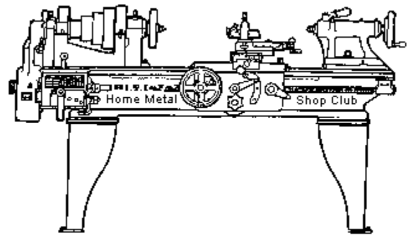
Home Metal Shop Club

December 2012
Newsletter

Volume 17 - Number 12



http://www.homemetalshopclub.org/

The Home Metal Shop Club has brought together metal workers from all over the Southeast Texas area since its founding by John Korman in 1996.

Our members' interests include Model Engineering, Casting, Blacksmithing, Gunsmithing, Sheet Metal Fabrication, Robotics, CNC, Welding, Metal Art, and others. Members enjoy getting together and talking about their craft and shops. Shops range from full machine shops to those limited to a bench vise and hacksaw.

If you like to make things, run metal working machines, or just talk about tools, this is your place. Meetings generally consist of ***general announcements***, an ***extended presentation*** with Q&A, a ***safety moment***, ***show and tell*** where attendees share their work and experiences, and ***problems and solutions*** where attendees can get answers to their questions or describe how they approached a problem. The meeting ends with ***free discussion*** and a ***novice group*** activity, where metal working techniques are demonstrated on a small lathe, grinders, and other metal shop equipment.

President *Vance Burns*	Vice President *John Hoff*	Secretary *Martin Kennedy*	Treasurer *Emmett Carstens*	Librarian *Dan Harper*
Webmaster/Editor *Dick Kostelnicek*	Photographer *Jan Rowland*	CNC SIG *Dennis Cranston*	Casting SIG *Tom Moore*	Novice SIG *Rich Pichler*

This newsletter is available as an electronic subscription from the front page of our website. We currently have over 220 subscribers located all over the world.

About the Upcoming January 12 Meeting

General meetings are usually held on the second Saturday of each month at 12:00 noon in the meeting rooms of the Parker Williams County Library, 10851 Scarsdale Boulevard, Houston, TX 77089. Visit our website for up-to-the-minute details and for the main presentation topic.

General Announcements

Videos of recent meetings can be viewed on the HMSC website.

The HMSC has a large library of metal shop related books and videos available for members to check out at each meeting. The library is maintained and curated by the club librarian, *Dan Harper*. These books can be quite expensive, and are not usually available at local public libraries. Access to the library is one of the many benefits of club membership.

We need more articles for the monthly newsletter! If you would like to write an article, or would like to discuss writing an article, please contact the Webmaster Dick Kostelnicek. In the September HMSC board meeting, the board elected to waive membership fees during the next membership renewal cycle for those providing newsletter articles.

Ideas for programs at our monthly meeting are always welcome. If you have an idea for a meeting topic, or if you know someone that could make a presentation, please contact V. P. John Hoff.

Recap of the December 8 General Meeting

By Martin Kennedy, with photos by Jan Rowland

Vance Burns

Twenty two members, three guests – Joe Sybille, Steve Briggs and Phillip Lipoma, and former member Ed Ellingsworth attended the 12:00 noon meeting at the Parker Williams County Library. President *Vance Burns* led the meeting.

Vance Burns and Martin Kennedy are looking for a new, centralized location for meetings and will report back with a recommendation. If you know of a central location that could provide free facilities for our monthly meetings, please contact Vance Burns.

Safety Moment

When using a table saw, use a push stick. Even better, have a second push stick in the other hand. Using your other bare hand can lead to unfortunate accidents.

Drinking and using heavy machinery don't mix! A member recounted an incident where a friend lost his finger using a saw after having two glasses of wine.

Keep one hand in your pocket when working with electrical circuits. Getting shocked is bad, but getting shocked when you're well grounded can be fatal. With a hand in your pocket, you won't be holding on to a good ground, like a pipe or a piece of equipment.

Presentation

Martin Kennedy, club Secretary, and *Joe Williams* made the day's first presentation about winding an electrical coil. Martin has an older lathe, and when he got it, it had a defunct and improper replacement DC contactor on the reverse electrical circuit. No replacement coil was currently available. Fortunately, there was a similar working forward direction contactor with a, good coil. Martin didn't want to cut in to the good coil to see what size wire was used, so he went another route.

The good coil was measured physically and electrically. Using a calculation spreadsheet on the internet, he was able to reverse engineer the coil and determine the wire size. He ordered the wire and made a new coil spool. Details are shown in the article at the end of this newsletter.

Joe Williams had experience with making several coils over the years. He wound 4,000-feet of wire on the spool by using his Sherline lathe. Details on the sequence and pictures of the operation are shown in the article.

The coil was put into service, and works fine.

Lee Morin made a presentation on a project he's been working on to control a spacecraft with foot pedals, instead of conventional rotational and translational stick hand controllers. The project was inspired by similar controls he used in a one-man submarine. In a spacecraft, there are many needs for using one's hands, and having foot pedals would free them up for other uses.

Lee built a prototype of the pedals in his shop (left photo). The pedals provide "on-off", or "bang-bang" controls. Proportional control was not needed. For the prototype, weight and size were not a factor in the design. The pedals will be used as input for a computer. They were designed to withstand a 175-lb kick load. One of the key parts to the foot pedals is the scissor spring. This assembly is located in the pivot, and provides spring return on pedals.

The pedals were fabricated primarily with a PlasmaCam table. Finishing touches were made with his milling machine, lathe and press brake.

The plasma table can cut up to a 4-foot square sheet. Lee ordinarily uses 2 x 4-foot sheets, as they are easier to manipulate manually. The cutting is done with a Victor Thermal Dynamics torch. The system can cut up to 1-inch thick plate. Cutting speed for 1/8-inch plate is 60 ipm. On ¼-inch plate it's 45 ipm. The software monitors the current supplied to the torch, and automatically adjusts the elevation on warped metal. It can even cut corrugated metal sheet! The plasma system uses proprietary software that is very easy to use.

Lee found that good grounding of the whole machine is very important to kill random errors in the computer signals due to the high welding currents. He has large ground cable that connects the machine into ground spike. The table uses high volume blower to remove welding fumes and dust from his garage.

After the parts were cut out on the plasma table, the next step was re-machining areas with tight tolerances using his Tormach PCNC-1100 mill.

Next, Lee bent the pieces on a press brake with some bending dies.

His first pedal design was supported with a bearing on one side only. It worked, but not well. The design was improved by adding a second bearing on the other side. Unfortunately, that led to another problem: misalignment ot the two holes. To make for a good fit, the second hole had to be machined after plate was bent. Lee built a jig to fit on his mill that allowed the second hole to be cut in perfect alignment with the first hole.

The pedal currently allows four controls: up/down, forward/back, slide left/right and rotate left/right. In a future version, Lee wants to add two more controls: pull up/down and rotate two feet simultaneously to allow complete six axis control.

Show and Tell

Vance Burns showed a Highlights video from the 2007 Welding Expo and Fabtech.

John Hoff brought in the clip holder that he discussed at last month's meeting. He had the original part, and the current part that he's building (left photo).

Dick Kostelnicek had an inexpensive sun visor he purchased at O'Reilly auto parts store. He modified it to use as a moveable chip shield on his milling machine.

Martin Kennedy built a custom replacement switch plate to match the original plate that was missing on his lathe (right photo).

Joe Sybille showed a novel concept for a radio tuning capacitor built with an automobile fender washer between two flat plates that he saw in QEX magazine (left photo).

He passed around another project that he wanted to make - a finger tuning knob to fit on a variable capacitor.

Mike Winkler continued showing tools he's made to support his new welding machine. He found that when learning how to use TIG welding, he tended to short out the electrode, which would then require resharpening. He obtained a Harbor Freight mini grinder which he refitted with a diamond chainsaw sharpening wheel and a custom cover plate.

Dennis Cranston talked about building an advanced signaling system for the HALS live steam railroad track. He demonstrated a searchlight signal he built that uses three different color (and very bright) 700 mA 12V LEDs. The voltage of 24V was selected so that a drop over 1,000' would still have at least 12V at the lamps. Only a single wire is run to the device with the track as an electrical return. Control is by an Arduino processor and communication is through either XB wireless or CAN protocol. Ultimately, he wants to be able to control the signals with a smart phone.

Problems and Solutions / Ask the Blacksmith

An attendee wanted to modify a bicycle wheel hub so that it could be driven. His original plan was to cut a 3" keyway with a broach, but this is impractical. Other solutions were sought. Members said that he could buy pre-broached spacers for a horizontal milling machine that would be of the appropriate length. He could put a pin through the hub and the drive shaft. He could drill a hole on the end parallel to and at the interface of the shaft and hub, and use a round pin. He could use a commercially made hub, built to use with disc brakes, which would already have mounts attached to the hub.

An attendee brought broken parts from his Craftsman drill press and wanted to make replacement parts. He didn't have much machining experience or even machines. It was suggested that the parts would be fairly easy to make using a vice, a file and a tap.

Novice SIG

The novice group did not meet this month.

Articles

Gate Latch with Electrical Contact

By *Jan Rowland*

I had to make a sturdy and functional latch for a fence gate shown in the photos at the left and right. The gate required an electrical contact that would remain reliable in all kinds of weather and would activate a signal-light LED inside the house. Illumination of the LED meant that the gate is indeed closed since it is totally hidden from view behind a garage.

I welded-up the gate's latch-spring from ¼-inch bar-stock and 1/8 x 1-¼-inch ordinary hot-rolled steel.

For an electrical contact, I used a small piece of 1/8-inch diameter tungsten-carbide rod with a coil-spring behind it pointed its contact end to 130º (photo below). It was placed to bear on the latch-end.

This worked OK for about one week, and then, instead of pushing through the inevitable rust as I had expected, the rust effectively insulated the contact, preventing it from conducting at all. Cleaning it with some fine-grit emery fixed it, but only for another week or so.

Finally, I removed the part that made electrical contact, held it in a vice, and with my torch melted brass on the latch-end. I used brazing-flux so the brass flowed smoothly over the metal. I re-installed the contact and it has been working satisfactorily now for several weeks.

Electrical Coil Winding

By *Joe Williams and Martin Kennedy*

I needed to replace an electrical coil to restore a DC contactor for a Monarch 10EE lathe of 1943 vintage. The coil was part of a pre-built assembly having multiple contactors and relays made by Struthers Dunn (RPXA595A). The original coil must have failed at some point in the past, and a modern solenoid coil was installed as a replacement. It subsequently burned up (it measured a dead electrical short), along with the reverse selector switch.

It would not be good to use another modern coil like the one that burned up. Although an identical coil could be found, it was likely the wrong coil in the first place. And forget about finding any repair parts today.

Fortunately, the original design employed two identical coils – one used for Forward and the other for Reverse. Only one of then burned up. The good coil was removed for testing. There was a very faint number fragment on the good coil, but it didn't provide any useful information.

It was decided to make a replacement coil. First, the physical parameters of the good coil were measured:

Hole in center of spool: 0.50" x 1.22" long
Wire on spool from: 0.625 ID to 1.42" OD (including tape around outside)
Length of space for wire: 1.08"

Then, the electrical properties were measured after removing the iron core from the coil:

Value: 3.25 H (Using a Sencore capacitor/inductor analyzer)
R: 2183 Ohms

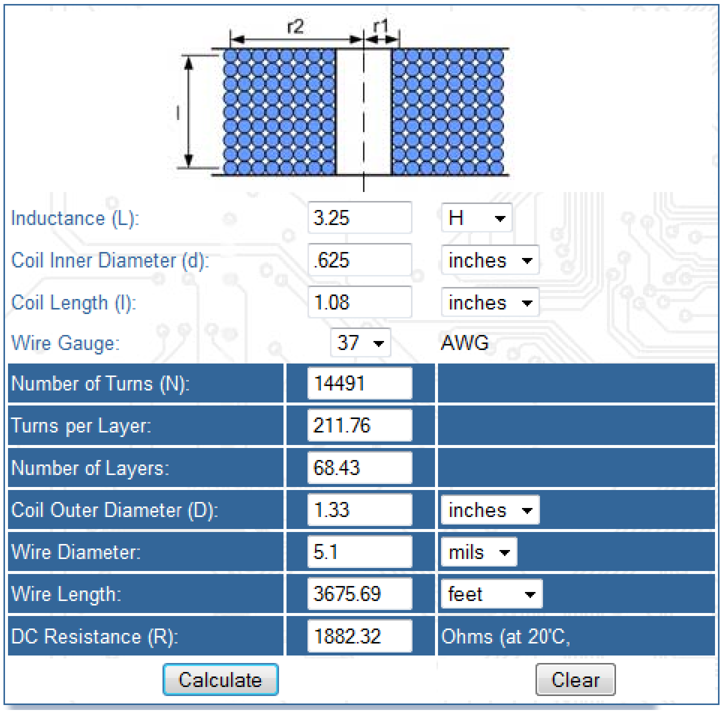
Wheeler's approximations from 1928 can be used to calculate coil parameters. His approximation for a multi layer air core coil with a rectangular cross section is:

L (uH) = 0.8 * a^2 * n^2 / (6*a + 9*b + 10*c)

where
a = average radius of windings
b = length of the coil
c = difference between the outer and inner radii of the coil
n = number of turns
all dimensions in inches.

Other formulas are necessary to calculate other parameters, but fortunately, there's a web page that allows you calculate coil parameters easily by plugging in the numbers. Input information is the Inductance, the coil ID and length, and the wire gauge. The wire size was unknown, but several of the output parameters were known. It was possible to guess the wire size and see if it resulted in something reasonable as determined by the Web calculator.

The most important output parameter is Resistance. A low resistance would likely result in another burned up coil because of the relatively high actuation voltage.



Assuming 36 AWG wire gives:
  Coil OD: 1.46"
  R: 1539 Ohms
  L: 3710'
This is probably not right, because R is too low and the coil OD is too high

Assuming 37 AWG wire gives:
  Coil OD: 1.33"
  R: 1882 Ohms
  L: 3676', 68 layers of 212 turns
This looks good!

Assuming 38 AWG wire gives:
  Coil OD: 1.2"
  R: 2360 Ohms
  L: 3642'

This looks like too big for R and too small of a coil

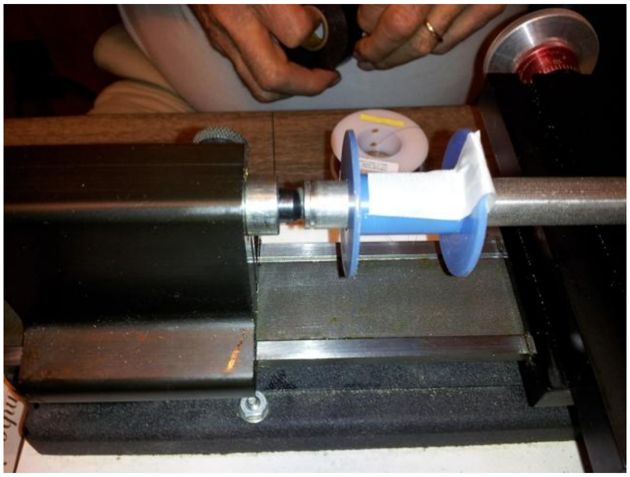
So, the best guess is that the original coil used 37 AWG wire.

The next thing to check is to see if the wire selected can withstand the expected current. The nominal voltage for a 10EE DC panel is 115 VDC. The current through the wire is calculated as follows:

$$I = V/R = 115/1882 = 61mA.$$

Various sources list the current capacity of 37 AWG wire as about 28mA, assuming 700 circular mils per Amp. The calculated current is more than twice this amount.

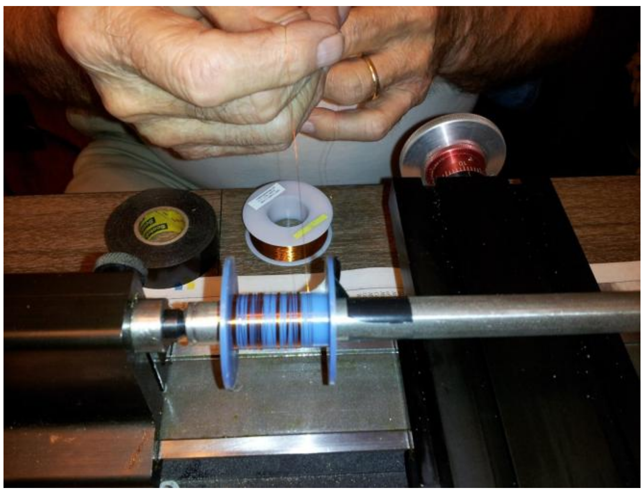
This results in a dilemma. 34 AWG is the smallest wire that can handle the current. But as seen above, larger wire won't give you the right parameters for coil size, inductance and resistance. This



won't work. A series resistor could be used to reduce the current. It would likely be a multi-watt, ceramic resistor, and there was no evidence of this on the original design. So the decision was made to wind the coil as calculated, test it after installation, and hope for the best.

The new coil form was made on a lathe from a block of Nylon. Other insulators could have been used, but this was on hand. A 4,000-foot reel of #37 AWG copper wire rated to 200C for a spool of wire was obtained inexpensively on eBay.

No special equipment was available to wind a coil. Instead, a small lathe was used to turn the coil. A small motor could have been used, or even a hand drill if it was mounted in a vice and didn't turn too fast.

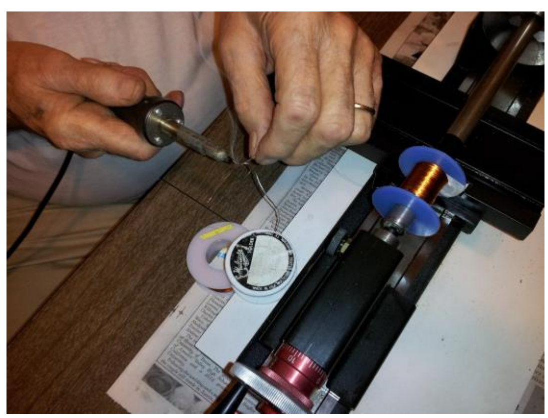


For this tiny wire, it's not necessary to wind the wire so that it's precisely spaced, so no special mechanism is needed. Electrically, the coil will have the same value whether the wire is perfectly spaced or not. A side note about the wire – it's about 5 mils in diameter. Human hair ranges from 1.5 to 5 mils in diameter! This is very small wire.

Following are descriptive pictures and text that show the entire coil winding process.

The coil form is being prepared to insulate and anchor the start of the winding process. The tape being used is fiberglass high temperature electrical tape. The first thing I do is to double back a short section of the wire to provide additional support for the starting end. This is brought out and taped to the outside of the spool.

An arbor was used and was a reasonably close fit to the spool but not enough to insure it would not slip. A few parallel chisel marks were placed on the arbor, and this provided enough grip to keep the coil from turning. The assembly was placed in a Sherline lathe having an off/on foot switch. This is important since you need both hands to manipulate the small wire.



The winding was started and the wire was slowly fed to the spool in a reasonable manner. Normally I would park a small reel on a rod placed across my legs. This very fine wire did not work that way.

Initially, the wire was allowed to come off the spool from the position shown. I've used this for larger wire, but unfortunately for this fine wire, it tended to kink and catch.

After a small quantity of wire was installed the dreaded thing happened - the wire broke. This required carefully

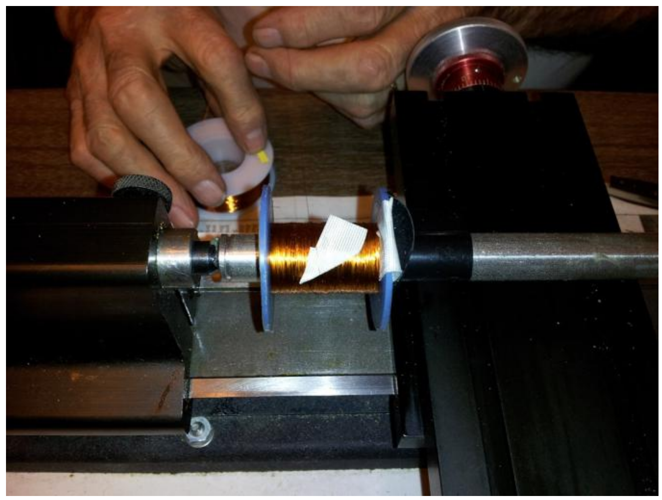
scraping off the insulation with a pocket knife, twisting the wires together, and soldering. Be careful not to nick the wire. This required some persistence, as the wires wrap and hold about as easily as two hairs would wrap – not easily at all.

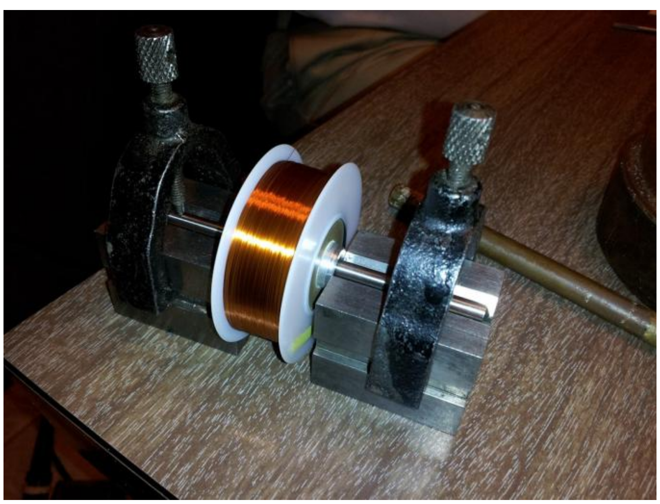
There are other methods to remove the insulation, such as paint thinner or 400 grit sandpaper. Wire is available where insulation can be removed with the heat of soldering.

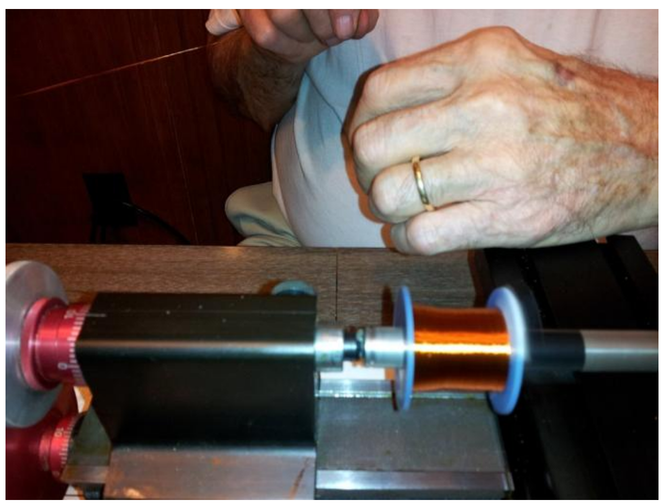
The splice was made and checked for continuity from the initial end taped to the spool being wrapped to the inside of the supply spool. Make sure that you have a good splice before going on!

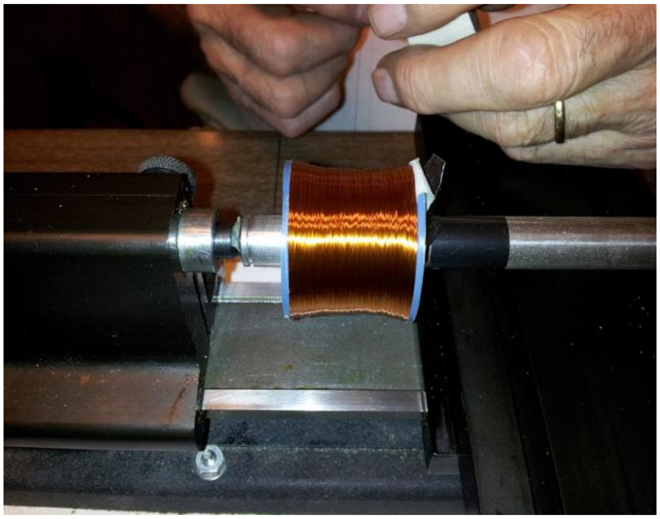
The wire was placed in a folded over section of tape and secured to the coil with the same piece of tape. This insulates it on both sides.

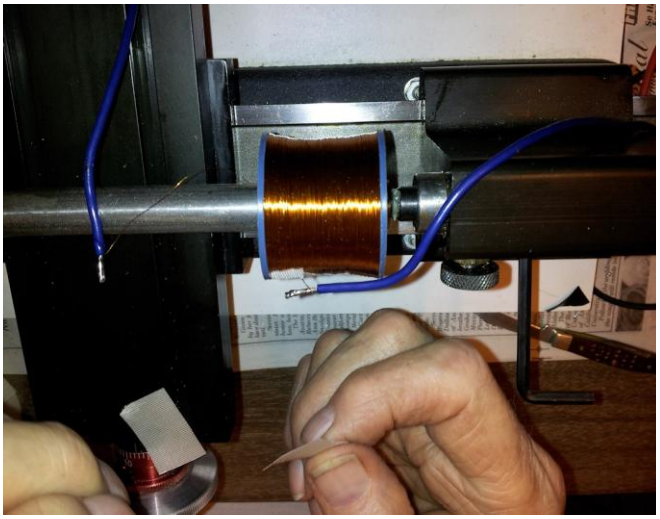
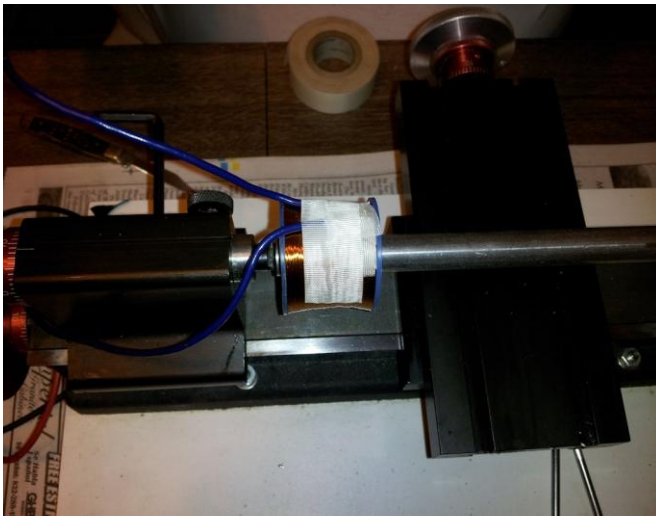
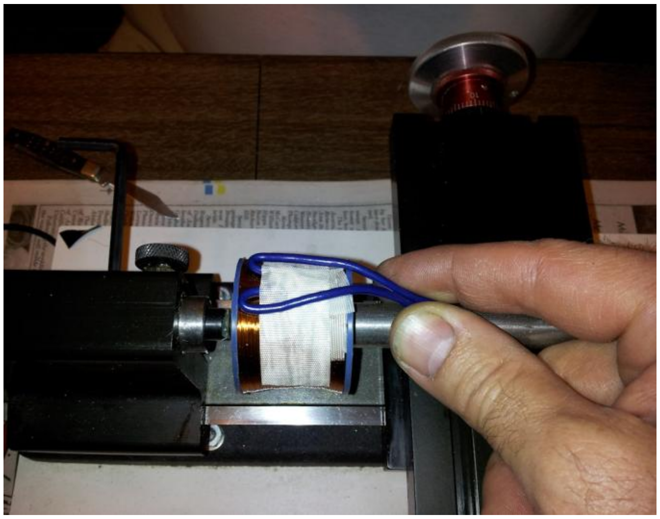
After two breaks, and after trying various methods to feed the wire, a short trip to the shop yielded a better method to handle the supply reel. It employed a small plastic bushing of the correct size with a metal center hole. The axle was a drill blank. The axle was clamped on to a pair of machinist's V blocks, which allowed it to clear the table and also provided some weight to hold the reel. Problem solved! It worked flawlessly for the remainder of the wire, and no more breaks happened.










The reel of wire contained 4,000 feet of wire. This was slightly more than what was called for to exactly match the old coil, but because of the concern on high current, it was all used. Another advantage to using the entire reel was that it was not necessary to measure the wire length directly with a gauge or by counting turns, or indirectly by the coil's OD.

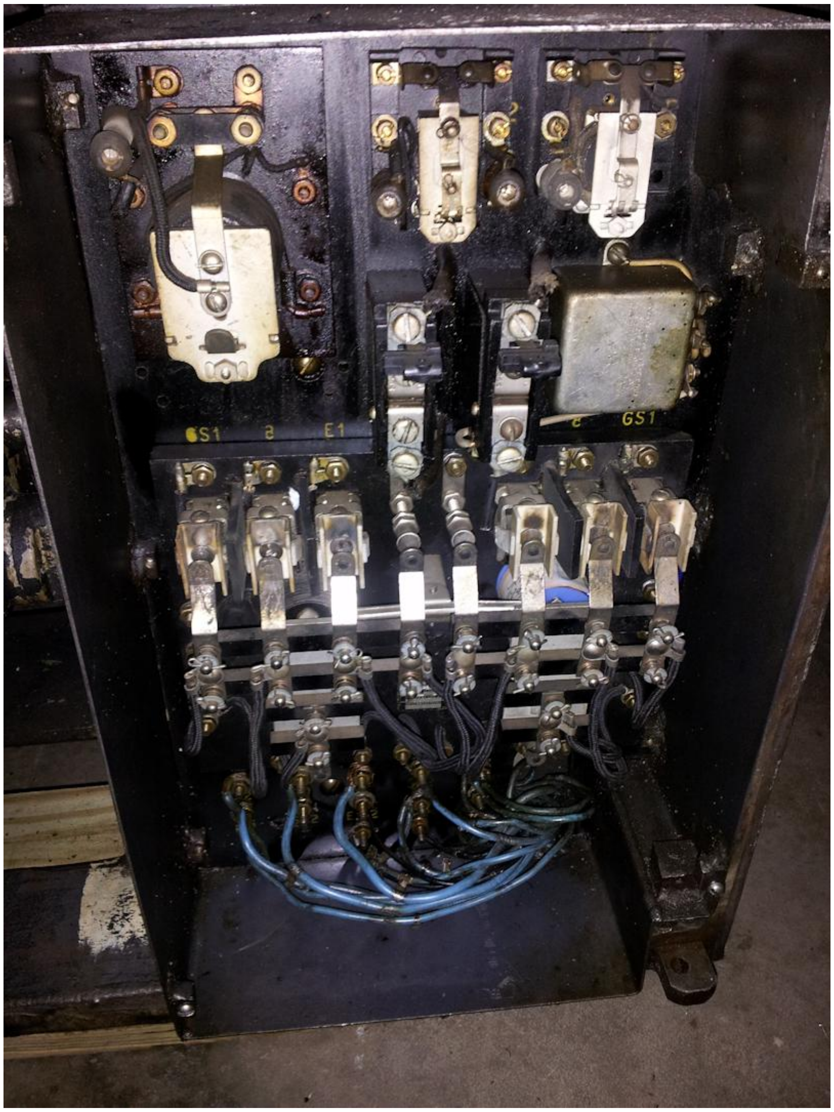
The winding process continued. I am used my left hand to guide the wire onto the spool and my right hand acted as a 'dancer' to control the tension and provide a little time should a problem arise.

When the supply reel was empty, the coil had a finished hourglass shape. I wound a little more wire on each end as the reel became full to provide a recess for the lead wire termination in the coil's center.

You can see the start wire end with the twisted wire and the single finish end. Next I conducted an Ohm-meter check. This showed a coil resistance at 2112 ohms. This is very close to the original coil's 2183 ohms. That was good news. A later check showed the inductance to be 3.86 H, a bit higher than the original. As the only effect of this is a slightly stronger electromagnet, it was deemed close enough.

The lead wires were then soldered to the coil wire and were insulated and taped down to the coil.

The next step in securing the lead wires was to tape them securely in place.



I prefered to bend back the lead wires and wrap tape over themselves to firmly anchor the wires. That way, if they are pulled and slip, they likely won't break the tiny wire. At this point the coil is finished and should be tied with lacing cord or plastic tie wraps and finally varnished. This is to protect the coil in later years, when the glue on the tape dries out. The product traditionally used for this is made by Glyptal. It is too expensive for a single use.

The contactor is a dual section Forward / Reverse unit with DC Blow Out coils at the contact area. The original coil can be seen in the background. The Blow Out coils create an electromagnetic field across the spark created when the contacts open, and force the arc away from the contacts down a ceramic chute.

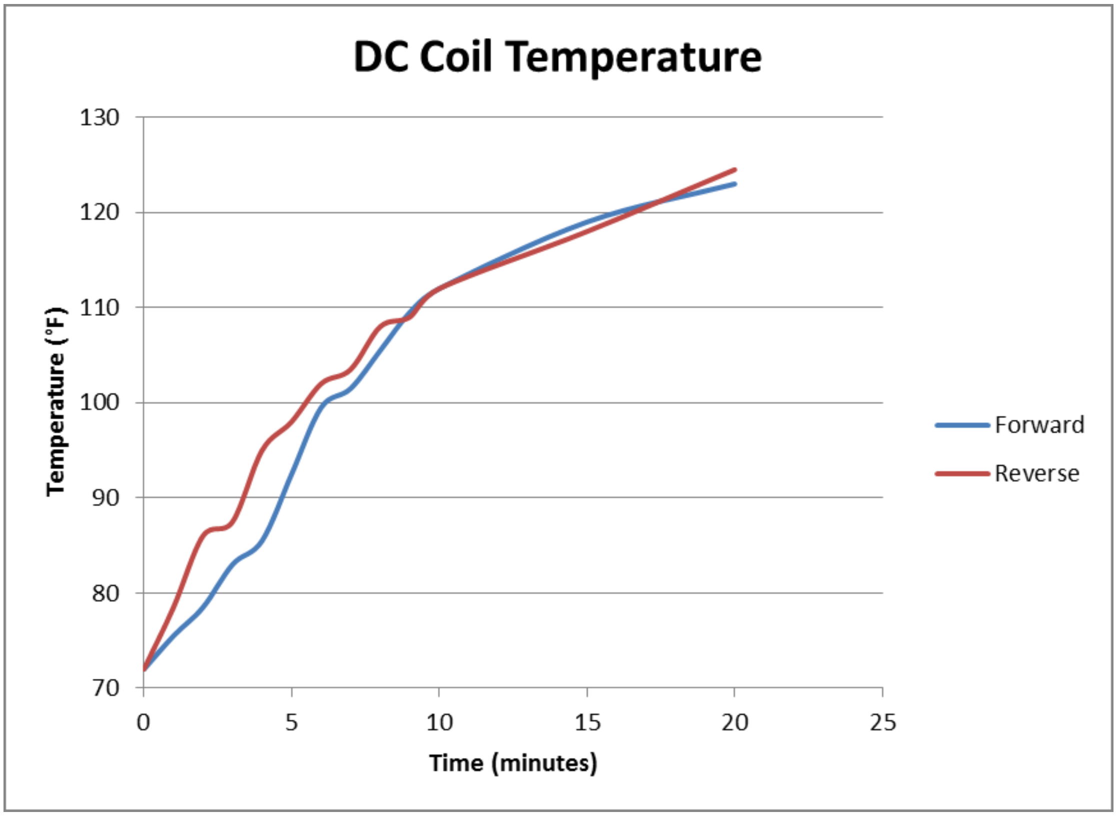
The completed unit installed in the lathe. The replacement coil is indicated by the blue coil spool at the center right (right photo). Final measured values for the coil were 3.86 H and 2112 ohms. The calculator predicted 3.83 H and 2050 ohms for 4,000-feet of 37 AWG wire. The lathe was powered up, and the coil worked well!

Because the current calculations for the coil showed a high current for the wire size, I did some testing on how fast the coil heated up during use. For my coil, I expected:

$$I = V/R = 115/2112 = 54 \text{ mA}$$

My measurement of the current through the replacement coil was 51 mA.

For the test, I put the spindle in Forward, which energized the original coil. I took temperature readings for twenty minutes with a non-contact infrared thermometer. I then put the spindle in Reverse, and repeated taking temperature readings for the replacement coil. Here are the results:



As you can see, the temperature rise for the two coils is essentially identical. I'm satisfied that the coil I made is nearly identical to the original coil. Additionally, since the Reverse on a lathe has only infrequent, short use (like backing up while threading, or making a cut-off on with the tool on the back side of the cross slide), it will likely never heat up very much at all.