting for smooth gray shading or when the power supply is turned to a higher setting for color and lining with larger groupings. The armature bar will reach a maximum stroke when the dial is turned up to a coloring setting, this distance should **not** change when turning down. Rear spring gauge and tension regulates this in combination with the distance set with the turning of the contact screw and the flex (gauge) of the front spring. Use this system in conjunction with the spring tension guideline to fine tune the machine. The smaller the needle grouping, the lower the setting on the power supply the machine will need to run at, to inject the pigment—a smaller stroke and a low power setting is recommended for single needle use because not much power is needed to make the needle puncture the skin. A little more power will be needed for 3 needles and higher. Wether you hang the needle out from the tip of the tube a little bit or wether you use the tip as a “depth gauge”, this system will work for you. The chart on the following page explains, in measurements, the distances these balls should travel. This is physics, it’s simple. Many artists say, “I love a large stroke”, but don’t understand what they’re saying, ask them to explain it and you will NOT get a technical (answer as to the benefits of a very large stroke) 90% of the time. It’s about function, there is a reason for everything!

Ball System Chart



Recommendations:

1) Recommended distance for single needle use, or 3 needle use. Some prefer a little more distance for 3 needle use.

2) Recommended for single needle and 3 needle use.

3) Recommended for 5 needle round and higher liners and Shaders

Play with these recommendations until you find what’s right for you.

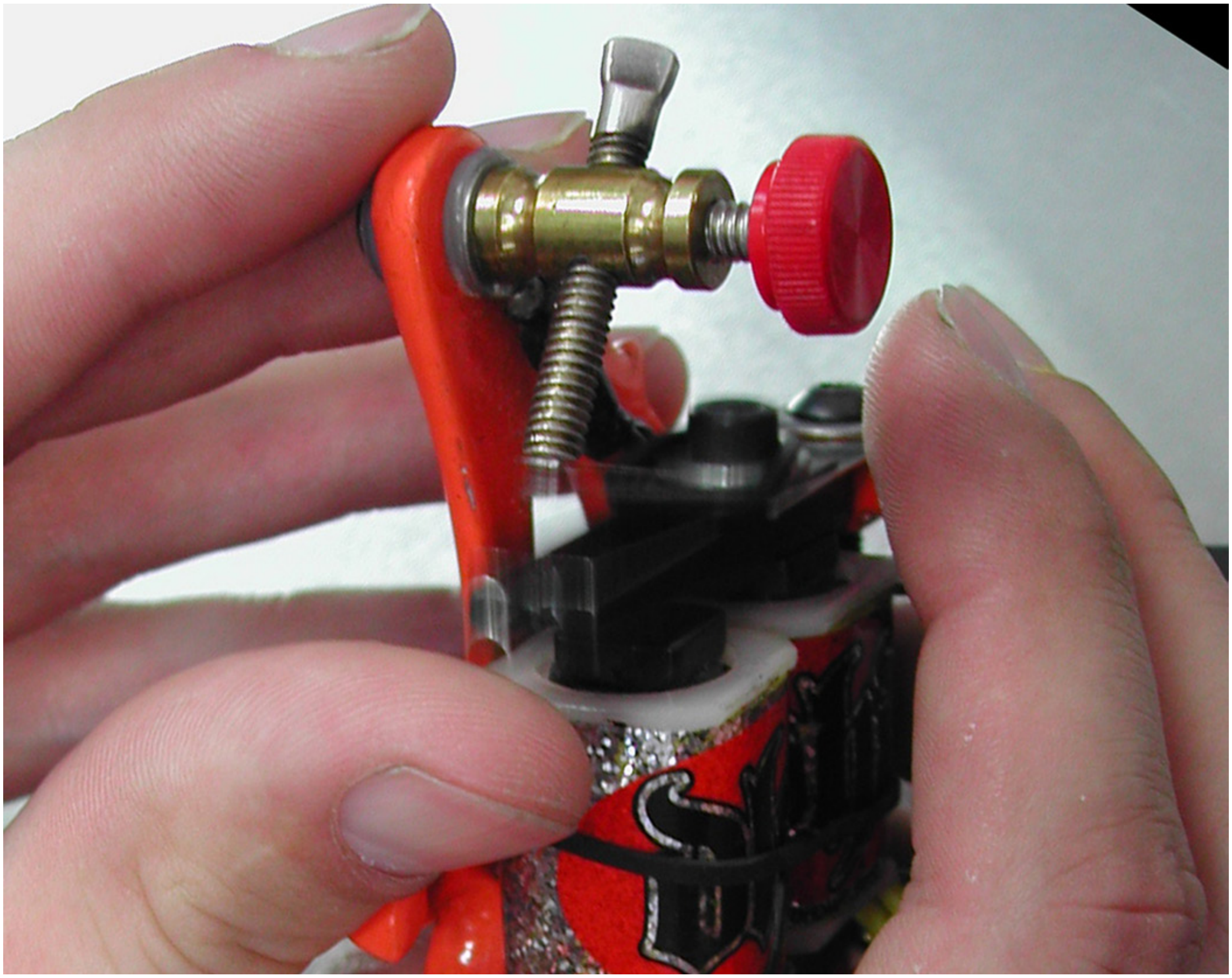
Recommended Machine use	Needle grouping	Stroke Distance
Outliner	1-3 needles	2.5 - 3 mm
Outliner (round)	3-7 needles	2.5 - 3.5 mm
Shader (magnum/flat)	7 and higher	3 - 4.5 mm

These measurements are taken from the center of the “ball” on the armature bar. If you run a consistantly larger stroke, larger than position 3 inthe “Ball System” chart, the machine will be harder to turn down to shade smooth grays, a slightly thicker spring set *may* be required.

Power supply

We will not discuss the details of construction concerning the power supply, instead we will discuss how it applies to a tuned machine.
Before we get into that, understand that if there are fluxuations in power, it may be the building’s own electrical wiring which may be responsible for any power surges. Using the power supplied in a wall’s socket is as close as we can get to consistent power without actually connecting the power source directly into a car battery. Therefore, whatever inconsistencies a building’s electrical current may have, will show themselves in the way a machine runs through the power supply which runs on this inconsistent current, even if the machine perfectly tuned (an untuned machine will be inconsistent anyway).

The adjustable power supply ***does not*** control the ***speed*** of the needle’s travel by turning the dial up or down (faster of slower), instead, it controls the strength of the coil’s magnetic field, which controls the force at which the needles will penetrate the skin. In other words, **the more current, the stronger the magnetic field, and the harder the needles will hit.** This is important, it enables the artist to check the machine’s versatility and function by **feel**. Using the “ball system”, turning the dial counter clockwise will lessen the current flow & the strength of the magnetic field and make the machine hit “softer”, the balls should not get closer together. This is a key factor in achieving the smooth gray shading we all want for portraits or large areas of even gray wash. An artist should be able to tune his machine with the “spring tension test” and the “ball system” alone and should not need to rely on a digital readout as each machine has different variables which may produce a different reading. Spring gauges, armature bar weight, width of coil post, contact screw material, spring shape and width, wire gauge and layers, resistance from tough skin and rubber band tightness will be factors which may change numerical readings. So always rely on feel, NOT sound or numbers, neither has anything to do with a quality tattoo as a final product. Neither of these will tell you if the skin is being over worked.



A further note:

Despite what others say, the way a machine runs, can, and should be checked with the the soft part of the thumb on the bottom of the armature bar nub. The way the armature bounces on the fingerprint of the thumb, can give a pretty accurate depiction of what the client will feel when being tattooed, it will also indicate how smooth the force and vibration will be as the needles hit the skin. Pressing hard on the balls or using the bony part of the thumb or fingernail will *not* let you know how this machine will run against skin, which is softer than that part of the thumb. It's a move we have all seen other artists do, just to look like they know a thing or 2. There is a reason for everything, wether it's to look knowledgeable or wether there really is knowledge behind the action. This is science and physics, simple. Again, we can't stress enough the importance to educate yourselves. This priviledged information is being shared with you so that you can help protect your investments, despite the poor quality control some tattoo suppliers' / manufacturers have on the machines they sell. Don't feel taken, or helpless. Learn how to make that lousy machine into a color packin', smooth shadin' hot rod.

10

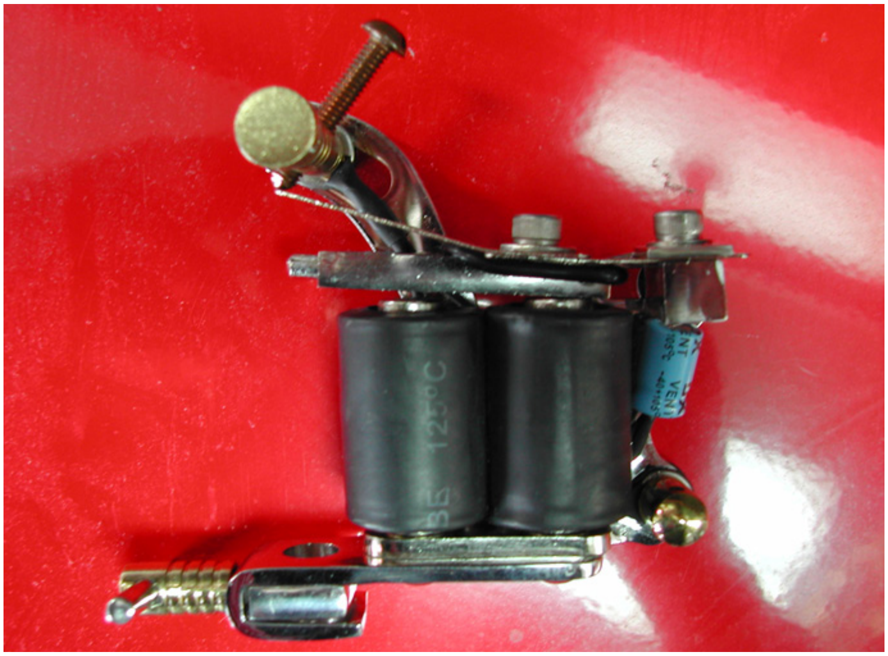
Machine Assembly Check list, Tuning, Troubleshooting

"When you've got crossed wires, everything's buzz buzz, every-thing's beep beep...."

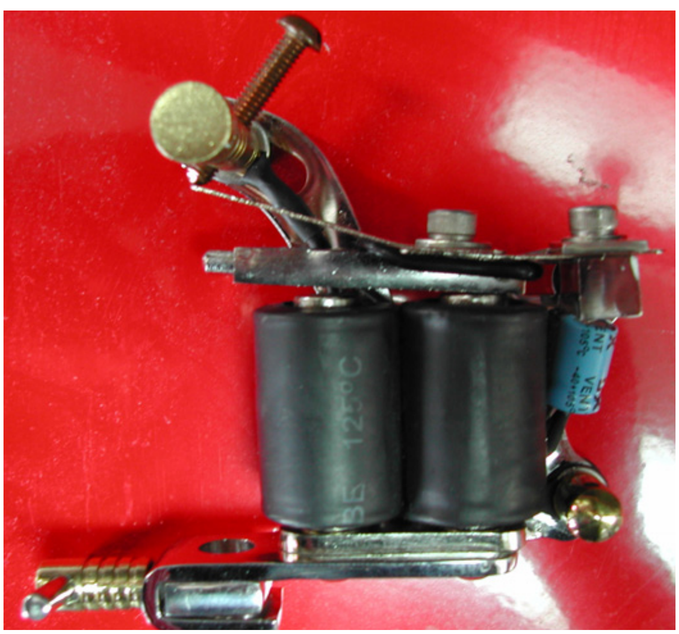
- Xtc

Once the machine is assembled:

Re-check the parallelism of the armature bar to yoke. Do this by pushing the armature bar onto the tops of the coils (p. 54), press down on the armature bar itself NOT by pushing the front spring as this will change the tension of that spring, if it is not parallel, make corrections- shims, filing etc.

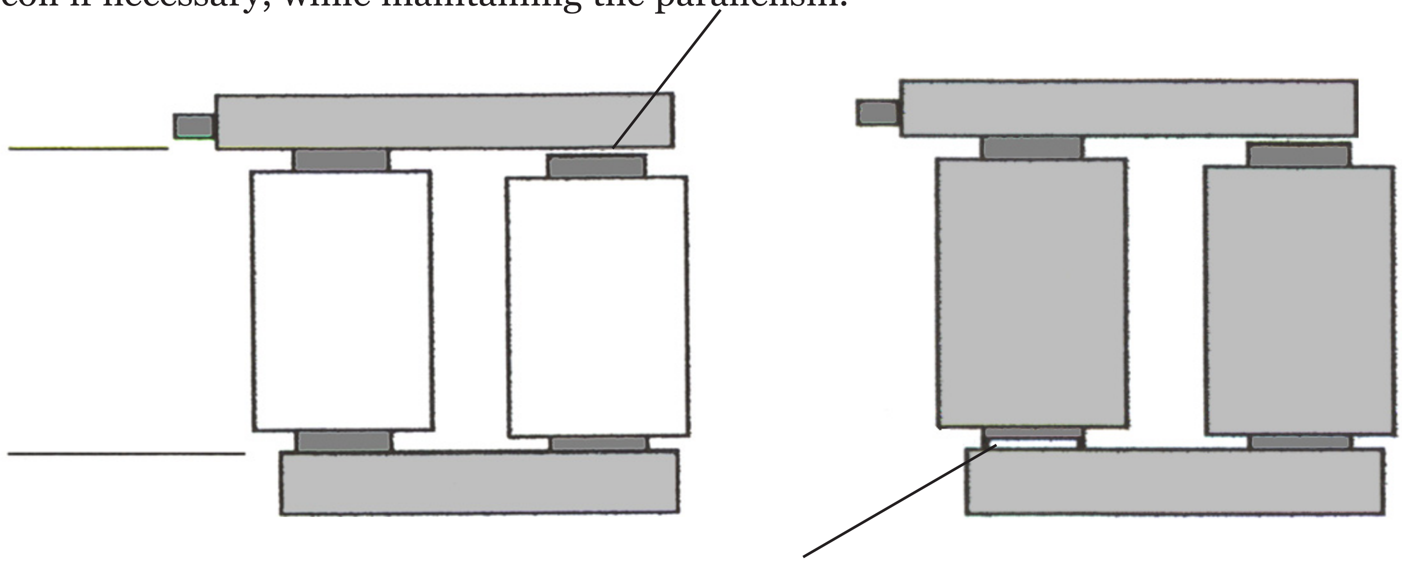


This machine was a “reward” from a manufacturer because the customer bought $500.00 dollars worth of products from them. The armature bar is not parallel, first because it’s not pulled down onto the front coil. It cannot be pulled down because the back of the amature bar hits the rear corner of the coil post which prevents any further examination until this issue is dealt with. It will take some work to make the armature bar parallel with the yoke/base of the frame. Take a look at the photos below.



These are the products manufacturers sell us. Educate yourselves, learn to fix these problems, don’t let them make our industry “cheap”.

Re-check for a small space between the rear coil and the armature bar, shim the front coil if necessary, while maintaining the parallelism.



Shim the front coil if necessary to make the armature bar parallel with the yoke or base of the frame.

Shim rear coil with a washer between the frame to reduce the space between the armature bar and rear coil. It should be paper thin. Using a feeler gauge can raise the coil and lessen the space by precise and perfect increments.

Shim the rear spring with a squared off feeler gauge if needed. The machine on page 65 would need the rear spring shimmed to take the armature bar off of the rear coil and bring it a step closer to making the armature bar parallel.

Make sure no terminals or wires touch the frame.

Tighten all securing screws.

Set the stroke to be a liner or shader: (bend spring(s) for more tension, un-bend spring(s) to lessen tension, adjust the contact screw accordingly by loosening or tightening or re-locating place of contact.

Perform the " Spring Tension Test" (p. 60) and run the machine.

Re-adjust the stroke if necessary and perform the "Ball system" (p. 61)

By now, you should have a pretty good idea on what needs to be done. The machine's components should be secured snuggly, the contact screw should be in it's place and the only adjustment left to do should be minimal.

Look at the machine head on from the front:

Make sure it all lines up— an imaginary straight vertical line should run down from the contact screw, through the front spring, through the nub on the armature bar, and the needle bar should run through the center of the tube and the needles into the tip of the tube.

Once you have checked the assembled machine and have it running, and have set it up with a tube and needle bar, it's time for further fine tuning.

Turn the machine to look at it from the rear.

Check that the spring / armature bar assembly (rear spring, armature bar and front spring) is straight. Follow an imaginary straight line from the rear spring securing screw all the way through the tip of the front spring. This will ensure an even "bounce" when the machine is operating.

Turn the machine to look at it from the side.

Make sure that the needle bar runs through the center of the tube or even a little behind center but should NEVER rub on the back of the tube, (only the needles should run on the back of the tip.) The needle bar should be as close to the coil as possible, the back armature bar nub should be back far enough to accommodate this (by sliding the rear spring back on the securing screw, if it stops on the"U-shaped" notch, the notch should be grinded out deeper with a dremmel. A frame's tube vice hole should be placed and-drilled into the frame to accommodate this as well.

Both photos are of the same machine. Note the needle bar's placement, traveling perfectly vertically from the armature bar's nub through the back center of the tube. DETAIL: Only one rubber band is needed to secure the needle bar enough to prevent any shaking of the needles.

Once the machine has had it's "lines" checked:

Performthe **"Spring Tension Test"**- the added weight of the needle bar, grommet / paper towel and rubber band tenesion should affect the travel of the armature bar very slightly once the front spring has stopped on the contact screw. The machine should not be running when performing this test.

Perform the **"Ball System"**, the bouncing balls should move the same way as they did the first time this system was performed. The balls should not get closer to each other when turning down the current flow on the power supply. If they do, remove tension on the rear spring little by little. The contact screw should now be in it's permanent place.

Troubleshooting-Common problems

If you push the foot pedal down and the machine doesn't run:

Make sure there is contact between the contact screw and the front spring, **with** sufficient tension on the rear spring to push the front spring into the contact screw.

Check for metal touching metal- terminals touching the frame, wires touching the frame, grounding is the most common reason a machine won't run, or just look for wires broken inside the insulation, at the ring terminals or at coil base.

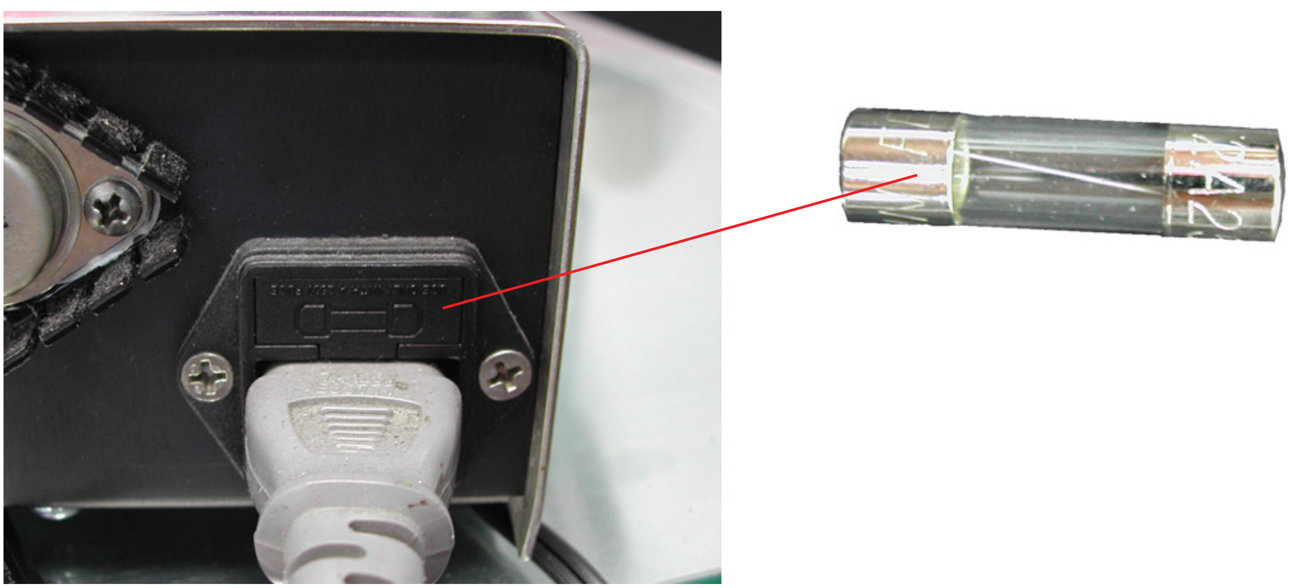
Wire terminals NOT making direct contact with the binding posts; may be accidentally assembled with a nylon washer between terminal and binding post.

Clip cord clips touching the frame.

There may be a break in the coil wire (rarely does this happen) at any point inside the insulation.

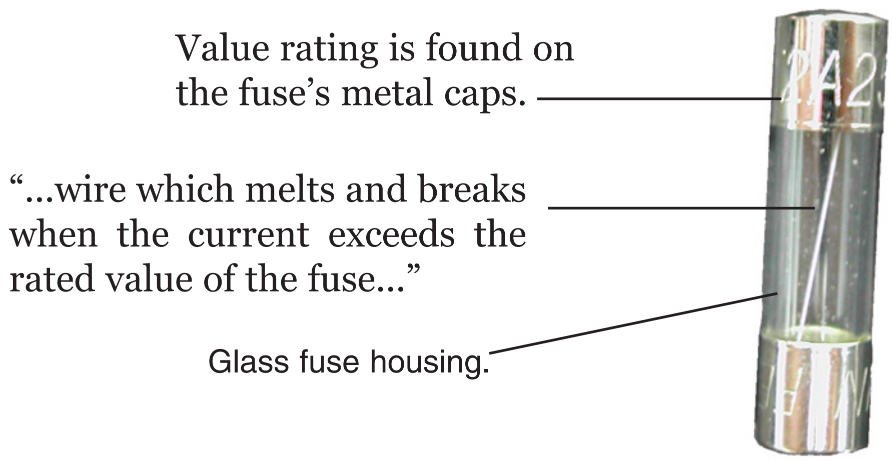
There is a good chance that the problem may be in the footswitch wires or footswitch assembly itself, or in the clip cord-wires themselves, check the jacks and terminals for bad solder joints...build a new clip cord or re-assemble the footswitch.

Check the fuse in the power supply and replace it.



In the case of this power supply, the fuse housing is in the rear. It's popped off with a flat head screwdriver exposing the fuse. In this power supply, the fuse sits horizontally. A **fuse** is defined as: "A protective device consisting of a short piece of wire which melts and breaks when the current through it exceeds the rated value of the fuse..."

In simple terms, in the case that there is a power overload, a fuse will “absorb” this overload and become damaged in order to prevent any damage to the other circuits in the power supply. To check the fuse, remove it and look for a break in the thin wire which can be seen through the glass part of the fuse. If the wire is broken, replace the fuse. Always replace the damaged fuse with a new fuse with the same rated value (usually engraved on the side of the fuse’s metal caps).



If you push the foot pedal down and the machine runs intermittently:

Check that the power supply is plugged into the wall completely

Check the soldering of the wire connecting to the terminals on the binding posts, or if no solder is used, check to see if the wires are NOT loose.

Check the wiring in the clip cord and footswitch jacks, there may be corrosion or loose solder connection.

Check the footswitch and clip cord wires for shorts by wiggling them every inch, from end to end, while keeping the pedal “on” with the machine attached, this will help locate the break in the wire. Replace the wire if necessary.

If the stroke drops when it shouldn’t, check the following:

Rubber band tension- a tight rubber band(s) will create more resistance and cause the machine to work harder.

Check rear spring tension- too much tension will cause a fluctuation in stroke when turning down current flow. Lessen tension (un-bend the rear spring) if this is the case, until the ideal tension is found.

There may also be a break or small crack in the rear spring.

Check for carbon build up, including on the clip cord ends that clip into the machine and file as needed to remove it.

Make sure there are no spring bends under any washers (spring saddle, armature bar assembly securing screw).

If the machine's power drops or raises and there is a big blue spark coming from the contact screw/ front spring:

Replace the capacitor.

General Maintenance

Over time, the constant use of the machine can deteriorate the it's function, just like in a car. Tune ups must be done to return the machine to it's optimal function. Checking it's non-moving parts and replacing the moving parts when worn, is necessary. Springs with excessive wear, or springs which simply need the tension re-set must be taken care of, loose rubber bands, capacitors breaking down must be replaced if necessary. To maintain your machine, here is a list of things to check periodically.

Periodically check the following:

Check rear spring tension and front spring flex.

Rubber band tension and quality. If it is dirty or starting to wear, or loosen replace it.

Check o-ring tension, if loose and "saggy" replace it.

Blue spark (replace capacitor if necessary).

Look for exposed wires.

Check contact screw for carbon build-up; a file, steel wool or fine sand paper will remove this.

Check front coil for carbon build up, if you use tape as a "muffler", clean gummy build up on the armature bar and on the top of the front coil and remove with WD40 and replace tape on the armature bar.

Check the armature bar for wear from the constant friction against the front coil. If the worn groove is too big, simply flip the armature bar over and use the "new" clean side. Protect it with a piece of Trans pore tape over the area which contacts the front coil.

Check springs for cracks & check front spring for wear replace if necessary.

Check securing screws for tightness on the following: binding posts (upper and lower), spring saddle, rear spring and front spring joint screw (on armature bar), and the coils' securing screws.

Check the condition of the acrylic ball or thread protector for the contact screw (inside upper binding post) and check the threads on the contact screw.

Don’t be afraid to take the machine apart, rebuild and/or replace parts!

Cutting corners or taking the easy way out gains you nothing!
Be a professional,
Join the professionals who know this information!

If you fail to prepare, then prepare to fail!

The Rubber Band

It seems silly to write a chapter on the "Rubber Band"...one of the very few non-mechanical parts included in the assembly and operation of a well running machine. It is such a simple ingredient in this process yet it needs to be addressed because this little band can make a difference in how a fully assembled machine (with a tube and needle bar) will run.

Some artists use 3 or 4 rubber bands on one machine, some use thick, tight rubber bands...most don't realize what they are doing...some of these artists think it makes them look "cool" or look like they know what they are doing. Truth is, that this simple item has a very important job to do and it's addition to the fully assembled machine should be taken very seriously.

The job of the rubber band is only **to make sure the needle grouping, and needle bar don't shudder or wiggle when the machine is in use**. Let's start at the beginning...earlier in this book, you read about springs and several times you heard about the weight and and resistance the REAR SPRING has to deal with. One of the most crucial burdens the rear spring has to combat is the tension of the rubber band. A rubber band that is too tight, will add to the resistance the rear spring spring has to fight against, in order to run the way it should. A rubber band that is too thick and tight will slow the movement of the armature bar. It may also keep the armature bar / front spring from returning (in it's upward movement) to make full contact with the contact screw this results in the machine not running. **Again**, the horizontal pull on the needle bar will make it's vertical movement more difficult by adding resistance to the rear spring. In addition, the bands will pull the needle bar, making it bow, this will move the needles away from the back of the tip of the tube. You can see this by simply pullling the rubber band tighter and watching the results. Watch the armature bar's movement slow down, watch the needle bar bow and the needles move toward the center of the tube tip's hole. **Needles need to rub on the back of the inside of the tube**, this is what helps the ink flow. If the needle grouping does NOT touch the back of the inside of the tip of the tube, no ink will flow, no pigment will be injected. Got it? So only one rubber band is enough. It is a good idea to stretch the rubber band before putting it on the machine...if ink is spitting out of the tip, check for shuddering or wiggling of the needle grouping, if so a tighter band could be used.

Prevention of cross contamination

Even though this book does not cover aspects of safe tattooing, there are a few practices which not only will help protect the artists and clients from health risks, but will also help protect the machine from corrosion.
Many artists spray their machines down with Madacide & many other types of disinfectants after tattooing, to clean the machine of any potential microorganisms. They SOAK the machine with these chemicals and let them dry on the machines. We discourage this practice because these chemicals can be corrosive to the steel screws, iron or steel coil posts, and springs. This rust and corrosion which develops, can "weld" the securing screws to the coils, weld the screws which secure the rear spring to the spring saddle onto steel or iron frames making the machine almost impossible to disassemble. These substances can get in between these steel or iron parts and will accelerate the oxidation, and leave a film on the rest of the machine. Prevention is better than cure, we recommend plastic baggies be put around the machine to minimize or prevent cross contamination, this is not to say that these bags will 100% eliminate any microbes from coming in contact with any part of the machine but it is harder to cross contaminate the machine frame when there is a barrier between the artists' dirty gloves and the machine. A paper towel or q-tip can be used to clean the machine off, slightly wet it and gently wipe down the machine and immediately dry it. Too much moisture in contact with steel or iron parts will start the oxidation.
It is NOT TRUE that machines heat up with a baggie placed around them, a well tuned machine will not heat up under any conditions, a rough running machine will heat up but again, this is NOT due to the use of a baggie.

Jory "Angel of Death" Helmes is a responsible artist who uses a baggie on his machines.

11

TOOLS and PARTS BOX

"I'm ready for whatever happens..."
-the Adverts

Every artist who is serious about tattooing should know their machine, should be able to be ready for emergency repairs or just a simple tuning or upgrade and should not be without a **tool and parts box**. All these tools will come in handy at some point and the investment is necessary and worth while.

TOOLS

Tin snips-used to cut springs.
Needle nose pliers- used to bend springs.
Vice grips-used to hold spring stock when using dremmel or hole punch.
Allen wrench/ hex head set-metric or standard.
Screw drivers-phillips and flat head.
Small jeweler's files-for the removal of burrs, carbon build up on the contact screw, removal of insulation from magnetic wire...
Large metal file- may be used to remove stock from coil post if necessary, smoothing sharp edges on freshly cut springs.
Drill and drill bits–necessary for drilling the pre -tapped holes.
Vice– to hold any frame or part securely**.**
Taps- 8-32. 6-32. 10-24, use with accompanying drill bit to re-tap stripped holes.
Dyes-8-32. 6-32. 10-24 used to re thread screws.
Heat gun-for electrical heat shrink for insulating wires.
Soldering iron-for soldering wire to tab terminals
Electrical solder / flux-tinning fluid, liquid flux is best. Electrical solder has a lower melting point and is ideal for the soldering of wires to flat tab terminals. Most contain lead, so don't make needles with electrical solder.
Safety glasses-save your eyes!!
Dremmel™ tool-in valuable...used to cut, grind, drill...bore out holes.
Dremmel™ bits-cutting discs-the thicker ones are recommended. Grinders, you will find endless bits with endless uses...
Feeler gauge set-used with a hole punch and you have an endless supply and variety of shims and or washers in a variety of thicknesses.
Feeler gauge stock-these come in foot lengths, good to stock ,019, .018, and .017.
Hole punch (optional)-saves time and energy on spring cutting- used to punch clean holes for the dremmel cutting tool to cut into
Hack saw-you never know when it may be needed.

PARTS

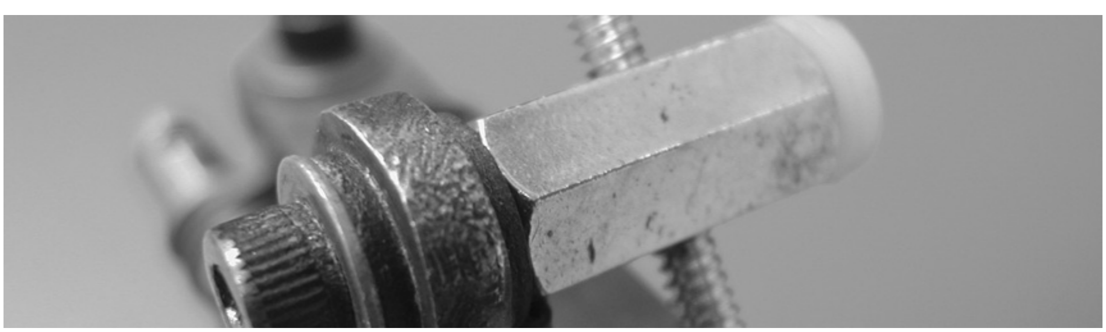
Screws- all screws below should be stocked in 8-32, 10-24...if your machine uses 6-32 screws, stock those as well. Always have larger ones on hand along with taps and dyes in case a 6-32 threaded hole becomes stripped in which case a larger hole can be drilled and re-tapped to accommodate a 8-32 screw...
The same goes for upgrading an 8-32 threading to a 10-24 threading.
Also, these can be bought for cosmetic reasons-there are stainless button head screws, black zinc finishes...brass. A variety of lengths should be bought—1/2”, 1/4”, 3/4”, 1”-(for swing gate machines, or split collet tube vice systems). Screw and fastener specialty stores carry an amazing variety of screw styles available in different materials and finishes. Home Depot has specialized sections with small screws, fasteners, washers, nylon or plastic screws and washers.
Screw types-
Allen screws-
Button head-
Phillips head / flat head-
Nylon screws-used as securing screw and thread protector for contact screw.
Wing nut or **Thumb screws**-
O-rings-used for increasing tension, smoothing vibration and pieces can be used for contact screw thread protection. These come in different diameters and thicknesses, have a variety of them handy.
Rubber bands- to keep needle bar on assembled machine from wiggling while in use.
Needle bars-used to check position of armature bar in relation to the tube vice hole from front and side view.

Washers and Terminals

Steel washers- buy #6 for 6-32 screws, #8 for 8-32 screws, #10 for 10-24 screws.
Nylon or neoprene washers (flat)– used between frame and terminal as insulators or as shims.
Nylon t–washers-used to block contact between binding post securing screws and machine frame.
Tab terminals-used to solder to capacitor wires when attaching capacitor separately from coil wires. Buy these in #8
Solderless ring terminals– terminals which require only a pinch from needle nose pliers to secure wire ends to the receiving end. Buy these in #8. NOT to be confused with the terminals with an open "u" shaped end.

Other

Heat shrink- to insulate wire, terminals, capacitor...shrink wrap coils.
Capacitors- different measurements of capacitance. Some may work better for different functions and on different machine frame specs. Always buy "Axial" Capacitors.
Coupler nuts-these can be made into binding posts just by drilling and tapping a hole for the contact screw. –These coupler nuts are commonly used as such on mass produced machines, and work well but understand that this **is** a cheap item which is being sold too expensively at tattoo suppliers, and can easily be made into a functioning binding post by you.
Brasso™-made by some asso...used to polish components and frames (only if they are not finished by powder coating, or zinc finishes).
WD 40™- will remove adhesive from surfaces...
Trans pore tape- used as a muffler, between the armature bar and the front coil.
Electrical tape / insulating tape– used as a last resort or if you are too lazy to heat shrink...easily seen electrical tape cheapens the look of any machine, use it if you need to insulate in an emergency situation.
1000 grit sand paper- use to remove carbon build up, or use a small flat jeweler's file. This can be found in the paint or finishing department of any hardware store.
Fuses- for power supply.



A .10 cent coupler nut can be turned into a binding post.

12

Resource Guide

"Don't'cha know where to cop, that's what New York Johnny said
you should get to know your town just like I know mine..."
-The Clash

The following is a list of sources where tools and parts can be purchased. Many of the parts which should be replaced periodically can be bought locally and do NOT need to be bought from a tattoo supplier. Sometimes, the suppliers will sell these simple parts like screws or washers for a lot more than a hardware store or a fastener specialist would. The names of the suppliers we have mentioned, we use, not only for tools and parts but for ink and other tattoo supplies.

Fasteners

All screws can be purchased at any fastener specialist listed in the phone book. There are several online which can provide you with custom screws, plastic / nylon screws, washers & hex head screw caps in various colors. The specialized screw, washer and fastener section of the Home Depot carries many of the screws we recommend. If they do not, seek out a "screw and fastener" distributor in your area.

Tools

Most tools we use can be found at your local hardware stores, even Home Depot carries all these things- allen key sets, screwdrivers, needle nose pliers, vice grips, dremmels and cutting discs, taps, dyes, files...Some items, like the hole punch may have to be specially ordered, be prepared, hole punches are not cheap!

Feeler Gauge Blades (12" lengths)

Precision Brand - www.precisionbrand.com **-** Precision brand feeler gauge blades are great. Most U.S. hardware stores will order precision brand feeler gauges. You can order directly online.

Starrett - www.starrett.co.uk – Starrett makes an excellent feeler gauge. Starrett is a British company their products are available in Canada also.

My Tool Store - www.mytoolstore.com – an online distributor of tools and KD feeler gauge sets.

Acklands Grainger - www.acklandsgrainger.com – this company has a large number of sister companies **worldwide** (even in Africa!), which distribute tools, feeler gauges, and industrial safety products. Their catalog is huge!

Eikon Device - www.eikondevice.com **1-800-427-8198** **Eikon** is not only a specialized "tattoo" supplier, but they also sell tools such as: hole punches, allen wrenches, hard shell machine carrying cases.

Silver Screws

D.H.D. Manufacturing - www.tattoolz.com **714-647-5582**. We sell sterling silver screws in 6-32, 8-32 and 10-24.

King Pin Tattoo Supply - www.kingpintattoosupply.com Silver screws, pre-cut springs, Power supplies, general tattoo supplies, great service. Phone# - **888-229-5675**. When calling, Ask for Bill Smith, tell him we sent you. Mailing address -3349 118th Ave N., St. Petersburg, FL 33716 .

Electronics

Radio Shack– Carries terminals, fuses, soldering irons, solder for electronics (not to be used for making needles; it's leaded). **They no longer carry capacitors**.

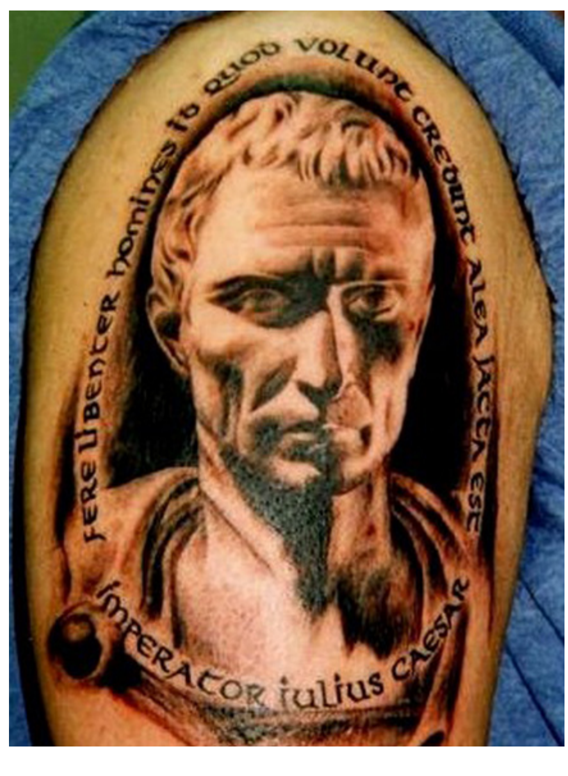
Any electronics dealer in your city will sell bags full of capacitors of all values, fuses of all values, heat shrink, screws, terminals, specialty washers, 1/4" jacks, rca jacks / rca adaptor kits, some sell foot switches, soldering irons...they even sell enough parts to build your own power supply!

13

Tattoo Photo Gallery

painted by "Super"

Juan “Super” Arreguin



Juan Arreguin is one of Mexico’s most recognized artists. He is has worked all over Mexico and the world. Look at this solid work. He is a specialist in every style of tattooing. No wonder they call him **“Super”**. He can be found tattooing Merida,Yucatan, Mexico.

Jeff Tam

Jeff Tam works at his Vancouver studio (Monkey King Tattoo). His specialty is Japanese style tattooing. This world traveler understands that work of this size needs to be done precisely and solidly. His machines need to be well tuned for this application. TIme is an important factor in the application of these pieces, not just to keep up with the appintment schedules but for the comfprt of the client. A well tuned machine will help to execute these pieces in a quick and less painfull manner.

Mark Lankin

Mark Lankin's tattooing style has been compared to that of a comic book artist. Because of his background in painting (skull below), he doesn't depend on heavy outlines to "make" his tattoos, the way most artists do. This amazing bio-mechanical piece shows the subtle grays which can be produced with a perfectly tuned machine. He is not limited or intimidated by any request because he is confident that his machines will do what he wants them to do.

Mike Drossos

Mike Drossos, or “Mike D” as he is more commonly known,can tattoo anything--from realism to new school...check out the plaid pattern on the tattoo on the left...look at the pencil’s point on the tattoo on the right and the foamy apple juice...Amazing! Without a well tuned machine, this work would much more difficult, if not impossible! You can find Mike D at Outer Limits Tattoo in Orange California. This work speaks for itself.

Jory Helmes

Jory Helmes is a Vancouver artist with a background in painting and animation. At 23 yrs old, and with a mere 3 years shop experience, the quality and clean-ness of the work he is putting out is amazing (spider). Most tattoo artists know that a solid grey (black-n-white mixture) is one of the hardest colors to put into the skin, look closely at the solidness of the different greys used to make this “brush stroke” drum kit. Jory knows that finely tuned machine will play a major role in injecting this pigment solidly into the skin.

Kody Cushman

Ask **Kody Cushman** to do any tattoo, and she'll say "yes", no job is too difficult for her, not only because she is a very talented artist but because her machines run the way they should. There is no room for second guessing when you are turning our work like this on a daily basis. Kody tattoos at Outer Limits Tattoo in Costa Mesa, California.

Ramón “Tigre” Perez

Ramon Perez is onwner and operator of Taxco Tattoo, in Saltillo Mexico. He is aversatile and innovative artist. His understanding of the tattoo machine has brought him to a level of interntional recognition. The evolution of his 16 years of tattooing,from hand pokes to home made machines to professional machines and NOW to the complete understanding of funcition and it’s application to technique, has transformed him into a highly respected artist who is able to put hit artistic renditions onto the skin confidently.

Jeremy Riley

Jeremy Riley is a Vancouver tattoo artist who's visions are **genius**, his unique style of art is easily recognized anywhere. His talent, originality and innovations are brought to life, on skin, not just by ability, quality pigments and sharp needles but by perfectly tuned machines. Note the the smooth even greys, solid white and fine details which make up this piece. Color shading with a 3 needle liner to make the small eyes look realistic.

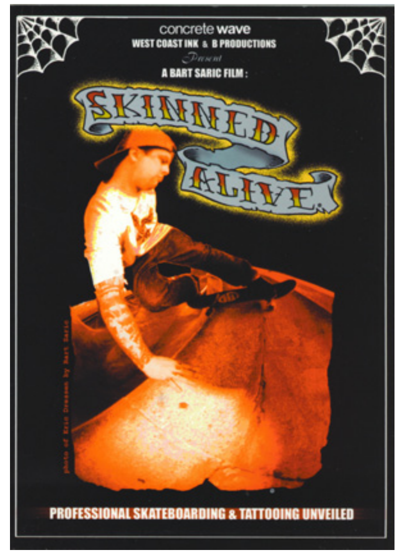
About the authors

Art and Steve Godoy

The Godoy twins are tattoo artists, machine manufacturers, recognized inventors, and ex-pro skateboarders. The twins' first major inspiration to get tattooed was a punk band called the Cockney Rejects. Their 1981 record entitled "the Power and the Glory" depicted the band on the back cover showing off their colorful tattoos...Starting to tattoo in Texas in 1985 (4 years later), at the beginning of their skateboarding career, maybe wasn't the best idea. This made it impossible to take on any formal full time apprenticeship and manage a skate career that depended on constant travel at the same time, so the only way to gain experience was to tattoo on the road. Already being artistic since childhood and doing t-shirt and skateboard art for companies such as : H-Street, O'neil, Pirate Surf, Killer Bees, G&S, Hobie, Iron Cross (their board company), was an advantage as it kept drawing skill in tune.

Skateboarding and tattooing did not go hand in hand in the mid 80's, like it does today, and because of the Godoy's rebel image, companies were wary of promoting the heavilly tattooed twins to an audience of day glo wearing, bleached hair, Vision street wear clothed youngsters and their parents who bought the kids the boards. Look at skateboarding now...this cross over is documented in the 2004 Bart Saric documentary "Skinned Alive"--citing the Godoys as the originators, and major influence of todays lifestyle crossover between skateboarding and tattooing.

Flash forward to today, the accomplishments speak for themselves--recognition for exclusively tattooing Julia Gnuse, the Guiness Book of World records most tattooed woman, t.v. appearances-"Guiness Prime time", "Mike and Matty show", "You Asked for it", "Ripley's Believe it or not"... "Pro Sieben Television" (Germany), "Fuera de Serie" (Latin America/Europe), KTLA Los Angeles...magazines-Tattoo, Skin Art, International tattoo, Flash, Pain Magazine, Crave, Tattoo Artist Magazine, Alternative Trends, Thrasher, Trans World Skateboarding, Rolling Stone...countless Australian Magazines, Tattoweir Magazine (Germany)...even tabloids like the National Examiner and the Globe!

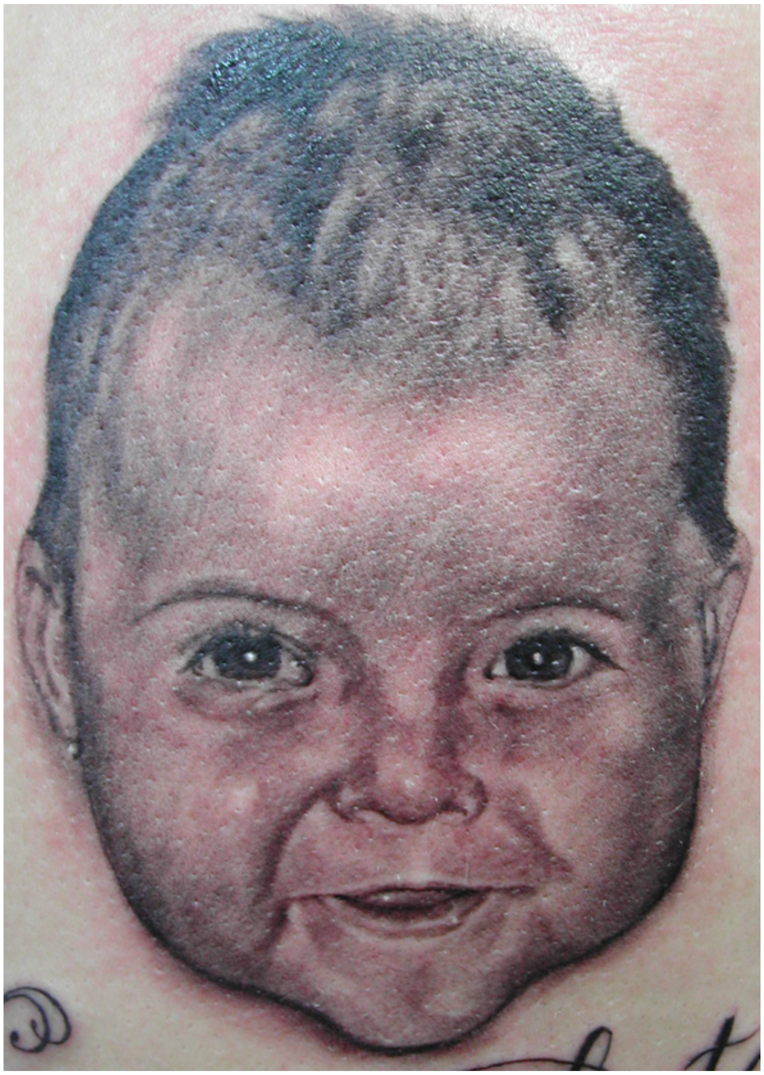


They are owners of DHD manufacturing, a company which manufactures their innovative tattoo machine designs and components.
They are recognized inventors with 2 U.S. patents under their belts for the "Quadrilateral Electromagnetic Coil" and the "Screw Tight Tube Vice Frame", both inventions appear on all DHD machines- the only machines in the world with 2 recognized U.S. and Canadian patents with international patent protection applied for.
Being bi-lingual, the twins also conduct seminars in English as well as Spanish, on machines--manintenance, tuning and manufacturing. And are available anytime for seminars.
The yearly machines seminars in Mexico have inspired a movement of advancement, and understanding of how the tuned tattoo machine relates to the application of quality tattoos. Art and Steve also write a monthly column for "Tatuajes y Perforaciones", a Mexican based magazine with major distribution in Central / South America and Europe.
Steve tattoos in Orange County, California, at Kari Barba's Outer Limits and runs the manufacturing and distribution of DHD products.
Art owns Funhouse Tattooing in Vancouver, Canada and handles the Canadian distribution of DHD products. --**John Rumberger 2005**

Art tattooing Julia, 1997, Venice Beach.

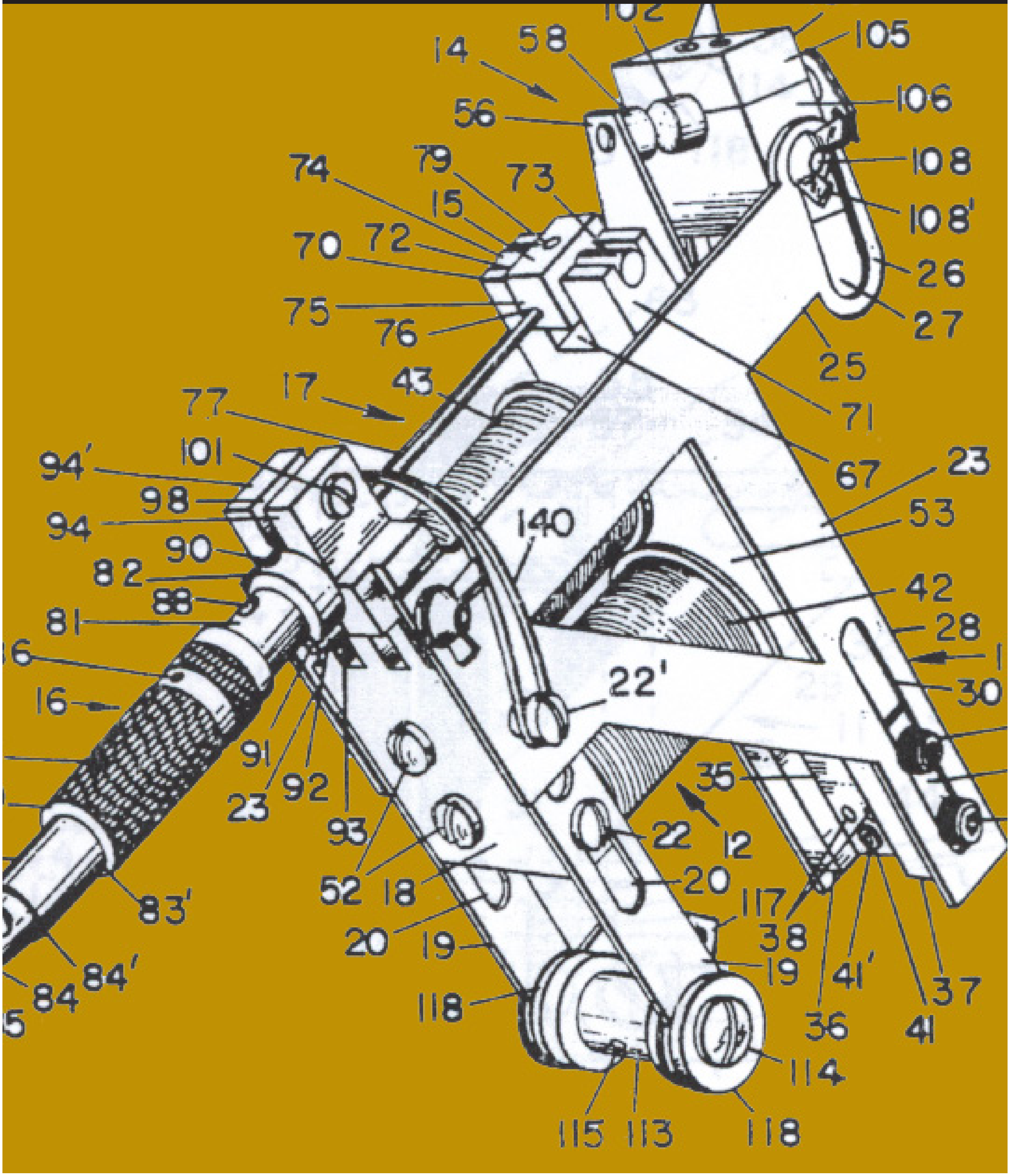
Steve tattooing Clark North (now from the t.v. show Inked) in 2002, Orange County.

“I can confidently say that there are very few challenges left for me, as far as tattooing goes. I love doing every style but prefer realism. Besides the artist’s natural ability, the way the machine runs is one of the most important factors in the completion of a good tattoo. The even injection of the pigment depends on the sharpness of the needles and the quality of the pigment but **more so** on how the machine is running. This understanding is something all artists should know.” -- **Steve Godoy**



“Realism is something we’ve wanted to master. Steve and I would talk about it since the beginning of our tattoo career, when our friends were getting realistic black and grey pieces from artists like Mark Mahoney or Mike Brown. Portraits and realism are considered some of the most difficult tattooing. Matching skintones is hard enough, doing fine lines with a single needle is no less difficult, but when your machines run the way they are supposed to, you eliminate most of the stress. This type of tattooing, for me is no longer stressful, I find it relaxing. Just knowing that my machines are tuned helps me to focus on the jobs I have to do.” -- **Art Godoy**

A gallery of handmade machines, and other machines of interest...



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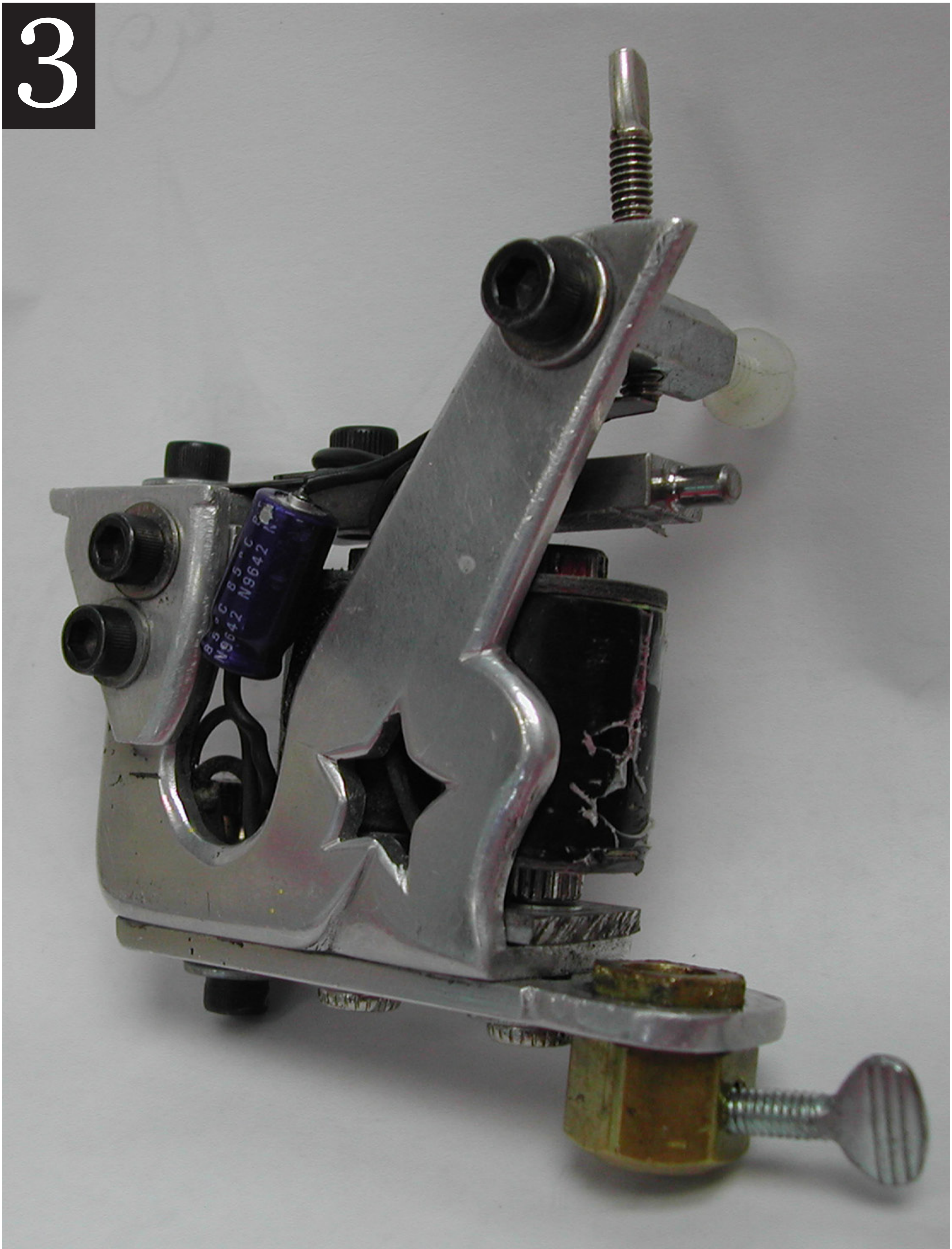


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"This book is an invaluable resource for any tattoo aritst who considers himself professional, modern and self sufficcient. It is a definitive work which clarifies and demystifies the science of the tattoo machine. In time, the I'm sure that the information contained in this book will become an industry standard. Like the Godoys say, "There is no room for lies, magic or superstition when it comes to tattoo machines, this is science, you either know it or you don't." That's exactly what this book is about. The information contained in this book, in the right hands, can become an incredibly powerful tool!"
--**Casey Altorf**-Tattoo artist, machine authority and builder, from Funhouse Tattoo, Vancouver Canada.

These machines are not the typical home made machines like the “jailhouse” rotary machines we all think of when we hear “home made”. These are hand made machines. These are made from simple hardware store parts by sawing, grinding, drilling, and bending...It is our recommendation that all artists should build one of these “Frankenstein” machines. It increases awareness of specifications, measurements and materials, it also will help in the understanding of “compensation” (shimming, filing, re-drilling, tapping) in order to make that machine run perfectly.

Descriptions of machines 1-7 (p. 100-106)

1). This machine was made by Casey Altorf of Vancouver Canda. It’s frame is made from a steel bracket used in the framing of houses.The construction of this machine was entirely based on bending. Because it is a steel frame, there is no need for a yoke.

2). This Machine was built by Steve Godoy, it was cut from a piece of angled aluminum, notice the tube vice is attached to a flat piece of steel which doubles as a yoke. The contact screw is copper, an excellent soft metal with excellent conductive properties. The tube vice is made from plumbing parts.

3). This machine was built by Art Godoy, also made from angled aluminum. This is a 3 part frame, note the screwed on spring saddle, and the screwed on base/tube vice support. The yoke is a flat piece of iron from a hobby shop. The binding posts are coupler nuts, drilled and tapped. This is a very simple and primitive tube vice system, it damges tubes...

4). Built by Steve Godoy, this machine is made from angled iron. This machine was designed to accommodate an extra set of 1” coils he had laying around the shop. Because it is an iron frame, there is no need for a yoke, the yoke you see in the picture is used as more of a “shim” so that normal sized needle bars can be used without any problem.

5).This is another of Steve’s machines. This is also a steel frame, sawed filed and drilled. The top section of the tube vice was cut out to bring the tube vice closer to the front coil in order to shorten the distance from the spring saddle to the base of the armature bar nub. This machine was sold by it’s original owner and was seen being used as a belt buckle...Jeremy Riley rescued it, cut off the welding (this can be seen in the photo) and rebuilt it...it is still in use today.

6). This machine is yet another Steve Godoy creation. It was built as a request from a friend. It has an obvious offensive design, but it is genius at the same time, look at the perfect placement of the capacitor inside it’s own “shelf”. Aesthetically, it’s squared off rigid lines do have a unique appeal. Notice the steel frame attached to an aluminum base to house the tube vice.

7). This Machine is a real work of art. It was built by Chris Self as a gift to Steve Godoy. Every inch of it has artistic value...from the contact screw, to the armature bar nub, to the smooth welds....right down to the “GODOY” stamped into the tube vice securing screw. Truly a funcional work of art.

The following machines are cast from aluminum or silicon bronze. Some are experimental designs of ours with patents pending, but all run in a manner unique to their designs and specifications.

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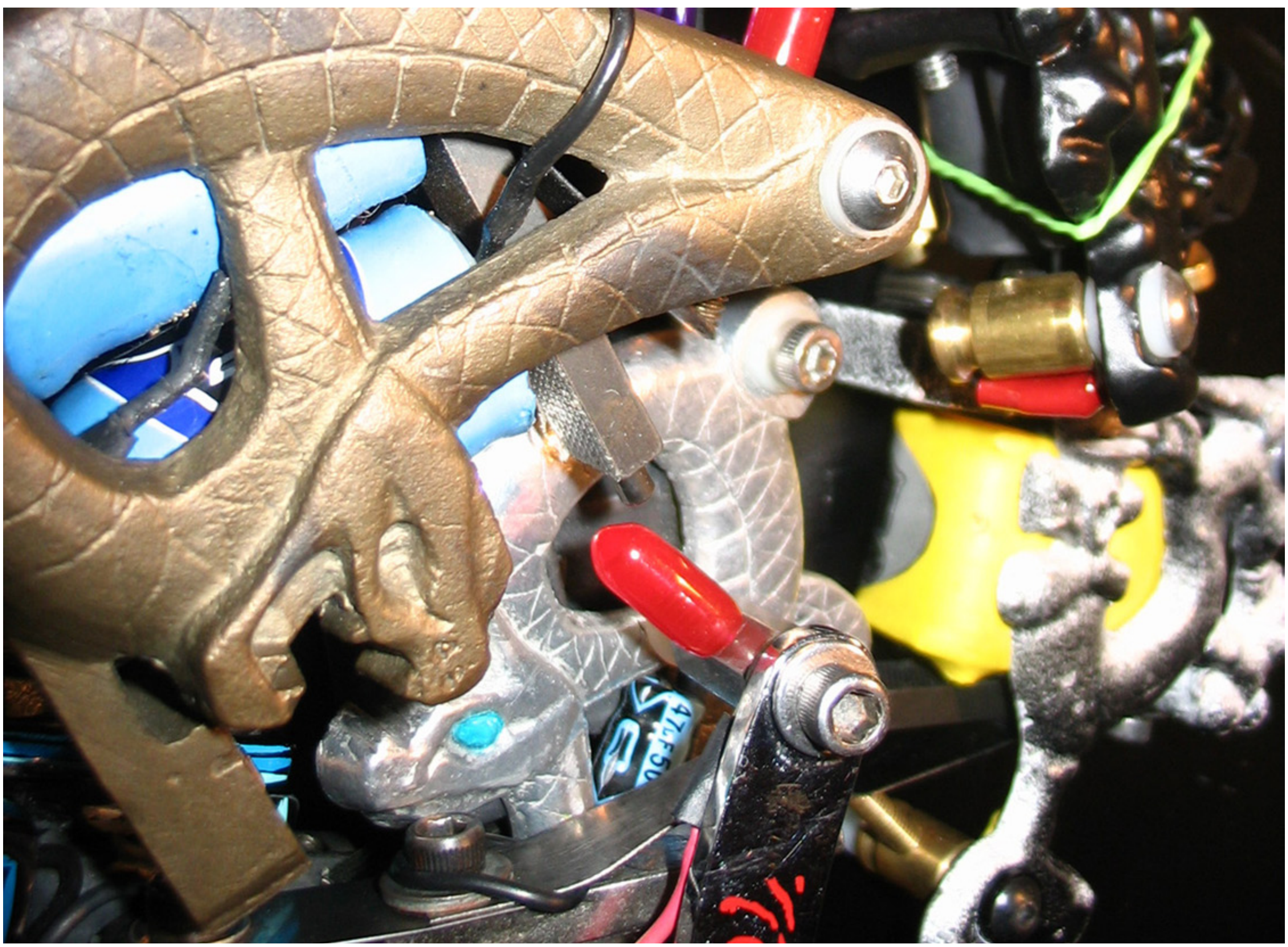
8 & 9). These machines are cast from Silicon bronze. These frames are done in a lost wax style of casting, that means that they were originally carved from jewelers wax. The weight of the was is no indication of how heavy the cast metal frame will be. These machines, fully assembled weight in at about a pound! Think about that...imagine lining for hours with one of these. The aluminum versions weigh in at half the weight!

10). This is an aluminum frame, it is from the first run of machines we built with our patented square coil assemblies. The idea that we should fool around with the magnetic field of the coil by increasing the contact surface was the inspiration for the development of the square coils, this is also the first run of our tube vice system.

11). These V-Twin Coils were inspired by a Harley Motor. Note that when the square coil is tilted on an angle, the surface becomes a rectangle, this simple formula increased the surface area of the magnet...combined with 6 layers of AWG21 wire...this machine is a monster....super sensitive, it runs at “0” on the power supply dial.

12). This design was an experiment in the shape of the contact area of the tops of the coils. We decided to move the magnetic field around the round armature bar. This particular armature bar had a bit of weight to it so a thicker rear spring was used, it was a .019, but slimmed down a bit. These coils were very costly to manufacture. Though the patents are pending on this design, production of these may not see the light of day. Watch for other manufacturers to make coils with larger tops...



ACKNOWLEDGEMENTS

It's been a pleasure to put this book together and we hope you put it to good use.

We believe that anyone who tattoos, needs a thorough knowledge of what they are doing. Everything from stencil making, to understanding the benefits of needle gauges and tapers, using sterile and safe practices in the act of actually tattooing and *of course,* knowing your machines' function. In our opinion, anyone who does not know this information, is not a tradesman and are making a living pretending to be experts. Read this book and if you are still unclear about anything, re-read it until you understand.

We wanna thank everyone who participated in the making of this book, namely:

Dave Hollander, Jeremy Riley, Casey Altorf, John Rumberger, Doctor / Reverend Terry Kaegin, Mark Lankin, Jory Helmes, Kody Cushman, Mike D and Chris Self, Jeff Tam, "Super", "Tigre". We're proud to showcase their talents, not only are they great artists, but they know and understand that to be an expert tattoo artist, one must know his/her machine's function. To be able to diagnose, repair, modify and finely tune your machine is key in anyone's advancement as an experienced tattoo artist.

Thanks also to **Dean Palmer** at **IP LAW** in Vancouver, and **Devon Ryning** at **Miller Nash** in Washington, for being our patent attorneys.

Thanks to **Sue** and **Jennifer** at **Buchanan printing** for pdf conversion, and other great services.

Thanks to the customers who gave us permission to publish their tattoos.

Thanks also to everyone who has taken our machine seminars over the years.
Thanks to Sammy Ramirez from Sammy Tattoo in Guadalajara Mexico, if it wasn't for him, we probably would not have written this book or be doing seminars!

For info on the artists mentioned in this book, go to:
www.artgodoysfunhouse.com
www.outerlimitstattoo .com
www.marklankintattoos.com
www.sammytattoo.com

For DHD information go to:
www.tattoolz.com

The quotes at the start of each chapter are lyrics by some of our favorite bands.

Illustration Index



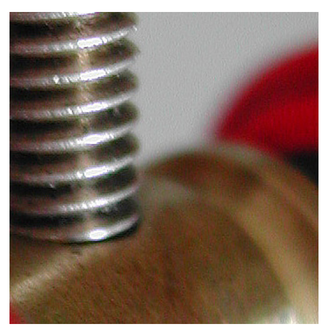




Photo / Illustration index

Tattoo Gallery / Machine Photo Index: