New Jersey Blacksmiths Association

N.J.B.A. Newsletter

NJBA Volume 25, Issue 2 November, 2021

Editorial: Did You, too, Forget to Renew?

Maybe because of the one-year dues holiday last year, or maybe because it's been a while since we've had an in-person meeting (due to the pandemic), **an unusually large number of NJBA members have yet to renew.** Dues were due July 1, and remain a mere $20 per year (plus $10 for a paper Newsletter subscription).

Please support NJBA by sending in your dues right away.

Please see the last page of this Newsletter for the combined renewal form, and volunteer form.

Upcoming NJBA Events

Nov. 6. Anvil-Repair Workshop

NJBA will be holding another of our famous participatory anvil-repair workshops beginning 9 AM on Saturday, Nov. 6 in Howell, NJ. The price per anvil will be $175 for ordinary repairs on edges, faces, and hardy hole. The workshop is open to NJBA members only, but nonmembers may join by adding the $20 annual dues.

Participants will be expected to assist with the work involved. Participants should expect to have to grind the excess weld bead on their anvils themselves. Instruction in these tasks will be available. Please read the rules for participating in NJBA events, including the COVID rules, on page 3.

Contact NJBA Director Tom Santomauro if you are interested. (See p. 2.) Please send him photos of the damage to your anvil. Assistance from nonparticipating members is also welcomed. Tailgate sales welcome.

Jan. 30, 2022, 10 AM-4 PM

Hammer-In at the Blacksmith of Trenton (hosted by the Hebrew Hammer Blacksmith)

Daniel Lapidow (the Hebrew Hammer Blacksmith) will be giving a tour of The Blacksmith of Trenton (334 North Olden Avenue, Trenton, NJ), an active blacksmith shop since 1823. The tour will focus on the history of the shop, the various projects that have been created on-site, and a live blacksmithing demonstration.

The live demonstration will cover various projects that have proven popular at craft shows and have been successful at generating individual sales revenue. The demonstration will focus on such items as fireplace pokers, household hooks, bottle openers, and other items that sell consistently.

The tour of the facilities will encompass a history of the shop, the various tools and equipment that are employed in blacksmithing, and an overview of the projects made in-house.

Daniel Lapidow's first exposure to blacksmithing was through his work on historical sites. He has been blacksmithing professionally for five years and his work focuses primarily on public craft shows and educational demonstrations.

Daniel is the current resident blacksmith at the Howell Living History Farm and serves at the primary blacksmith for Washington Crossing State Park, Wild West City, and multiple Renaissance Faires in the New Jersey area. Additionally, Daniel is a participant in the annual Trenton Art-All-Night event and teaches blacksmithing in his shop and at multiple sites throughout New Jersey and Pennsylvania.

For more information, you can contact Daniel at dlapidow@verizon.net

(continued on page 2)

New Jersey Blacksmiths Newsletter

NJBA Board of Directors

Ryan Amos	**David Ennis**
William Barrett	**Bruce Freeman**
Marshall Bienstock	**Mark Morrow**
Bob Bozzay	**Bruce Ringier**
Larry Brown	**Thomas Santomauro**
Eric Cuper	**Ben Suhaka**
	Dan Yale

Upcoming NJBA Events, continued

Sun., April 7, 2022 Jonathan Nedbor at EJOT

We were within a few days of holding this meeting at East Jersey Old Town in Piscataway, NJ, last September, when Hurricane Ida flooded out EJOT. We have therefore rescheduled the event for the spring. More details will be provided in a subsequent Newsletter. For further information, please contact

Open Forge Meets

(See Rules, p. 3)

Monday Night Open Forge, Howell, NJ

NJBA Director Marshall Bienstock hosts an open forge meet every Monday evening at 7 PM, except major holidays. (Please call ahead to make sure the forge will be open.)

Sunday Open Forge, Smithtown, LI, NY

From the beginning of November through the end of April, Ron Grabowski will open his forge in Smithtown, LI, NY, to NJBA members. Please call ahead to confirm and get directions: 631-265-1564. Ronsforge@aol.com

We like to thank those who joined NJBA as Business Members:

Marshall Bienstock

NJBA's Official Address
NJBA, P.O. Box 224
Farmingdale, NJ 07727-9998

NJBA's Website:
http://www.njblacksmiths.org

NJBA Newsletter:
Will be found on our website (above). Look for "Current Newsletter" and/or "Newsletter Archive."

NJBA's Facebook Page:
https://www.facebook.com/njblacksmiths/

NJBA's IForgeIron subforum:
Scroll down at https://www.iforgeiron.com/.

NJBA's subreddit:
Reddit.com/r/NJBA
You can get a free Reddit account and post questions, links, pictures or whatever here.

Rules for Participation in NJBA Hands-On Events

These rules apply to workshops, open forge meets, demonstrations with hands-on components, etc.

1. Participation in NJBA-sponsored hands-on events is limited to adults (i.e., 18 years or older). This rule was effected as of December 4, 2016.
   (Note: This policy ***does not apply*** to open forge meets and similar events *that are sponsored or co-sponsored* by youth-oriented organizations such as scouts, 4H groups, schools or other venues.)
2. Workshops are open only to NJBA members, but nonmembers may join by paying dues when they register.
3. All workshop fees are due upon registering. Any materials fee is not refundable. A workshop fee is refundable only if your place in the workshop is filled by another person.
4. If you only want to watch the workshop, the fee is half the listed workshop fee.
5. Workshops are intended for the purpose of teaching certain skills and/or completing certain projects, and are subject to the authority of the workshop leader or instructor. Accordingly (as per a vote of the NJBA Board on Jan. 28, 2018.):

- ♦ The participant shall work *only* on the project at hand and not on any other projects, *without exception*. (Note: Any NJBA member may attend an NJBA open forge meeting to work on his own project.)
- ♦ Every participant will be required to follow the instructions of the workshop leader, especially any instructions pertaining to safety, or he may be ejected.
- ♦ A person who has a history of failure to follow instructions may be refused admission to any workshop, at the sole discretion of the workshop leader.

Rough-Cut Crane-Rail Anvils Available to NJBA Members

Former NJBA Director Dan O'Sullivan donated some heavy crane rail to NJBA for conversion into anvils. NJBA Director Larry Brown torched these to rough anvil shape.

We are now offering these rough-cut anvils to NJBA members for $3/lb. Four such pieces are available:

- =2 ea. ~9.5" long and 28 lb, $84.
- 1 ea. ~13" long and 38 lb, $114.
- 1 ea. ~13" long and 40 lb., $120

Special COVID-19 Rules

(As per a vote by the NJBA Board on April 12, 2021)

All attendees at NJBA events ***must***

- be able to prove they are vaccinated
- wear a mask covering mouth and nose,
- observe social distancing by remaining 6 feet apart.

So at *every* NJBA meet you attend.

- Show your photo ID
- Show your COVID-19 Vaccination Record Card (or a photograph thereof)
- Wear a mask,
- Maintain social distance.

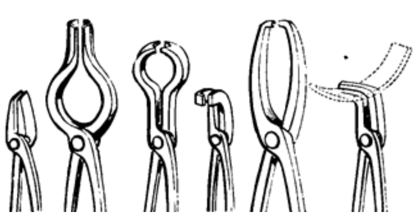
You will not be admitted if you fail to follow these rules; you will be required to leave.

Report on Meet at Princeton U.

by Ryan Amos

After Princeton University cancelled last year's annual blacksmithing event (known as "Hammer Time") due to the pandemic, the NJBA returned on Saturday, Oct. 2, to help introduce Princeton students to our craft. Dozens of undergraduate and graduate students joined, likely driven by a mix of exciting activities and the promise of free food.

With six stations and 2-3 students at each station, we got as many students time on the forges as possible. Students made projects ranging from hooks to hearts to bendy things to slightly flatter pieces of metal. On a more personal side, I'm hoping that, as the current head of the Princeton blacksmiths' club, the enthusiasm from this event will help me find a successor.



Part-Time Blacksmith Needed

Princeton University Institute of Materials is looking for a part-time blacksmith to assist with running the Princeton blacksmith club. The primary responsibility would be to help students set-up and use on-campus forges and to provide blacksmithing instruction and mentorship. The expected time commitment/compensation would be based on approximately one evening per month for 2-3 hours. If you are interested in learning more, please contact Ryan Amos (rbamos@princeton.edu, 832-830-2880) for more information.

Furnacetown Vandalized; Seeks Donations of Forged Items

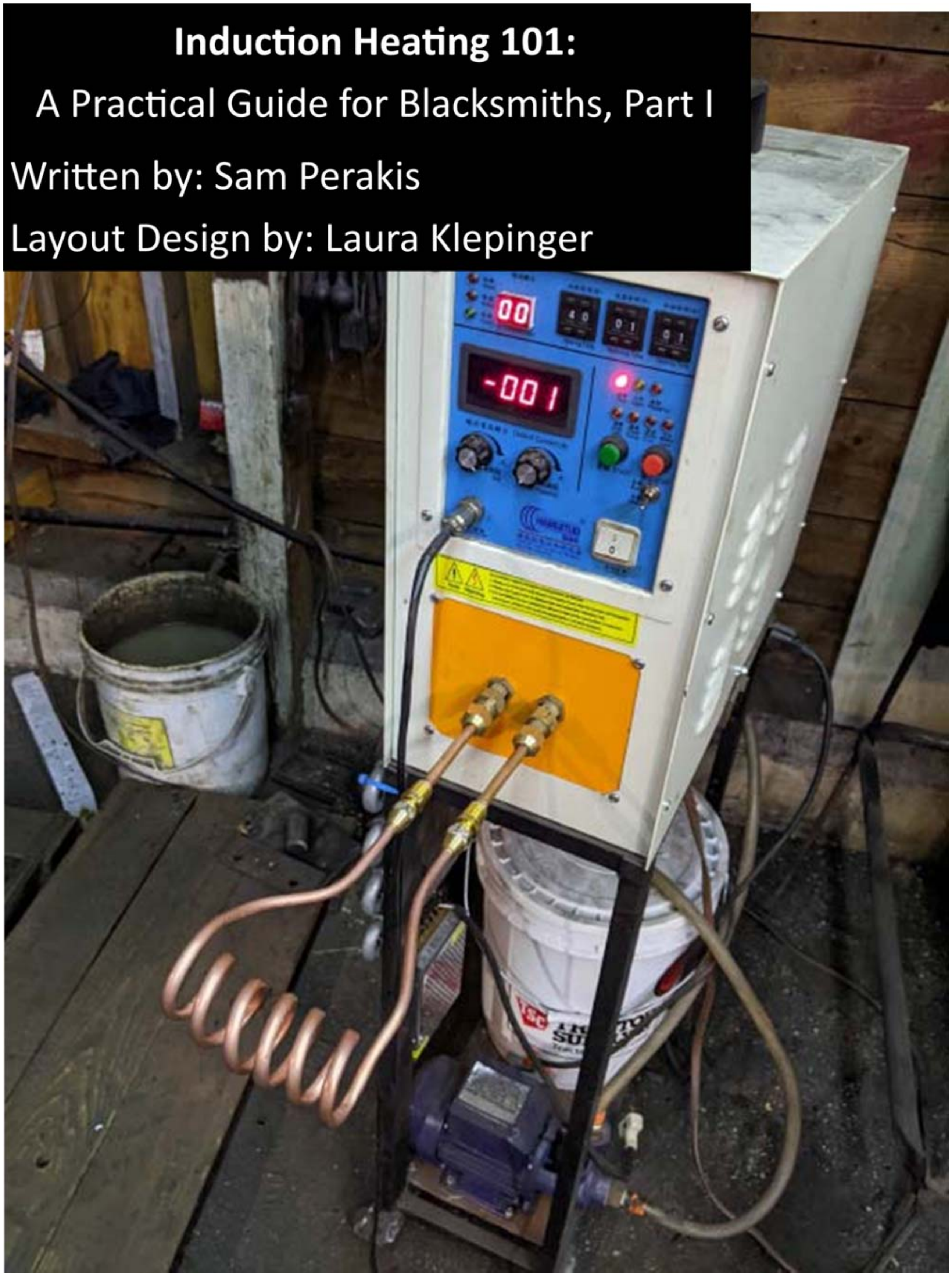
There will be a benefit event for Furnace Town held on October 23rd. As many of you heard, the whole facility was vandalized and robbed recently. They are looking for forged items to be donated for a silent auction. If you would like to help contact Larry Furst at 410-310-5715.

Induction Heating 101:

A Practical Guide for Blacksmiths, Part I

Written by: Sam Perakis

Layout Design by: Laura Klepinger



From the Newsletter of the New England Blacksmiths

Winter, 2021 and Spring, 2021

Recently I recorded a YouTube video about induction heaters and I re-tooled the script for that video into this article. If you're interested in a video version, look up my YouTube channel BigPigForge and check out my video called "Induction Heating 101: A Practical Guide for Blacksmiths." Please find me online and give me your feedback - I enjoy making these educational videos and your feedback will help me produce better material.

I'd like to talk about magnetic induction heating in the blacksmith shop. These heaters have become accessible within the past 5 or 10 years via eBay or other US-based sellers but they're all based off of the same Chinese-made 7.2 kW (15 kW peak) design. They take 240 V out of the wall and turn it into a high efficiency heat with no fumes, no hydrocarbons, and much less waiting than traditional heating methods like coal or propane.

The basis for this technology is magnetic induction which you might have heard about from induction stovetops. To talk about it we need to get into some light physics.

When you have a current running in a conductor, it always generates a magnetic field orbiting the conductor according to the "right hand rule" where if there's a current going along my thumb, magnetic field lines will form a loop around that conductor in the direction of my fingers (Fig. 1).

If the conductor itself is bent into a loop or a coil, the sum of those field lines generate a donut shape or a "toroid" that wraps itself through the coil (Figs. 2 and 3). This results in a tunnel of highly organized magnetic field lines inside the coil with most of the lines near the coil and very few at the center of the coil. This will become important when we design coils.

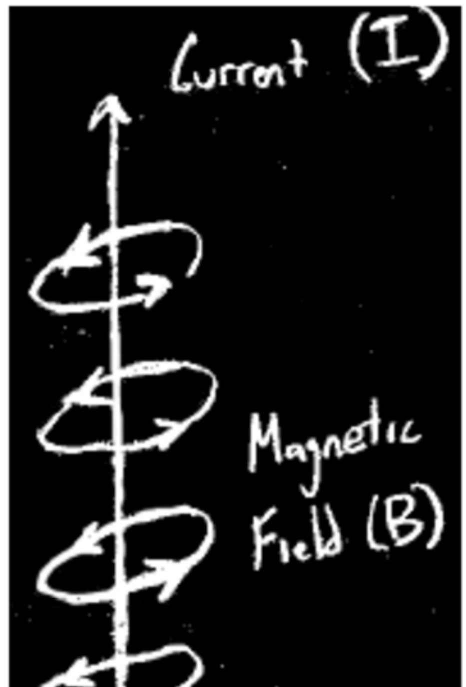


Fig. 1

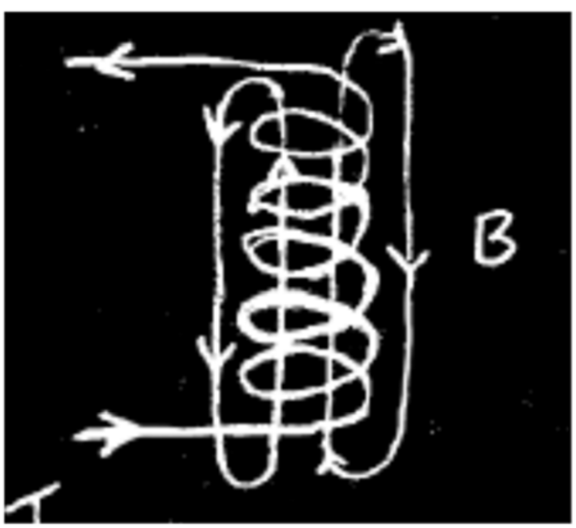


Fig. 2 The Right Hand Rule in a Coiled Conductor

Fig. 3 A Toroid of Magnetic Field

The converse of the right hand rule is also true, where if you have a moving magnetic field moving in the direction of my thumb, it'll generate a current in the direction I curl my fingers. So for every magnetic field line that pierces the material in the coil, a tiny loop of current will be "induced" in the material hence the name. The sum of all these little eddy currents becomes a net current that travels in the material in the opposite spin of the current in the coil (Fig. 4). You can basically think of it as the material resisting the current in the coil by generating a current of its own. In induction heating, we switch the direction of the drive current back and forth at tens of kHz so the bulk current in the material is changing thousands of times per second but the effect is the same: it heats up.

Fig 4: Eddy Currents Caused By Induction

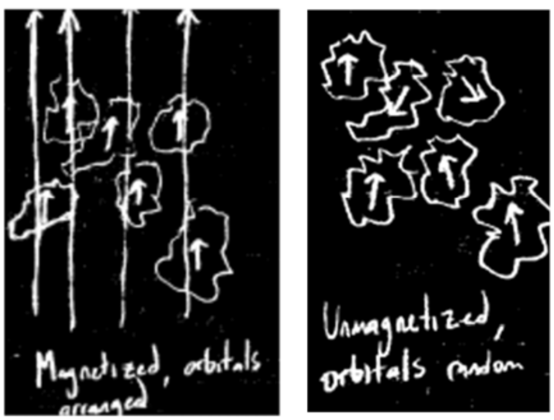


Fig 5 & 6: Applying A Magnetic Field Arranges the Electron Orbitals

If I try to heat this piece of copper, it doesn't heat as quickly as a piece of steel because the steel has a trick up its sleeve: it's a ferromagnetic material. Iron, steels, and nickel are all common ferromagnetic materials which means that they can be made magnetic by applying a strong magnetic field and forcing their electron orbitals to "line up." This aligning of orbitals generates the north and south poles of the newly formed magnet and new magnetic field lines which flow from north to south, even after the original magnetic field is removed. (Figs. 5 and 6).

When we apply an alternating magnetic field to a ferromagnetic material, new poles form and collapse over and over as the orbitals are aligned in one direction and then flip to be aligned in the opposite direction. But magnetizing a material isn't a perfect process, some of the energy needed to create order in the material is wasted in heat from the molecules shifting and bumping on each other when they flip their alignment. This effect is called hysteresis and it's why ferromagnetic materials heat so astoundingly fast in induction heaters and it's why you can't effectively use an aluminum pan on your induction cooktop.

Like I mentioned before, the magnetic field lines in the coil are most concentrated along the inside surface of the coil and least concentrated in the center - the field lines tend to take the shortest path in a circuit around the surface of the coil, just like current takes the shortest path to ground in a conductor.

When a piece of metal is heated, the magnetic field lines and the heating energy are absorbed mostly at the surface of the metal since it's closest to the most field lines. This outer surface heats rapidly but only until the Curie temperature of the material is reached. When that happens, the material can't be magnetized anymore and it can only heat by eddy currents. At that point, another small layer (about 1/32") deeper in the middle will heat rapidly until it hits the Curie temperature and so on.

This is what happens in theory; in reality, you can't see individual layers heat up from the outside in. This process is muddied by the conduction of heat through the material and heat loss from the material to the surroundings, but the point is that the metal heats from the outside in and that the heating rate slows dramatically after the Curie temperature is reached (about 1400°F).

One important thing to mention is that these induction heaters operate between 30 and 80 kHz and there's a computer inside that chooses the correct frequency at which to drive the coil. Induction is a lot more complicated than I've described here, but in reality there's an ideal frequency of current that couples best with a given diameter and type of material to be heated. General purpose surface heating like I've described happens between 10 and 100 kHz, deep heating for melting metals occurs at lower frequencies below 10 kHz.

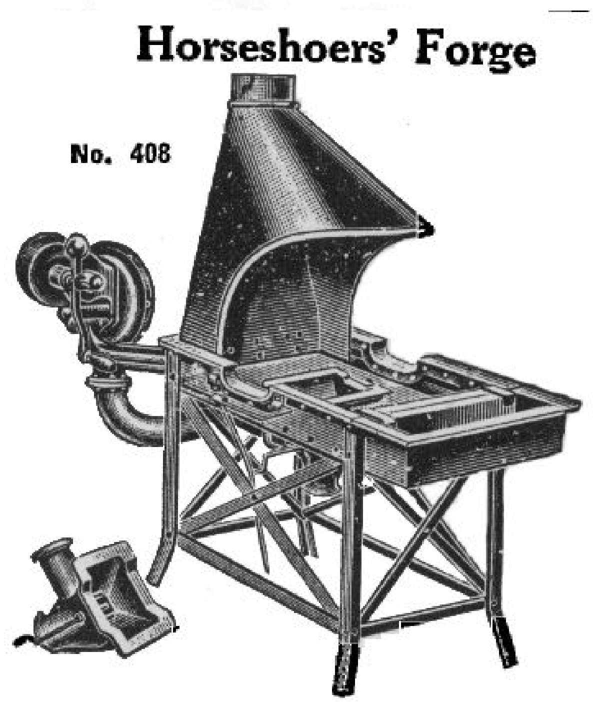
Some induction heaters are even specialized to heat insulating materials like wood or plastic at frequencies in the MHz range. I won't go into the details here because it's not relevant to us, but the heater basically generates an electric field across two plates and with the insulator in the middle, turns the whole package into a large capacitor. This high frequency electric field oscillating back and forth generates internal friction inside the material kind of like magnetic hysteresis but based on the charge of molecules inside the material, not their magnetism.

This is the end of Part I. I hope it's helped demystify how induction heaters work a little bit and all of this information will be important to understanding the information in Part II about the heater itself and the principles of coil design. If you're interested in more, check out my YouTube video or the book "High Frequency Induction Heating" by Frank Curtis. See you in Part II!

Blacksmith Coal and Coke Available to NJBA Members

NJBA purchased ten tons of "nut" coal of good analysis. In addition to our using it for our demonstrations, this coal will be available for purchase by NJBA members at 20¢ per pound, on a bring-your-own-bag and bag-it-yourself, honor system basis.

The coal is located across the drive from the larger door to Marshall's pole barn, formerly the site of the coke pile. We still have some coke available at the same price, *behind* this same bin. (Walk around by the path to the left of the bin, but watch for poison ivy.) Plastic bags of at least 3-mil thickness are recommended. (A spring balance, *not legal for trade,* has been mounted beside the bin for your convenience in *estimating only*.) Please inquire of Marshall Bienstock for more information and to make payment.



Induction Heating Part II by Sam Perikas

In the Winter 2021 edition of the NEB Newsletter, (Vol. 41, No. 1), I wrote the first part of this article detailing the basics of induction heating. This article and the previous one are two halves of an intro to induction heating for blacksmiths. If you'd like to see me explain the contents of these articles in detail, check out my YouTube video: "Induction Heating 101: A Practical Guide for Blacksmiths" on my channel BigPigForge.

In the last article I discussed the basics of induction heating. Now that we have a foundation in how it works, we can take a closer look at the commonly available machines, how to get them running, and how to design coils to do the work that you want to do.

Induction forge details, specs and where to get one:

These units are typically sold at 15 kW models, but they are actually closer to 7.2 kW (240V, 30A), about the size of a small welder in terms of power. Theoretically, this is enough power to bring 1 lb. of steel to 2000°F in 90 seconds. (source: High Frequency Induction Heating by Frank Curtis). If you can wait long enough, you can get them for about $500 on eBay, shipped. There are US-sold versions, but I believe they're built in the same factory as the Chinese sourced ones. Find the cheapest one you can, I believe they're all constructed the same way. Often waiting a few months for a new shipment to come in can save you a couple hundred dollars.

Buy the 240 V, 120 V model can be converted to 240V, but is no cheaper and 120V circuits need 60A to get any useful power from the coil. EJ of the Anvil is a good YouTube resource for induction heater information, including a guide to rewire a 120V model to take 240V. These units operate between 30 kHz - 80 kHz, and are computer controlled, so the frequency is automatically set to give the max output power. If you read Curtis's induction heating book, don't pay attention to the frequencies, the machine takes care of it in this case and that makes our lives a lot easier.

Building vs. buying cooling system:

I built my cooling system for about $150 from eBay parts, but a pre-made TIG cooler is a good option that many people use. If you have one already, it's probably the best bet to use that. Do NOT use automotive antifreeze, use either pure ethylene or propylene glycol mixed with water (50/50 is good). I found propylene glycol available for $25/gal at Tractor Supply Co. and it works perfectly well when cut with distilled water. If your shop is heated, 100% distilled water is perfectly fine. You don't need to cut with anything unless you need antifreeze protection. Just be sure to use distilled water, the coolant is in contact with the electrical conduction path so it needs to be electrically resistive (contrary to popular belief, pure water is a quite poor conductor!).

Coil conversion kit:

Figure 1: From left to right: 8mm tubing flare, 8mm flare nut, ¼" NPT to ¼" MIP nipple, ¼" flare nut

Derek Melton has a great article on how he converted his heater from 8mm tubing and flare nuts that are supplied with the machine to ¼" tubing and flare nuts, a size much more easily found in the US. 8mm flair nuts can be ordered from a Chinese manufacturer but they are prohibitively expensive. The link is: https://www.derekmelton.com/my-induction-forge

Many people insulate their coils with furnace cement. This is the best option I've seen to keep the work from shorting out your coils. Don't use the fiberglass weave insulation - it doesn't last long and it makes a mess when it melts. Be wary of how thick the cement coating is, though! It may reduce the inner diameter of your coil if the coating is too thick. Your mileage may vary.

Coil Design:

Once you get your unit it will rapidly become apparent you are going to need a selection of different sizes and shapes of coils. Coils are made of copper with no exceptions because copper has good electrical conductivity and a low heat capacity and it's cheaper than silver or gold. This gives a coil that can put out a lot of heat and not suck up very much and that doesn't break the bank.

The most common coils will probably be multi-turn coils (Fig. 2) for heating stock going through them, but you can have all kinds of shapes. Most coils are made of tubing so that you can conduct current and flow coolant at the same time, but they don't have to be either. A lot of single turn coils used in industry are strips or bars of copper designed to wrap around a very specific shape with a copper tube brazed to the inside or outside to keep the solid coil cool. This can be a really handy trick when trying to heat multiple objects or get a very specific shape that you can't bend a coil into, for instance trying to heat a gear blank by machining the gear profile on the inside of a bar.

Figure 2: The standard coil

Figure 3: Pancake coil

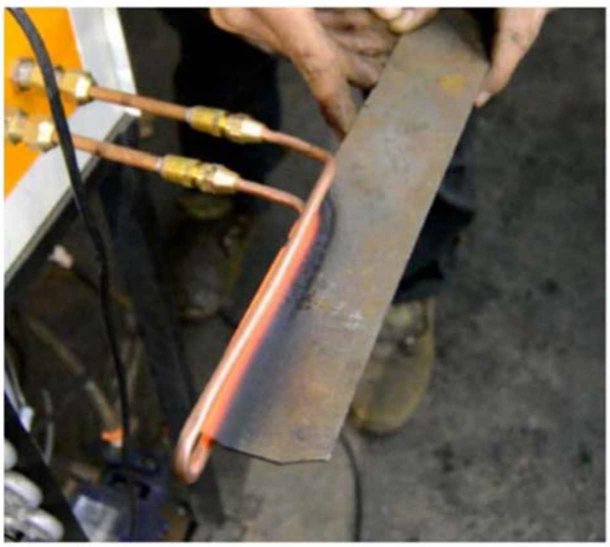


Figure 4: The hair pin coil

Pancake coils (Fig. 3) are really effective at heating wide flat areas, but because they don't constrain the magnetic field lines as well as an annular coil, they end up being around 75% as efficient as "normal" coils in terms of heating.

Hairpin (Fig. 4) and internal coils can be handy because they're low profile and can fit into holes or pockets in material, hardening internal surfaces. But again because they don't constrain the magnetic flux lines well, they end up being only 50-60% as efficient as normal coils.

You can make C-type coils that have an opening in the side and allow you to quickly pull out long bars that would be hard to push through one end of the coil but again you lose efficiency. EJ of the Anvil on YouTube has a good video showing this type of coil in action; he calls it a "taco" coil because of the shape. Lastly there are some commercial options for making a flexible wand for coils so that you can use the induction heater kind of like an electric torch. I'll be getting more into that in another video/article. Long story short, you're only limited by your imagination and your needs.

Now let's go over some design guidelines for coils. Induction is really complicated as I've said before and these machines are a bit of a black box, but some simple rules of thumb will get you far.

If you look online, you can find some summaries that blacksmiths have posted as a result of their experimentation and recommendations from the manufacturers of these machines. I can't speak to whether or not these are true but I can give some general guidelines I found in a book called "High-Frequency Induction Heating" by Frank Curtis. You can find it online as a PDF which is where I found it and I believe it's still being published by McGraw Hill. My version was published in 1944 but it's still a great resource. If you're having a hard time finding a copy, email me and I'll send it along to you.

Editors note: One of the difficulties forming coils is the tubing can collapse during the bending phase. I have solved this by filling the tube with table salt and crimping the ends shut. This helps the tube maintain its shape. Once the coil is complete you can cut off the crimps and the salt easily spills out. Any residual can then be blown out with compressed air.

Coil tips:

Small gaps between coils (< ½ tubing OD)

This prevents the escape of magnetic flux lines through the lines of the coil. If you have a really spaced out coil, you might notice it doesn't perform that well or you get banded heating patterns. This is an indicator that the coil is too loose and you're losing power .

Small gaps and short runs for excess tubing

This is the same story as before: you're losing flux if there are a lot of gaps and long runs of tubing going back to the heater so reduce those as much as possible.

Multi-turn coils should be no longer than 4x the coil ID

Coils that are too long offer diminishing returns - after 4x the ID, the field lines are organized and packed as tightly as they can be and any additional turns will just be turning the coil itself into a bigger and bigger heatsink, wasting energy.

You'll often see people saying to keep the coil length less than 24" and this is why. However, I think this is a bad rule of thumb because you can technically use more than 24" of tubing and have an effective coil, but you have to be more mindful about wasting flux elsewhere.

Single turn coils should be no longer than ½ the coil OD

Same reason as before, but this only really applies to coils that are made of solid bar and cooled by an external tube. Single coils made of just tubing will rarely violate this rule.

Use the smallest coil possible

The smaller the gap between the coil and your work, the higher the density of magnetic flux, and the highest possible heating rate
Insulating a coil with furnace cement can prevent shorting out when closely coupling a coil

That about wraps up the basics of induction heating for the blacksmith as of 2020/2021. The dramatic drop in the price of IGBTs has allowed these machines to become cheap enough for the average person to afford, and the use of computer controls to set the drive frequency means that induction heating is finally a viable option for blacksmiths. Whether you're trying to reduce your carbon footprint or build a semi-automated production line in your shop, induction heating is a powerful and efficient means of heating with near limitless applications. I hope these articles and the sister video can serve as a suitable introduction to the topic and get you started along the path of induction heating in your shop. As always, if you liked the article/video or you have any questions, don't hesitate to reach out to me personally.

samuel_perakis@gmail.com

Happy forging!

Using an 1⁄8 inch diameter fuller, distinct straight or curved veins can be easily made.

Make a tight 180° bend in the center of a 32 inch piece of 1⁄2 inch round rod.

Bend 1 1⁄4 inch, 90° in a vise.

Make a second bend in the vise allowing enough length to clear your hardy hole by at least 1⁄2 inch. Bend the ends as far down as your vise allows.

On the anvil, hammer the short end down to the long end.

Now forge the doubled over end so it fits nicely into your hardy hole.

For anvils with hardy holes larger than one inch, use a piece of angle iron of approximate size as a shim.

Place it in the vise, bend the two rods down, and hammer to 90° . While hot, place it in the hardy hole and make sure it seats level with the anvil's face.

By making a slight taper between the rods, larger as well as tapering veins can be made, using 1⁄8, 3⁄16, 1⁄4, and 5⁄16 inch fullers.

Fullers should be slightly curved to allow "walking" and corners of edge rounded to blend in.

Also refer to Bill Morrison's unique keyhole design that combines both a vein tool and a leaf cup on page 19 of the November-December 2018 issue of the Upsetter. The January-February 2019 cover picture is a sample of Bill Morrison's excellent forged leaves.

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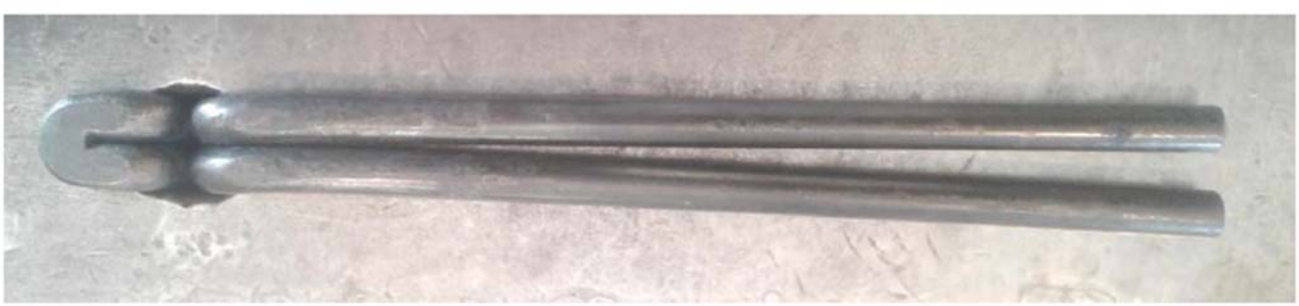


A Series on Fastening

By Tim “Red Oak” Hatch

There are seven operations that can be done by a blacksmith.

- Drawing out
- Bending
- Swaging
- Punching
- Welding
- Upsetting
- Shrinking (a form of upsetting)

While this article is not to go over them all, we will be touching on quite a few of them. I am going to provide these in short sections, working on one piece at a time so that if you desire to try this you can open this and read the instructions for which part you are working on.

Progression:

Concept ☚Tool making ☚Mortise ☚Tenon ☚Assembly

Concept:

A mortise and tenon joint go back a long way and is a joint used in woodworking as well as metal work. Sometimes they are permanent, sometimes they can come apart. The essentials of the joint are that a part of one (tenon) sticks through the other (mortise).

Tool making:

Apart from the standard tools in the shop, you will need to have a punch and a drift to make the mortise, and a swage and monkey tool for the tenon.

The **punch** is made from 4140 but it is not heat treated. The material is tough and has good heat properties. The material diameter is 5/8”, and the length about 4” to start. Proper attention must be paid to the working temperature, it ideally should be 2000-2200°F, and not below 180°. Heat as often as necessary to maintain the working temperature. Draw out about 1 ½” to 4” (approximately), square, then octagon while keeping the flats about equal spacing. Then proceed to round the punch. The small pointed end should have a diameter of about 3/16 – ¼ inch when complete. Make sure it is centered and grind the point to ensure a square end that will go straight and not angle off.

The **drift** is mild steel, check the size of the metal and upset the middle to swell about .015/.030 larger that the pin intended. Draw out 1 side longer to push thru the hole, the other end should be shorter and less tapered (striking end). The struck end should be reviewed to make sure the length will allow for the drift to get thru the part.

Tool Kit for Mortise & Tenon

The **swage** is made by using the following materials (these can be changed to suit the purpose): 2-blocks 1.5" X 1.5" X .75 thick, 1- piece 1.5" X .125 thick X 20" long. The two blocks should be made of mild steel, uniform, squared up and clamped together. The flat stock should be marked in the center and bent over the horn (cold, do not heat) so that it is in a nice radius, (not a sharp fold) and the ends align with each other. Weld one end of the flat stock to the outside edge of one block and the other to the alternate block. Heat the blocks up to near yellow and insert a bar of material of similar size and shape to the tenon intended. Have a friend or use a treadle hammer to hit the swage when you have the tool positioned and the bar of material between. This may take a few heats to get the swage blocks to get to face each other flat. After that radius the seem edges heavily (the diameter top to bottom sets the shape so the sides can be blended well). Clamp the blocks together and round the ends. This may involve putting a small chamfer via a drill, then hand file to blend.

Mortise:

A round mortise is simply the correct size hole to accommodate the tenon. The tools for this are the punch, drift, and a bolster (backing plate).

Start with upsetting the area where the mortise will go. Keep the bar straight though out the process. Measure and prick punch where the mortise is going to be made. Heat the metal and center the punch over the prick punch mark and hit it to make a mark. Review that the placement of the punch is where you want it (should show a bull's eye like feature, circle with a dot in it). If yes, heat and continue. If not, adjust, review, and then continue. As you continue, cool the punch often. Also keeping some coal dust handy and rolling the end of the punch in it before inserting it will help to keep it from sticking. Continue the series until the bottom is black, and the bar is still red. Flip over and center on the dark spot and hit through. This will give you a small wafer that was removed unlike drilling which removes all the material from the hole. This operation moves the majority to the area around the hole. Depending on the size of the punch, you may be able to open it up a bit further making sure to leave enough size for the drift to properly size the hole. Next, heat up the metal, and set the bolster plate over the hardy hole. Drift the hole which may take several attempts depending on the material thickness. When it does go through, it will fall and it will be hot (just in case you thought to pick it up quickly or catch it), so cool it as necessary and repeat the sizing process several times.

The **Monkey tool** for this application is made from mild steel, 5/8 square by 4" long. Find and mark center, punch, step drill to the desired size and a whisker. The depth of the hole needs to be deeper that the tenon is long. Chamfer the ID on the end and then smooth out to a nice radius (about .050" / .070"). Do not make this end to a sharp corner or a stress riser will form. Next, mark and drill a hole in the side of the block to connect to the approximate bottom of the previous hole. This is a vent and does not need to be the same size.

Tenon:

The first step is to establish the size and length required. We have already made the hole to accept a Ø3/8" tenon. The length is the distance thru plus the amount needed to make the head. (roughly the diameter of the tenon *1.5)

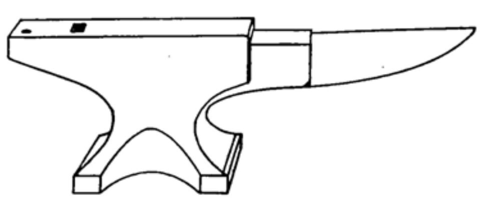
To begin, we will use a hot cut and heat the ½" bar and cut in on each flat 1/8" max. The hot cut should be set so the material is pushed toward the end of the bar. Then go in on the corners, 45°, trying to make the depth without going too deep. This can also be done with a guillotine if you prefer and have the set up. Next start drawing this out and once it has been sufficiently reduced and rounded, heat and use the swage to round to size. Heat the tenon, put the bar into a vise or another method for securing (getting the monkey tool straight will affect the final fit) and hammer the monkey tool on to square the shoulders.

Assembly:

Stick the tenon thru the mortise and add the material needed to close the rivet. This is done by adding the distance through the metal, and the material needed for the head. Make sure the tenon sits square to the mortise and the length is correct. Adjust if necessary. Finally, insert the tenon through the mortise and clamp in place. Heat the tenon (torch), then using a rivet header, round over the tenon. When this cools the metal will shrink and tighten the joint.

Tim learned these techniques and many more during a class at the New England School of Metalwork on traditional joinery. This class was funded in part with a scholarship from NEB. He will be demonstrating some of these techniques during the Fall Meet in the green coal area for those that are interested.

From the Newsletter of the New England Blacksmiths, Spring 2021



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NJBA Volunteers List

Note: *NJBA is a strictly volunteer organization.* ***We need your help*** *in any of several capacities. In particular, we could use help with editing and issuing the Newsletter and we would welcome additional members to the Board. We always need volunteers to host or help conduct events. Please indicate your interest below or by contacting any Director.*

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