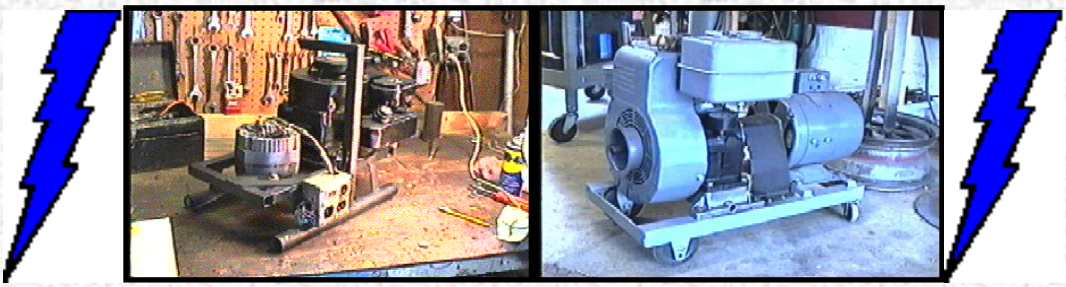
Portable Lightplants and Generators



Welcome! For some ethereal reason, I have a genuine interest and fascination with generators and electricity. I'm sure it all started 39 years ago when I was 4 years old and was playing in the basement of our house. Little did I know, I was about to get my first electric shock. I reached over to move a large electric fan, that had a short in it and was hot with 120 volts of good 'ol Alternating Current. Well, it took me quite a while to let go of that fan and after I did I went screaming to Mom. I had to be thinking, "What in the world happened and why did that hurt? What mysterous force did that?" After that experience, I was hooked on electricity.

My Uncle Norm (Mom's brother) did nothing to dispel that fascination! He would bring me boxes of electronic/electrical/mechanical "treasures", books and other things that furthered my interest. A lot of fascinating stuff for a curious kid like me. Geesh, I

learned a lot of things from him! He is a superb machinist and craftsman of the first order.

Because of all the above reasons, I've built, designed and played with various forms of "Rotating Electrical Machinery" throughout my lifetime.

I'm not sure if it has reached the obsesion level yet... I still have a job so maybe I'm OK...?

(In building the more critical components of these generators, I have to give credit to Dewey King, NJ8V, a master machinist. He helped me with the machining and design of many of the parts, adaptors, couplings and other things too numerous to mention. If he ever decides to call in my debts to him, I'll be out at least an arm, a leg and my firstborn...)

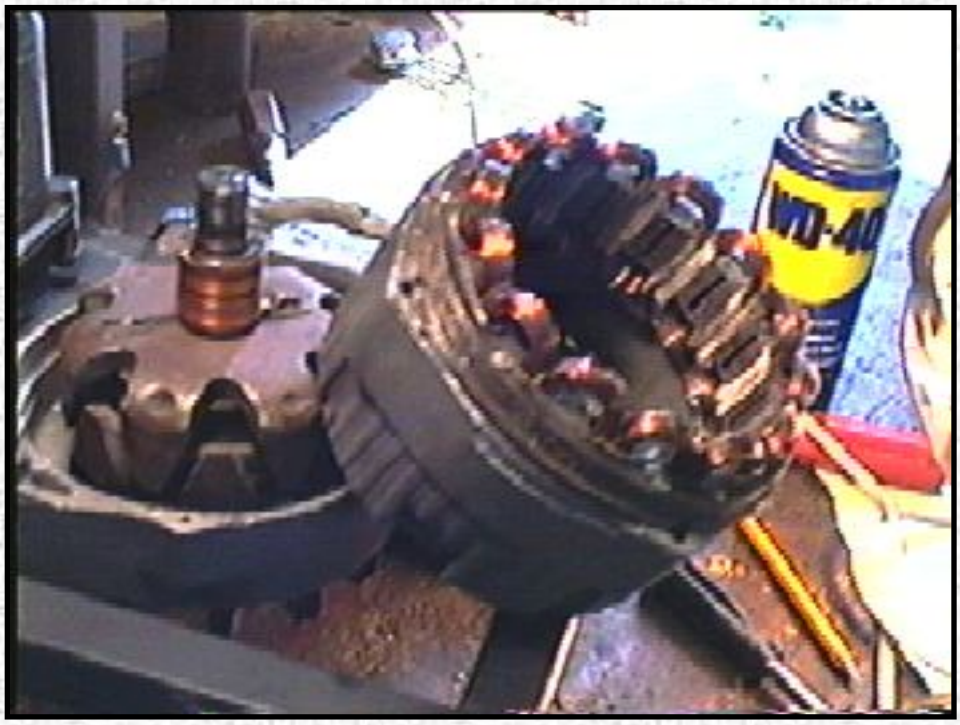
One of the neatest ones that I built was this Delco Automobile Alternator (3 phase) that I converted to a single phase alternator. Voltage is regulated by a homebrewed regulator. The generator/engine combination is mounted on a small welded steel frame and powered by a typical lawnmower-type Briggs and Stratton Classic 3.5 hp engine.

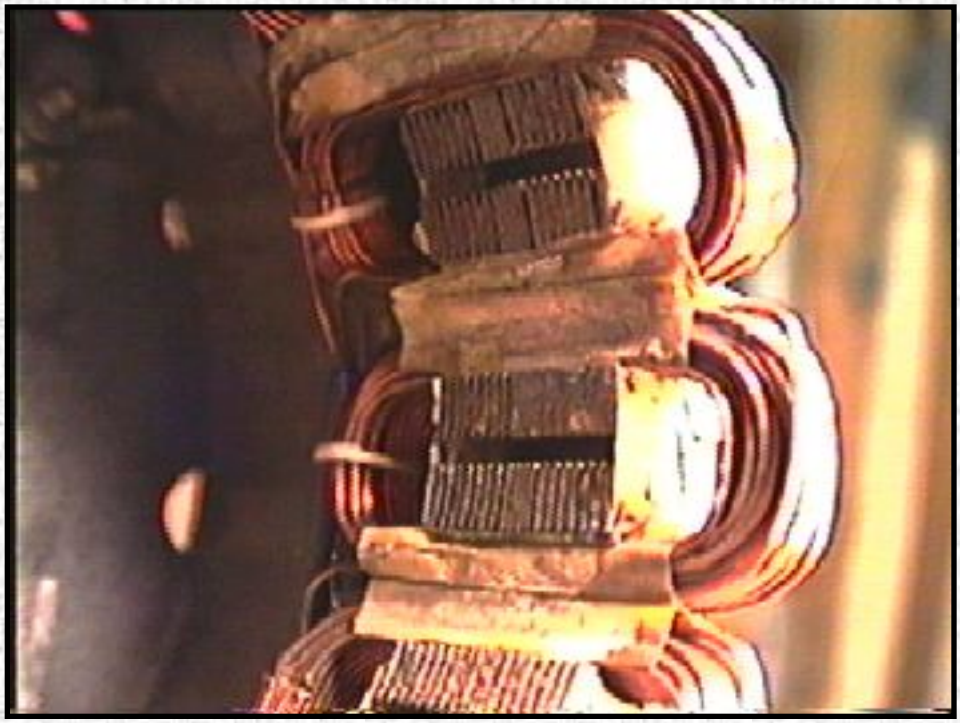
It is capable of 700 watts at 120 Volts AC or DC output. The AC frequency is about 250 to 400 hz, depending of engine speed. You may ask, "What can you power at that frequency?" Plenty! Lightbulbs don't care what frequency they operate at. Devices that are power-transformer operated, such as a radio, TV, VCR, etc. work very well on this frequency.

I included a full wave diode bridge to also provide 120 Volts DC. This makes it possible to operate any universal-motor operated device. Power saws, drills, angle grinders, etc.

This generator is a veteran of a ham radio expedition to Manchester islands on the Ohio River. There it powered a TS-520 ham transceiver at about 350 watts maximum for the day. I'd refuel it about every hour or so. This power source has seen a lot of use and is very reliable.

You ask, "How in the world did you convert a 3 phase alternator to a single phase system?" In its original condition, it had 42 poles on the stator. The rotating field has 14 poles. (42 stator poles divided by 14 rotor field poles equals 3 phases,... Hey! How 'bout that?) Well, NJ8V helped me cut out every third pole on the stator of the alternator. This left 2 poles with a large space between them and the next 2 poles. I wound each of the 2 pole pieces as a single pole, for a total of 14 poles.





In this close-up shot, notice the two pole faces wound as one and where each third pole has been cut out. A small coil form was made out of plexiglass to wind the coils. I used epoxy glue to hold the coils in place, with fiber tape as an insulator. The coils are about 36 turns of #18 wire, all connected in series.

The only advantage of converting the alternator to single phase was that I could get the full 120 vac out of the windings. That was better than having to use a transformer or other method of getting 120 volts out of it. Besides, it was a good education!

Here is a new welder/generator that I've just finished in February, 2000. It is a 100 ampere DC welder, powered by a B&S 8 hp gasoline engine. Click on it to go directly to this welder page.

Click here to see some of my other generators

Chrysler, Navy Surplus, Dayton, Kohler, Induction Generator, Renewable Energy Experiments, Dayton '99.

Other cool lightplant/generator links:

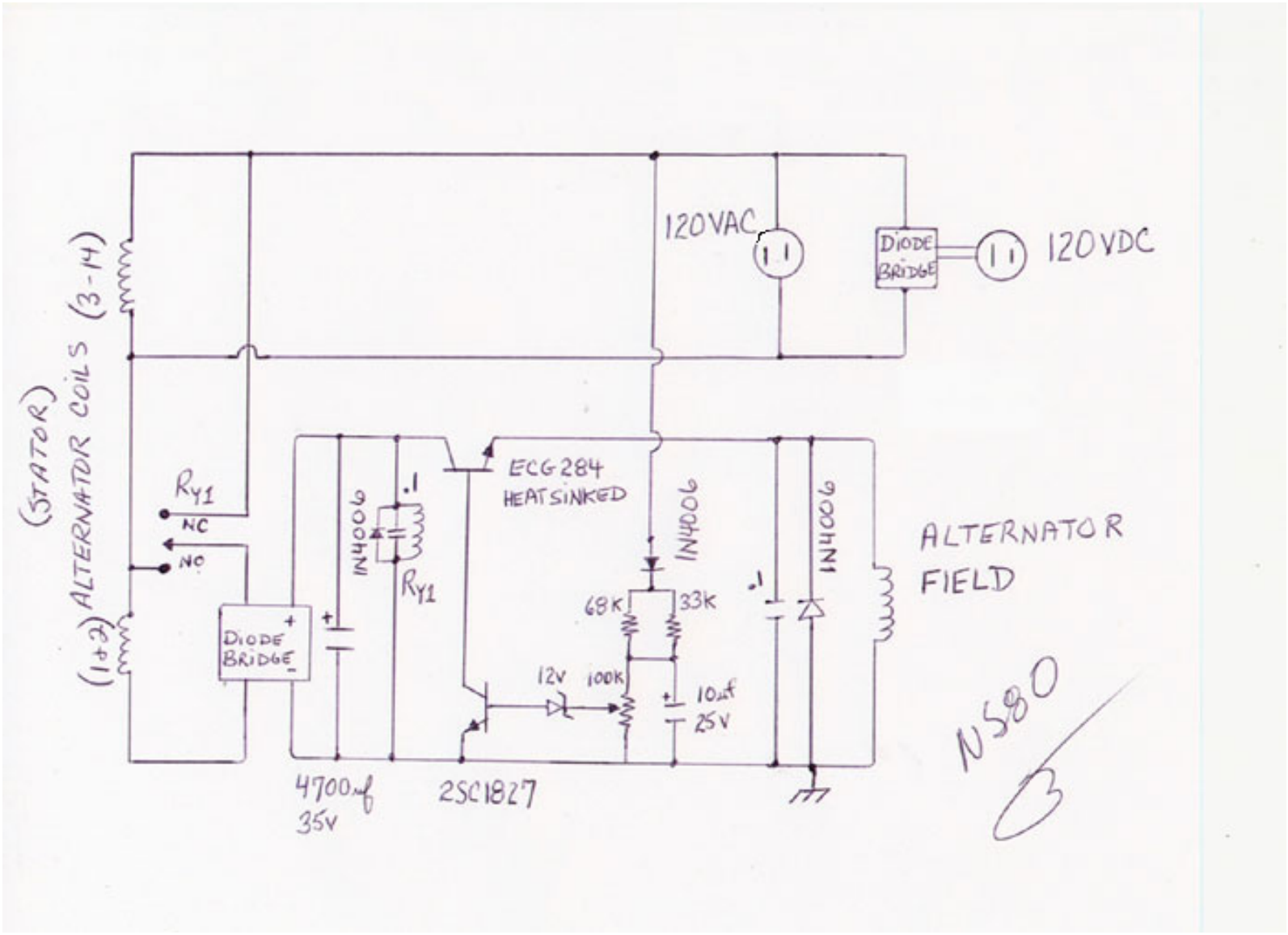
Antique Lightplants by Frank DeWitt Very good site!

Dan's Handmade Electricity page

Dan has some great ideas on making low rpm generators using Neodymium magnets. Included is experiments and results with pictures!

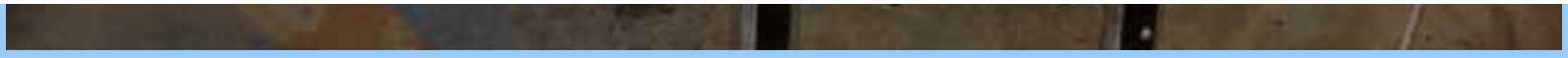
Greg's Lightplants page last changed Feb. 9, 2000

Email me at: NS8O@qsl.net


(STATOR)
ALTERNATOR COILS
(3-4)
(1+2)
120VAC
DIODE BRIDGE
120VDC
RY1
NC
NO
DIODE BRIDGE
IN4006
.1
RY1
ECG284
HEATSINKED
IN4006
68K
33K
12V
100K
10uf
25V
.1
IN4006
ALTERNATOR FIELD
4700uf
35V
2SC1827
NS80
3

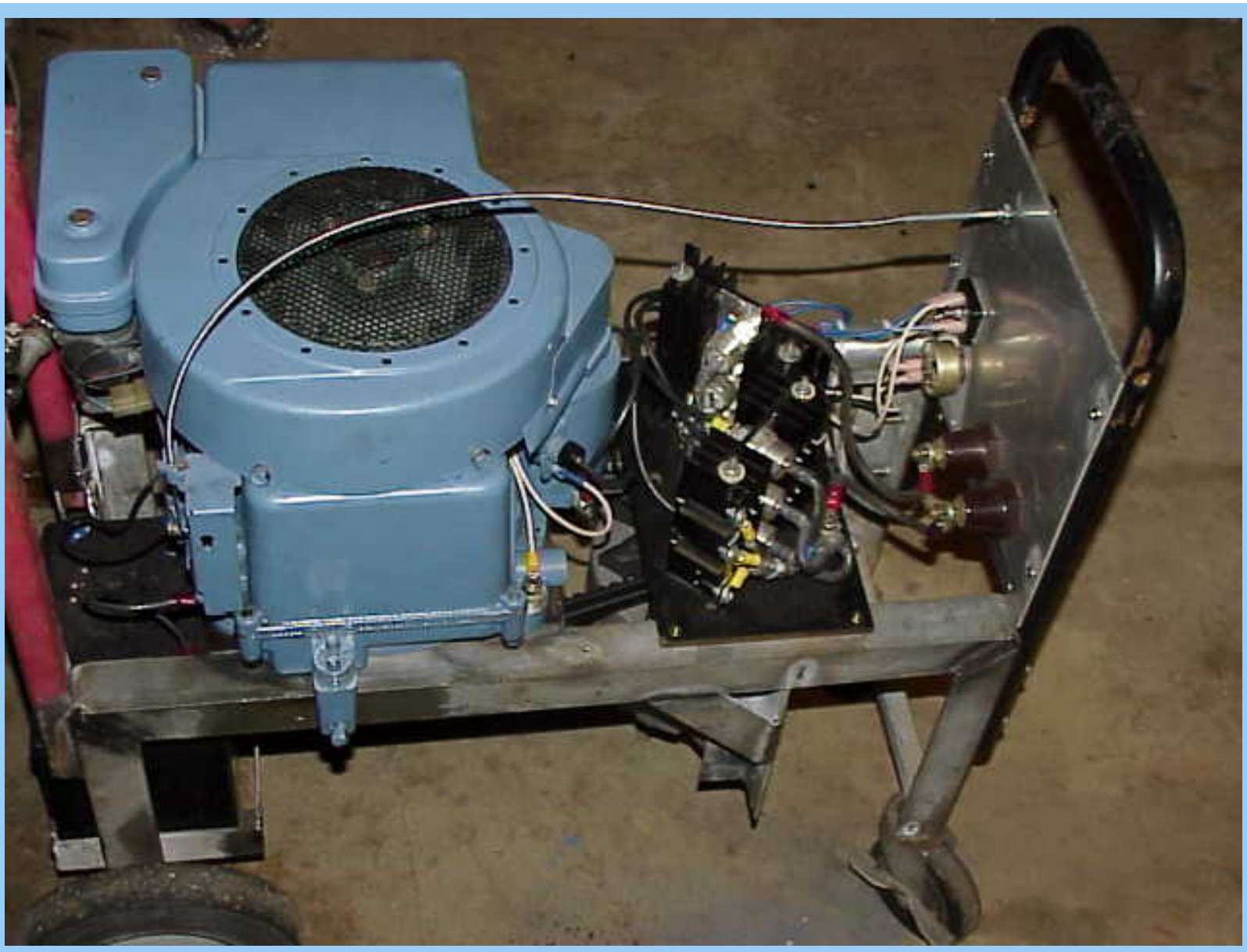
Homebrew Gasoline Engine-Powered Welder

8 hp Briggs and Stratton engine with a Chrylser 100 amp alternator. A 3 phase external diode bank consiting of six 300 amp diodes converts 3 phase AC into DC.

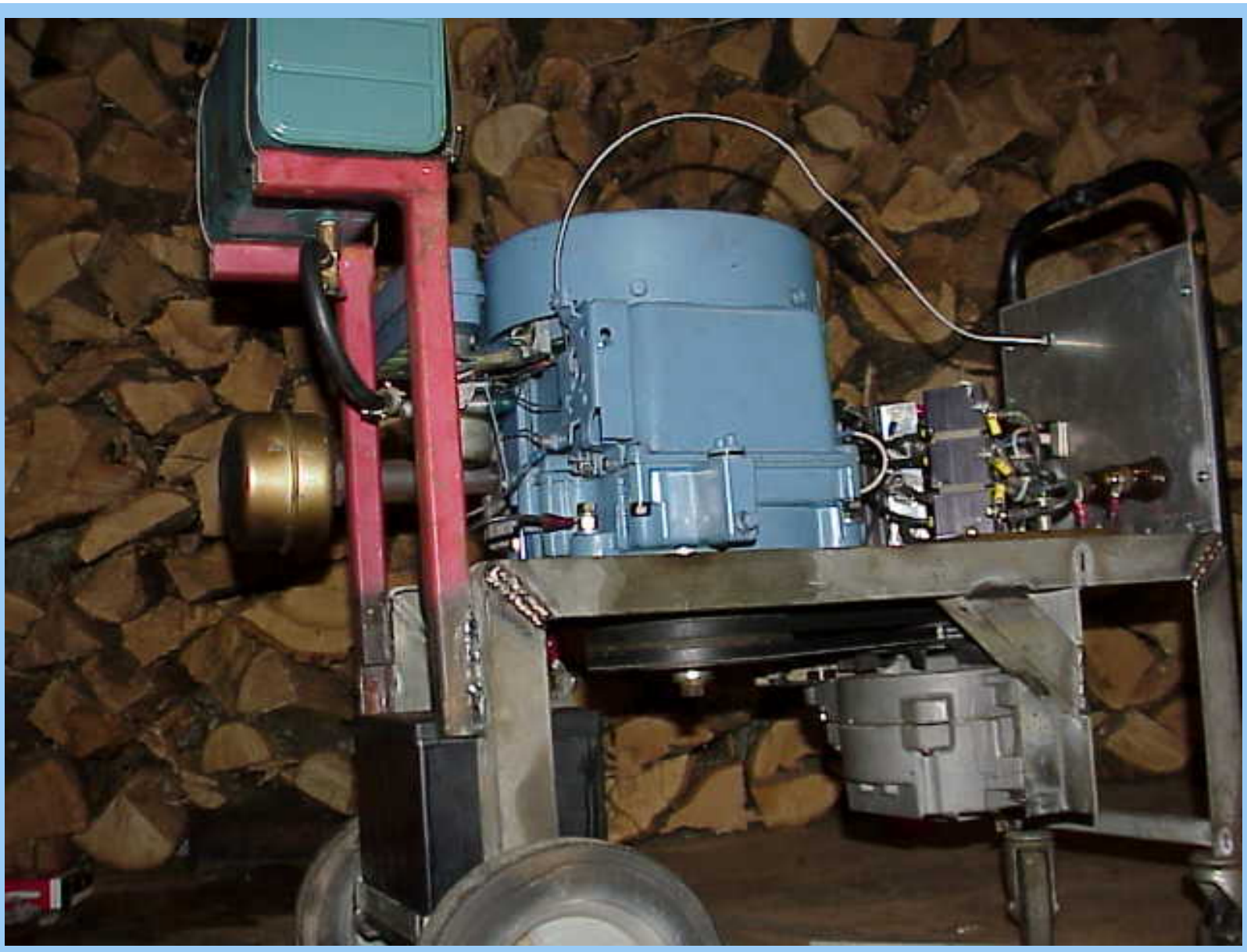


Here is the front view showing the welding terminals. Black is the negative lead, Red is the positive. The key switch and throttle are also visible.

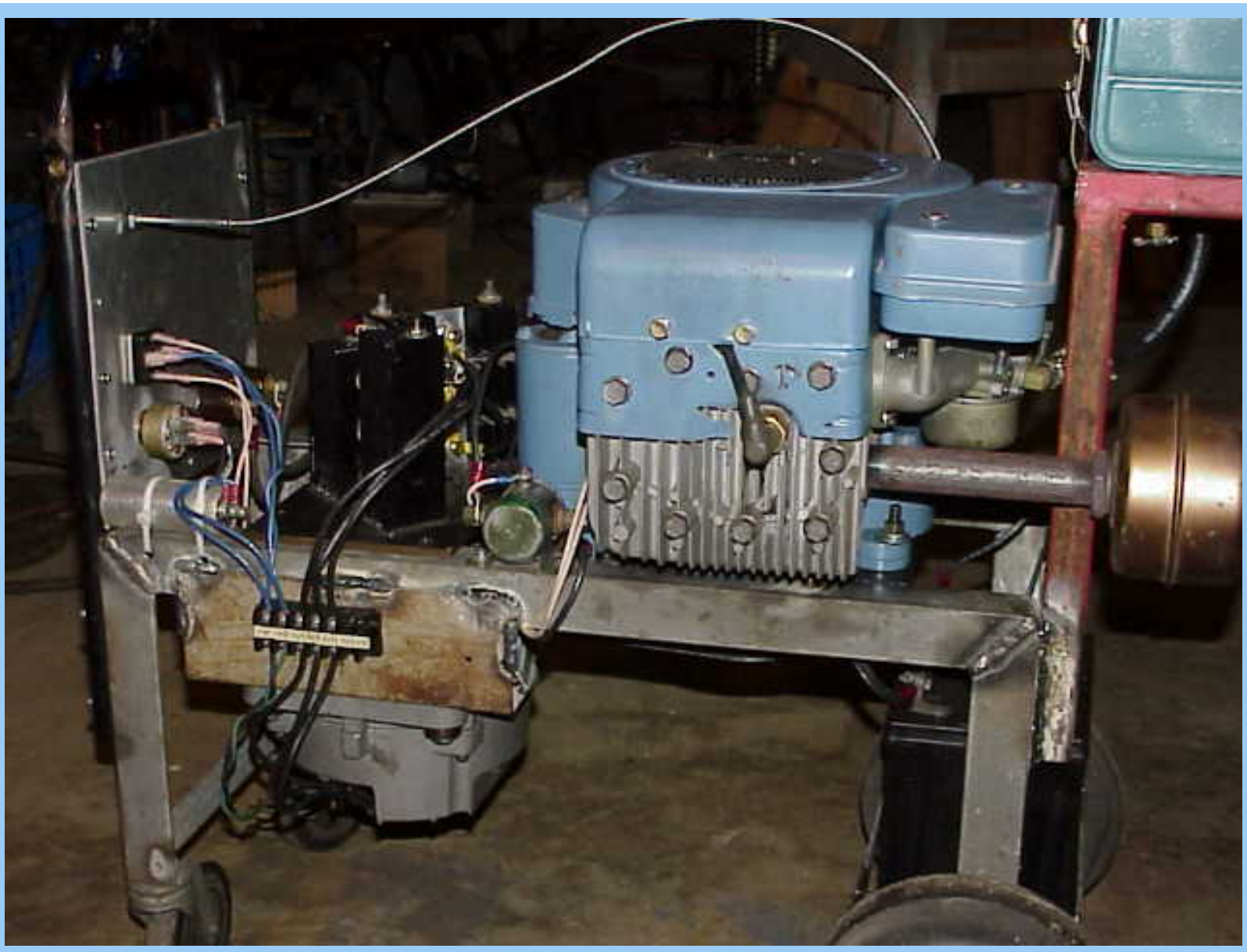
Dual drive belt for maximum power transfer.



In this view the three phase diode bank with its black heat sinks can be readily seen between the engine and the front panel.



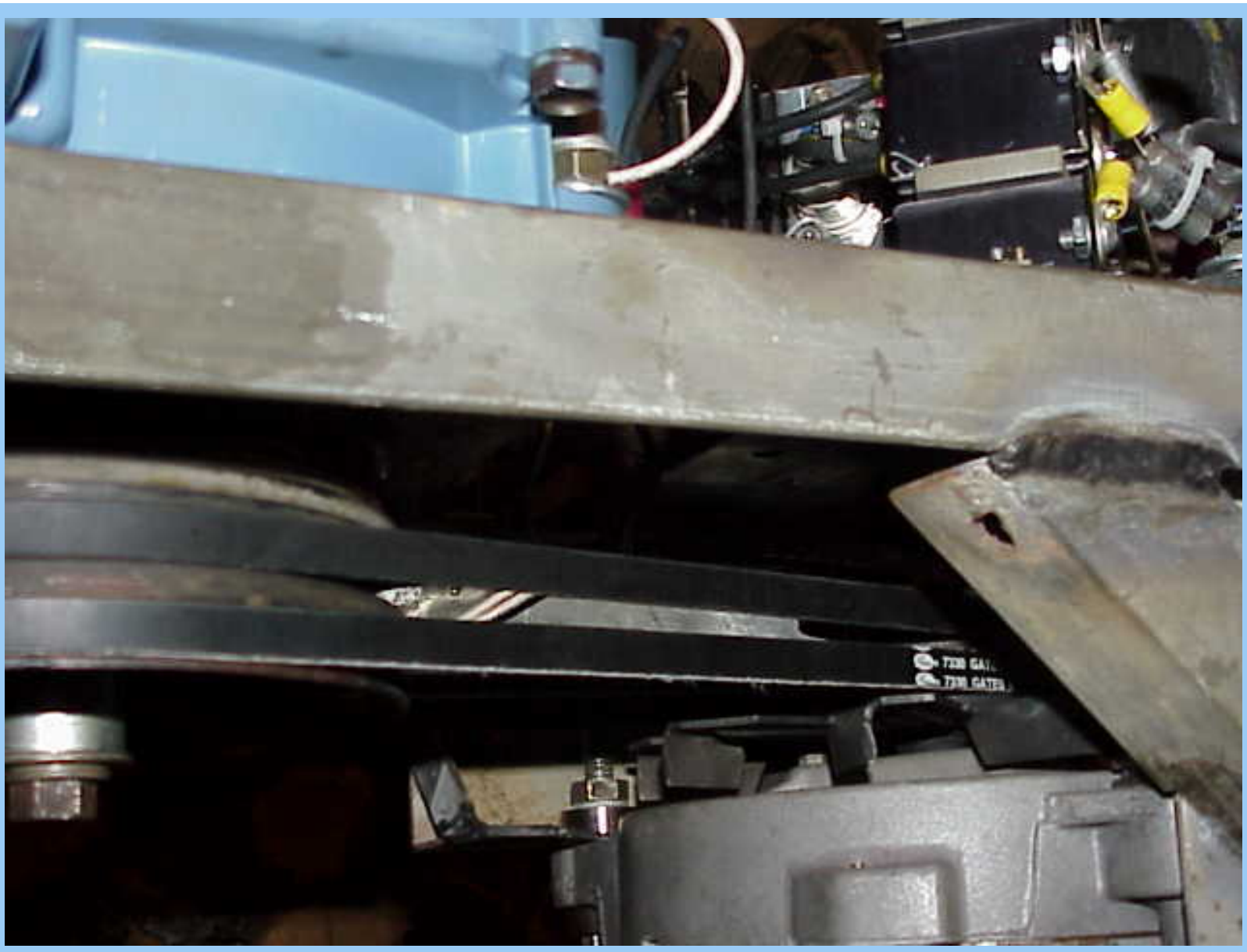
Another view of the left side. The exhaust pipe is either going to be shielded or moved from under the gas tank for saftey reasons.



The terminal block above the alternator has, from left to right: Field power, negative and positive, then the three wires from the three phases from the alternator.

Above the keyswitch is the full wave bridge that rectifies the AC from the engine lighting circuit. This AC voltage is produced in coils that are under the flywheel. Originally used to power the lights in a riding lawnmower, it now provides 8 volts DC to power the rotating field of the alternator.

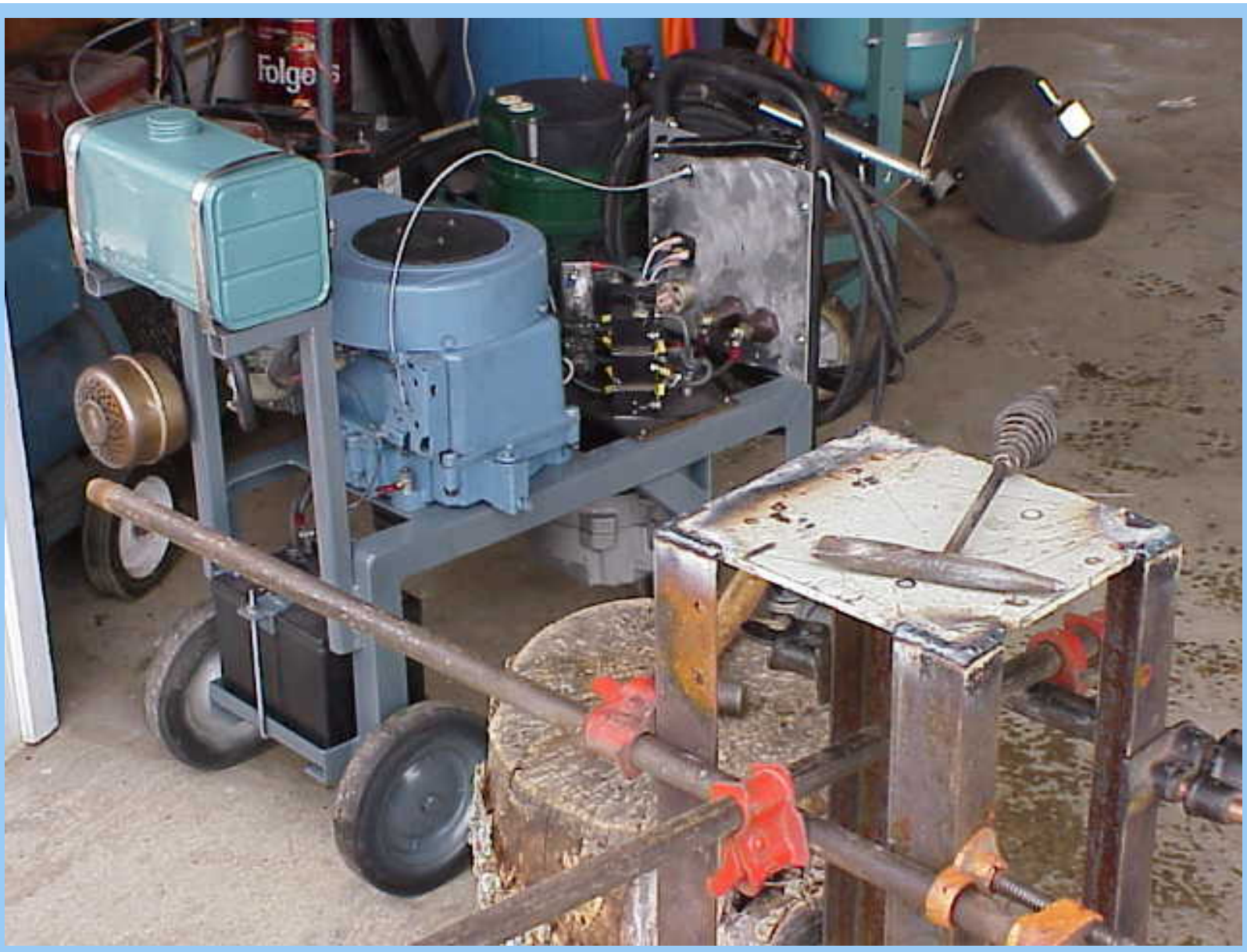
A one gallon gas tank provides a couple of hours of continuous operation.



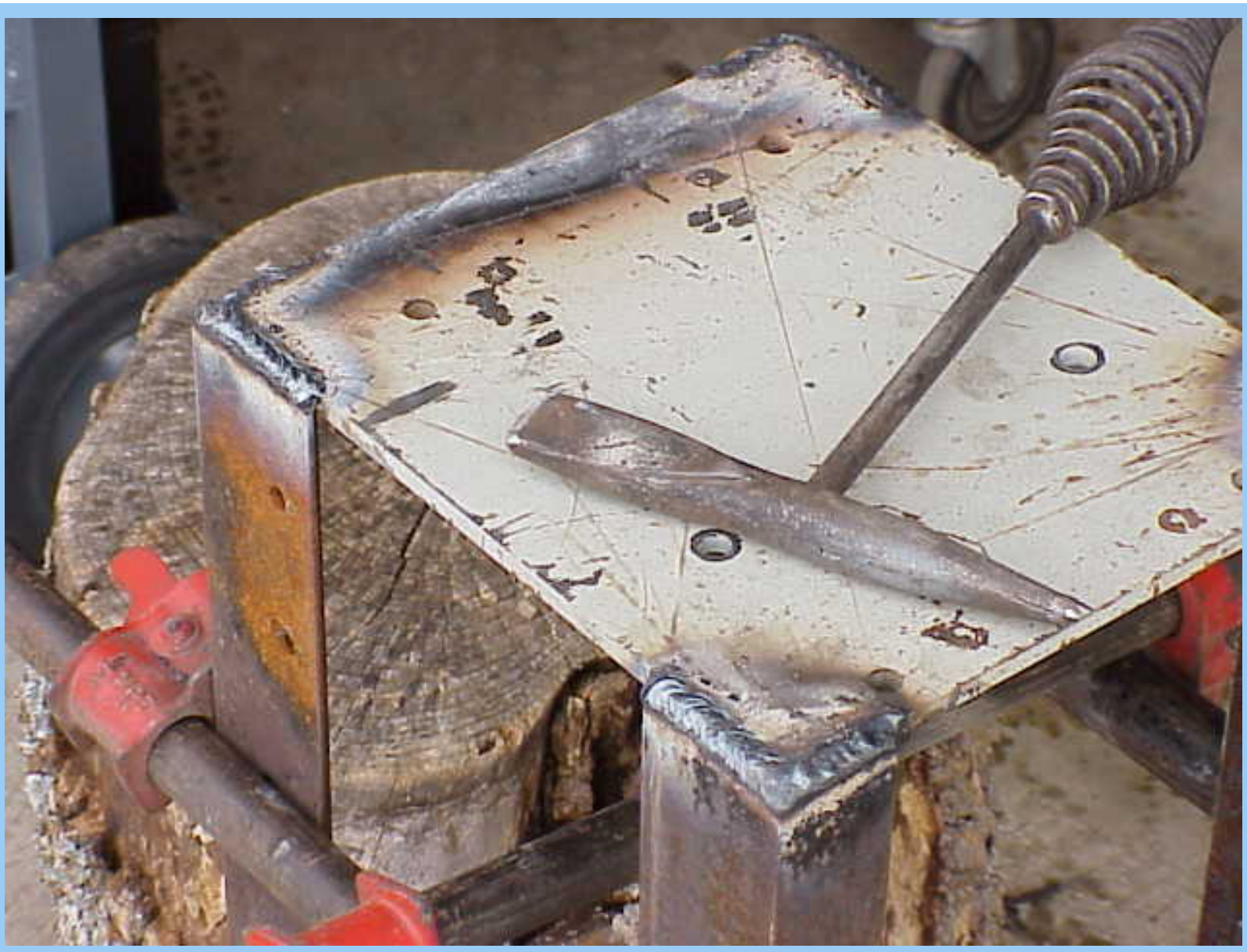
Close view of the belt drive system.

Wow...I'll bet those engineers at Lincoln, Hobart, Miller, etc. are drooling over this shot of the new Kitty Lane Nuclear Fusion Welding Power Unit.

Over view of Kitty Lane machine shop with Gas powered welder and a new project on the floor, which is going to be totally welded with the new portable welder.



Project of the day: A disc grinder stand with 33" high mounting plate. (Legs are not flared out yet)



Shot of disc grinder base where legs attach to top plate.

Close up of weld, 1/4" steel plate to 1/8" legs. Welded at about 85 amps, with a 3/32", Lincoln 6013 electrode.

That's it for now. 73 de NS8O Feb 8, 2000

Homebrewed Generators Page

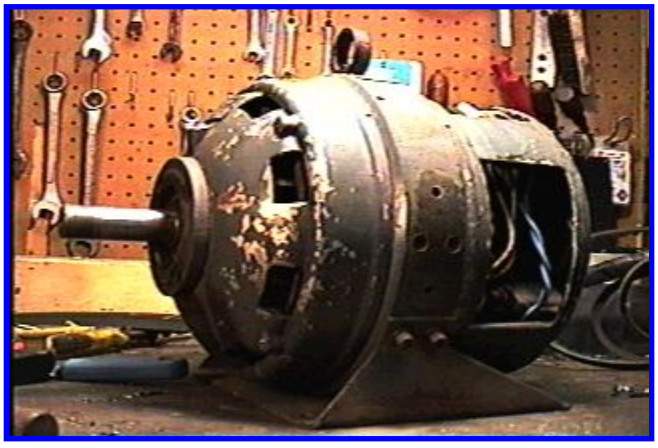
All of the following generators and engines are refugees from the junk yard. Most of them just needed some TLC and a bit of machine work to bring them back to life.

02 Feb 2001 Greg Weinfurtner

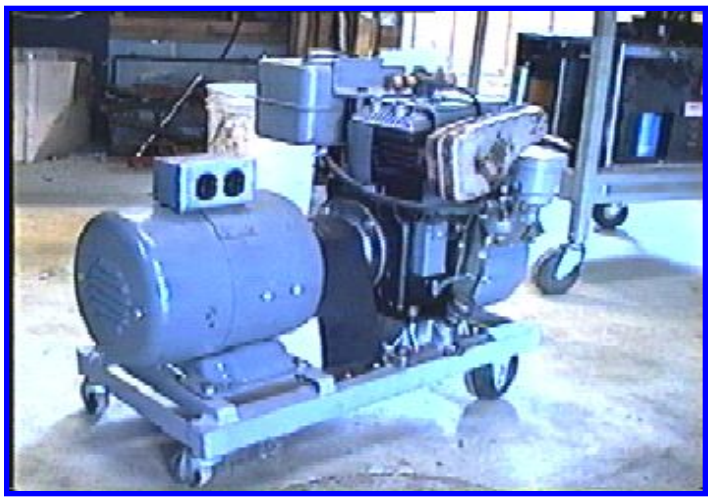
Gasoline Powered Welder

Homelight 4kw

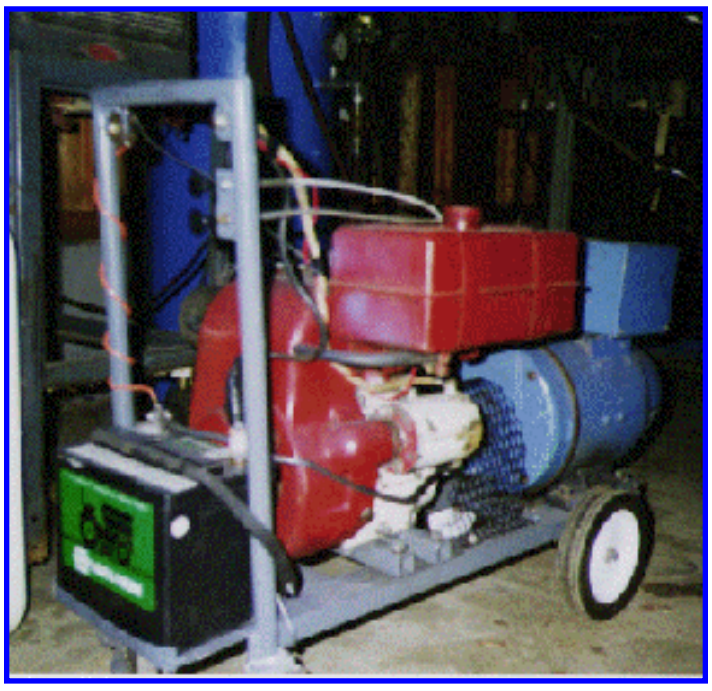
B&S/Chrysler Alternator12 VDC @ 50 A



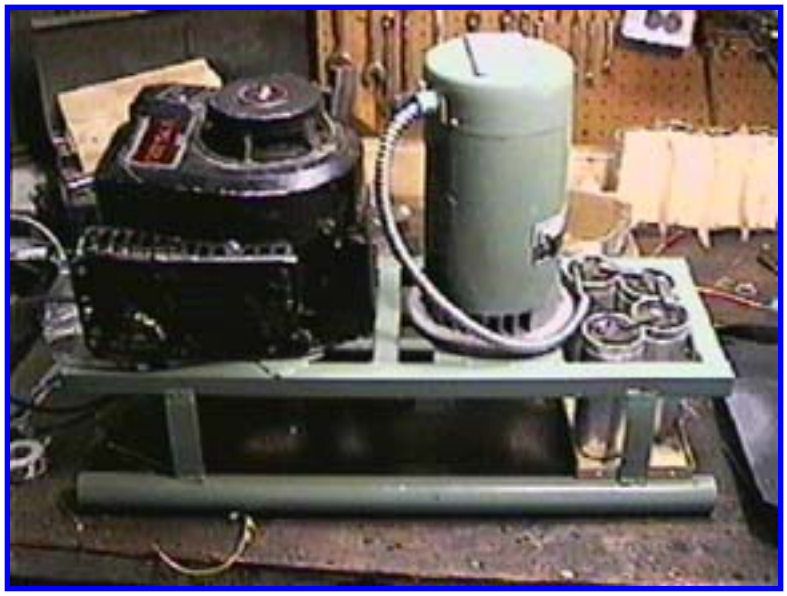
Navy Surplus Generator (New Update! Check it out!)



Dayton Generator No. 2M094



Kohler/Tecumseh 5KW



Induction Generator

New! Dayton 1.5kw

Renewable energy experiments

HANDMADE ELECTRICITY

This site is devoted to those who have "more time than money" and want to make electricity! In it I will feature home power systems that are cheap or free to build, including solar, wind, water, gasoline, and perpetual motion(just kidding-there is no such thing!). I'll be posting the systems and projects from my community-the upper Buckhorn canyon in northern Colorado. I'll be using it as an excuse to show off my own projects-opinions-etc. I'll also try to cover other peoples projects and plans-if they choose to share. Keep in mind-projects need not be finished, and they need not even work to appear on this site. Please email me with any pictures or plans that you wish to share! In the future there will be free plans, parts-and possibly surplus items for sale. Please check out the pages-and be sure to visit some of the links below!

Please look at the other pages!

Homebuilt alternator tests

Antique gas engine chargers
Wind power
Water power
VERY STRONG MAGNETS
Email me!

Other Links of interest

Antique Lightplants - an excellent site with wonderful pictures and information about some classic generator sets.

Pico-turbine - Books, info, plans and great information on remote power systems.

Hugh Piggott's website -This fellow really knows his stuff where wind power is concerned-great site!

SOLARIS - Lots to do and think about here-a huge site with gobs of ideas. Be patient though-it loads SLOWLY!

Flywheel Dangers - Very interesting-entertaining site about the dangers of flywheels in stationary engines.

Photovoltaics DIRT-CHEAP! -This fellow sells surplus/chipped photvoltaic cells for the best price Ive seen yet.

HUMPHREY PUMP - An amazing-very efficient liquid piston 4 stroke gas engine.

Windmission Home page - Looks like they build and sell quality windmills. This site is full of excellent information.

My Ford adventure -My brother and I set out 160+ miles to get a new company car!

MAGNETS

Low RPM alternator tests with surplus hard drive magnets 9-13-99

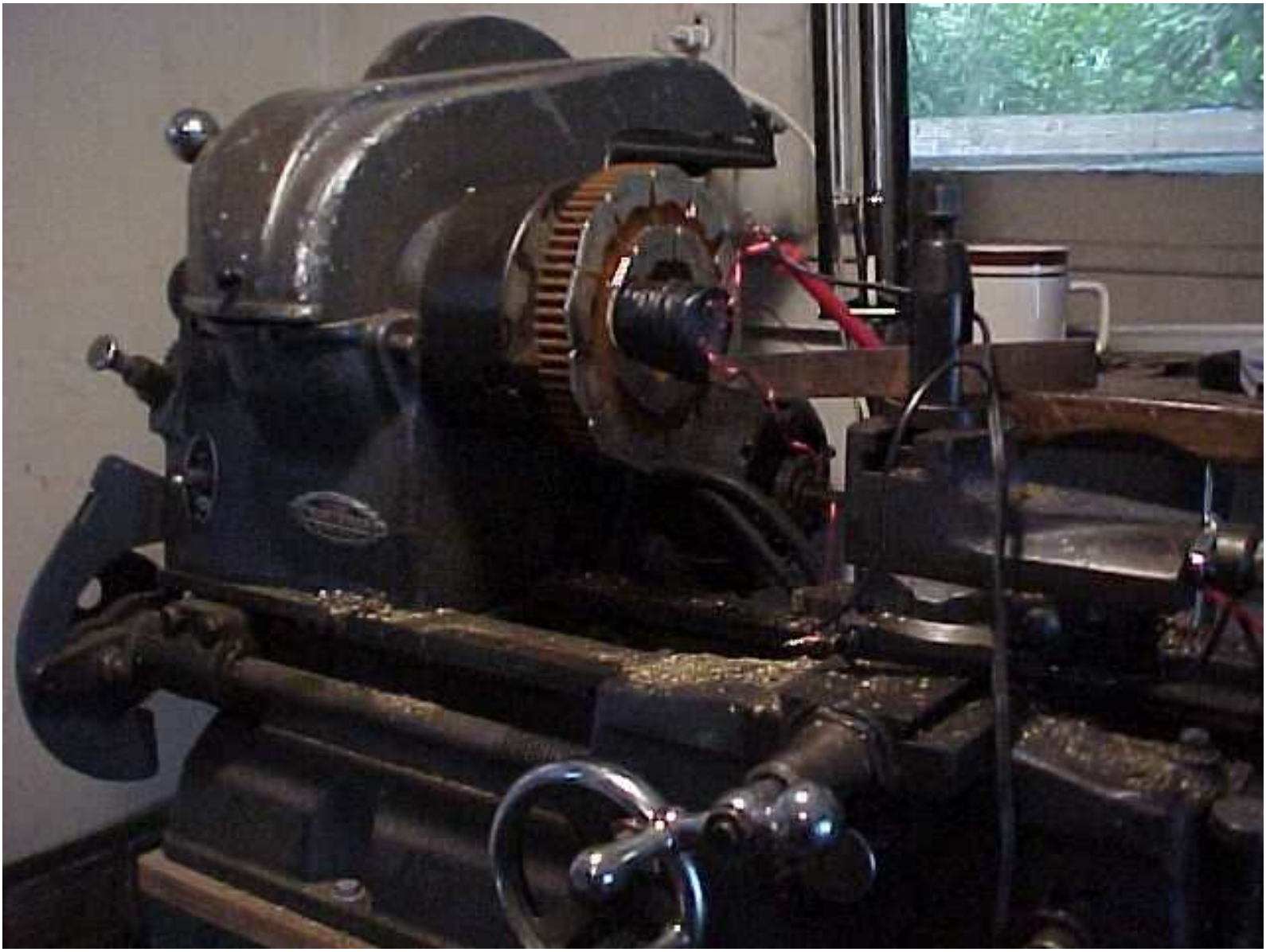
This page is about an older project of ours. We keep ALL of our projects up on the internet for anyone that's interested...but we are no longer pursuing many of these older ideas. Before starting this project, please check our main Wind Power page to check for similar, more recent designs. These will be the top of the list and flagged with an "active project" tag. If you have any questions about what is current and what is not, or why we no longer work on certain designs, first check out our Wind Turbine Evolution page for a detailed history of how our designs have changed over the years. You can also Email us and we'll fill you in as our email volume permits...check the Evolution page first.

In the effort to build my own low RPM alternator for small wind/water power applications, these are some of the tests I've performed and their results. First step is the magnets. I used surplus hard drive magnets which I salvaged from scrap computer hard drives. These magnets 1.4" long, .80" high, and .090" thick. They are nickel plated Neodymium Iron Boron magnets of impressive strength. I sell surplus magnets on my web site. In this test used some of my smaller ones, due to their seemingly unlimited supply.

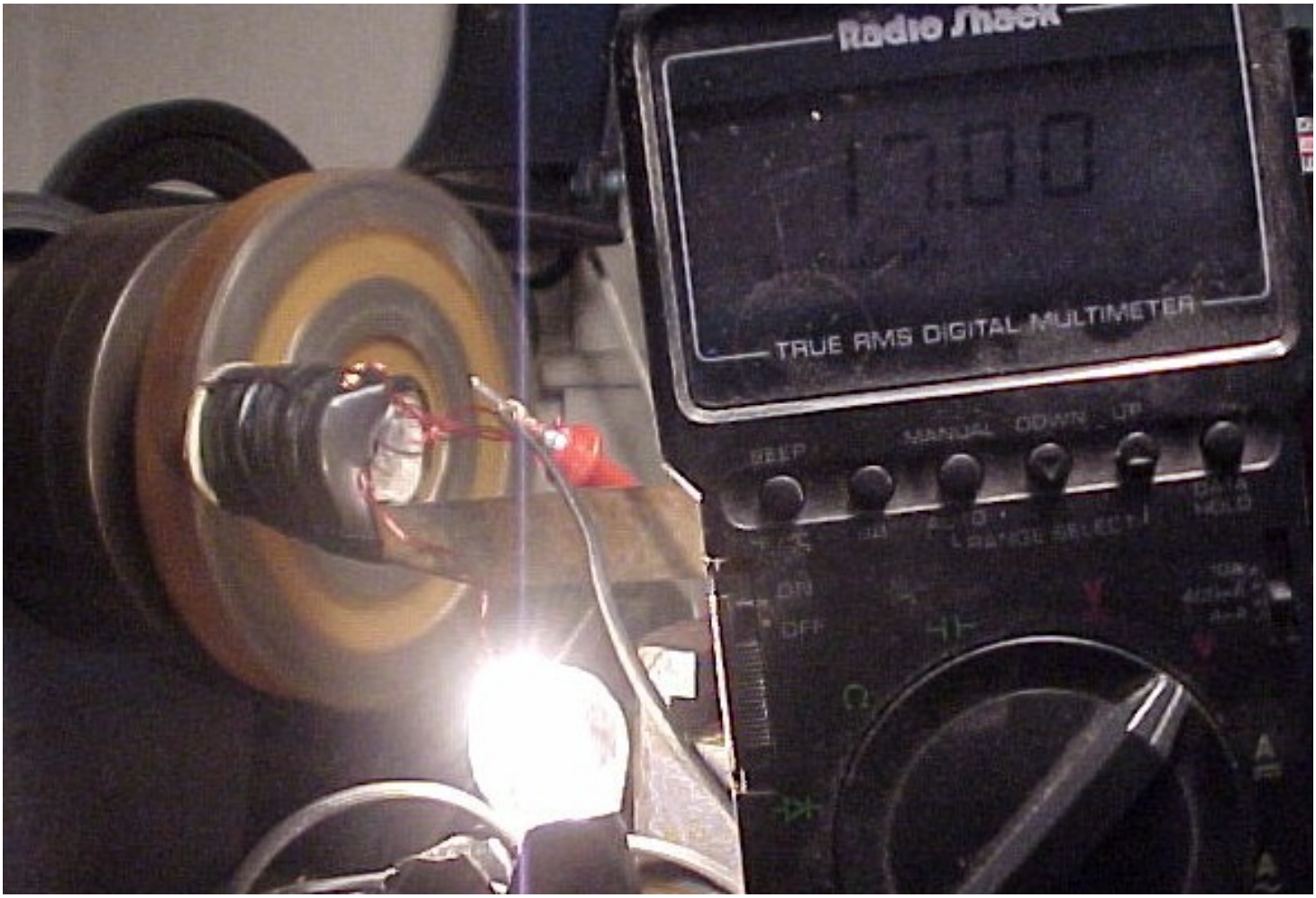
Item #2 on my magnet web site

Next wound a coil from 23 gauge magnet wire. The coil is slightly under 2" long, and consists of 700 windings, with taps at 100, 200, 400, and 700 windings. The core for the coil is made from 20 2" long segments of enameled coat hanger wire, super glued together. This should reduce inefficiencies due to eddy currents through the core. I believe annealing the wire segments would probably improve performance, but I skipped that step here. The spool on which the wire is wound are made from paper, poster board, and super glue. There are certainly better materials to use here, although paper and cardboard worked just fine. The alternator Im currently building will have spools made of phenolic sheet.

Next I took a gear, 5.5" diameter and placed two rings of surplus computer hard drive magnets on it. Each magnet has 2 poles on each face. 7 of these ones fit tightly together in a ring, having 14 poles. I placed two rings of magnets on the face of the gear, one ring containing 7 magnets(which fit together nicely), and the other ring containing 12 magnets(which don't fit as well). The inner ring of 7 magnets is a little over 3.5" diameter. The outer ring is a little over 5.5" diameter. I then placed the gear in a small metal lathe on which I performed tests at 3 different speeds.. I tapped the coil to a boring bar, so that I could adjust its position in relation to the two rings of magnets.



Next step was to turn it on, and test the different taps on the coil, at 3 different speeds. I used a 12 Volt, 5 watt light bulb as a load, and tested the voltage of each tap on the coil, at each speed, with, and without the load. The tests were done at 200, 400, and 600 RPM.



INNER RING(7 MAGNETS-14 POLES)
200 Windings

	200rpm	400rpm	600rpm
Light off	2.3 Volts	3.4 Volts	5.5 Volts
Light on	2.1 Volts	3.2 Volts	4.8 Volts

INNER RING, 400 Windings

	200rpm	400rpm	600rpm
Light off	4.4 Volts	7.3 Volts	11.3 Volts
Light on	3.8 Volts	6.1 Volts	9.1 Volts

INNER RING, 700 Windings

	200rpm	400rpm	600rpm
Light off	6.5 Volts	11.1 Volts	18.6 Volts
Light on	4.3 Volts	7.0 Volts	10.5 Volts

OUTER RING(12 magnets, 24 poles)
200 Windings

	200rpm	400rpm	600rpm
light off	3.2 Volts	5.5 Volts	9.5Volts
light on	3.1 Volts	5.1 Volts	9.1 Volts

OUTER RING, 400 Windings

	200rpm	400rpm	600rpm
light off	7.8 Volts	11.8 Volts	18.6 Volts
light on	6.5 Volts	9.9 Volts	14.6 Volts

OUTER RING, 700 Windings

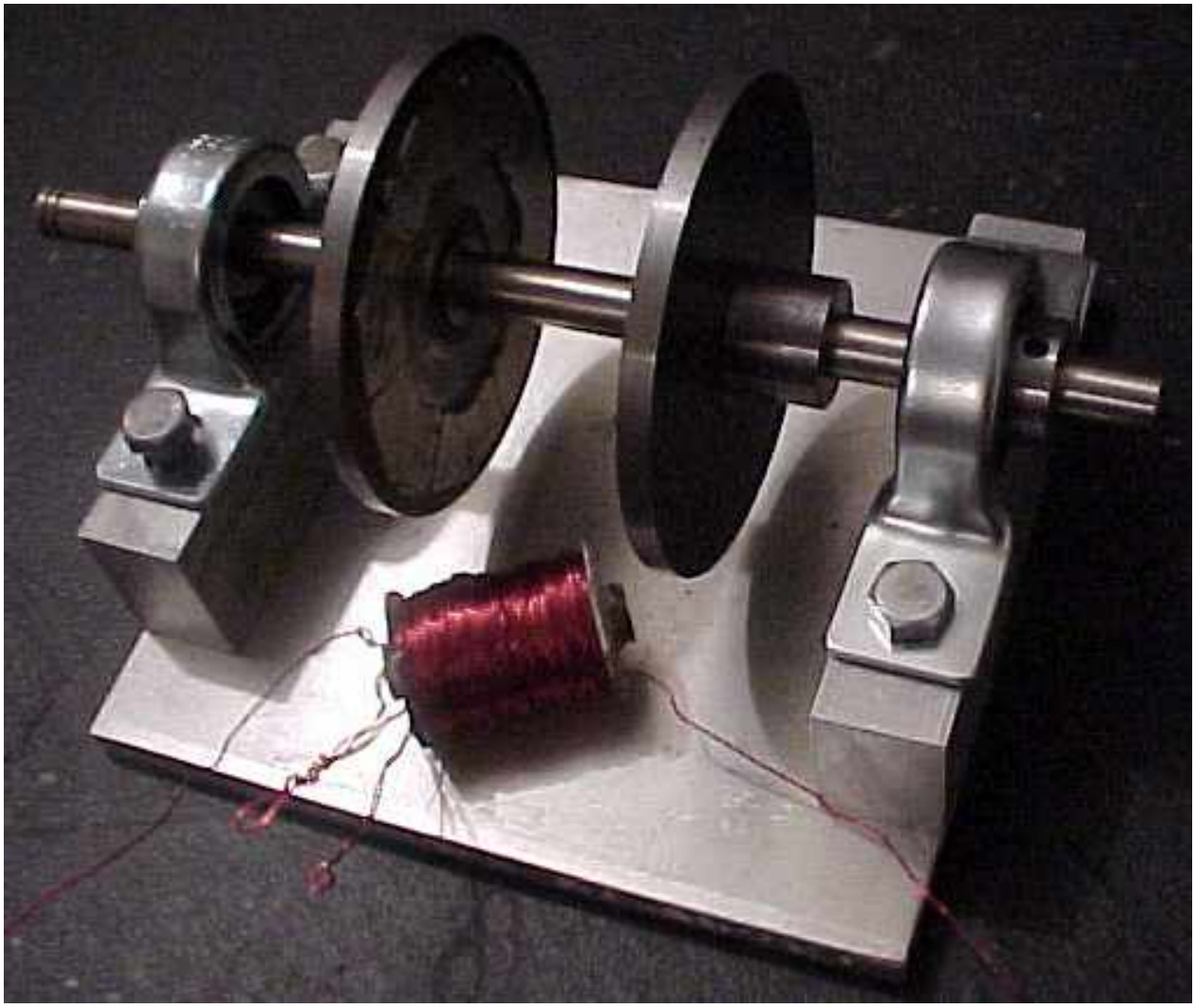
	200rpm	400rpm	600rpm
light off	13.9 Volts	19.2 Volts	30.9 Volts
light on	9.3 Volts	10.8Volts	14.6 Volts

Considering this data, Its my guess that 400 windings is closest to ideal for charging 12 volt batteries. It surprised me, that in every test performed, the lightbulb did light-

though it was rather dim on some. 1 problem with the test, is that the coil was tapped to a boring bar, attached to the compound rest of a rather cheap, old, and worn out lathe. As the machine ran, the coil would creep towards the magnets. Although I tried to keep the gap between magnets and coil consistent, I know this varied some throughout the testing. A slight change in gap has a causes a significant change in voltage. In another test, at 600 RPM with the light on and 700 windings used, output was at 18 volts. It was interesting, to be able to move the coil front/back, and side to side while observing the output voltage.

IMPROVEMENTS?

There must be many improvements. I have no doubt a better iron core could be used. The length of the coil, I chose 2" off the top of my head, I doubt its perfect, but I'm using that because I am building an alternator that will employ two discs, each with a ring of magnets, on opposite sides of the coil. 2" seemed like a good distance. 23 guage wire was convenient, and seemed like a good starting point, though I have a feeling that fewer coils of thicker wire might work better. Stacking magnets? I didn't double up the magnets for fear of the lathe launching them like bullets off the gear. I'm sure that this would have a good effect though-but-it would add to the cost of an alternator. More coils-the coil is exactly big enough such that 7 of them could fit nicely in an alternator using the small ring of 7 magnets. At this point, seems to me like an alternator built with 7 coils hooked either in series or parrallel-(or a combination) would perform reasonably well at low rpm. I have no idea yet what the effect of adding a second spinning ring of magnets to the back side of the coil will be, but I'm sure it will be significant. Although already somewhat obsolete, (because of the base/bearing arrangement) you can see my current alternator project in the picture below. I intend to finish this one, and test the output. The next one will have a much improved bearing arrangement, larger discs, and more coils.



Click here for updates!

SOME INTERESTING LINKS!

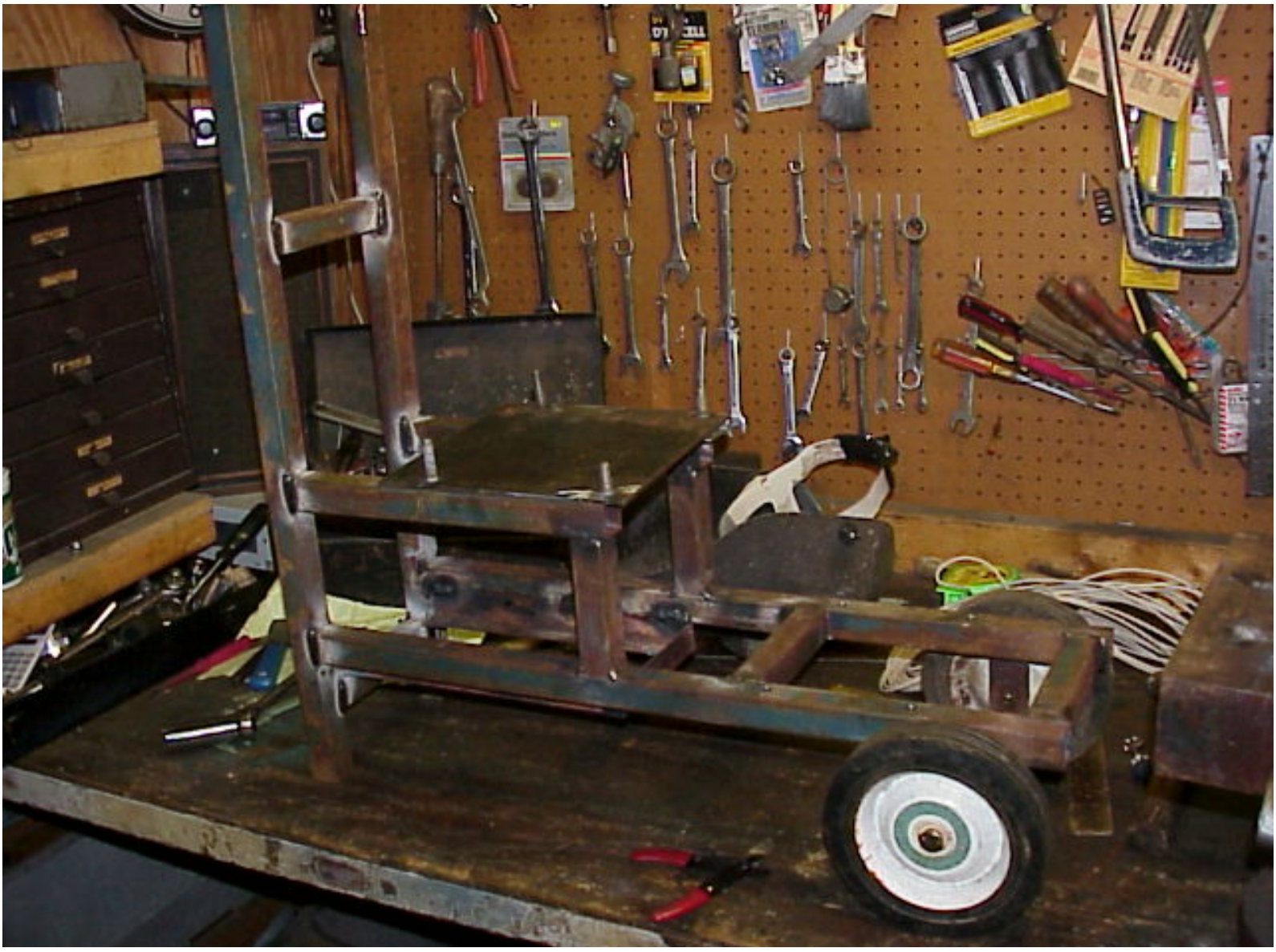
Surplus agnets for sale on my Forcefield website
Homebrew Electricity this is a site currently under construction about homebuilt, dirt simple-or antique power systems that may, or may not work!
Matt's magnetic levitation page shows a quick simple way to demonstrate magnetic levitation with a spinning aluminium disc.
Pico-Turbine - a great site offering books, plans-and valuable information on home-built alternators.
Home made lightplants and generators - another interesting site about homebuilt

alternators.

EMAIL ME

Wisconsin BKN and Homelite 4KW Generator

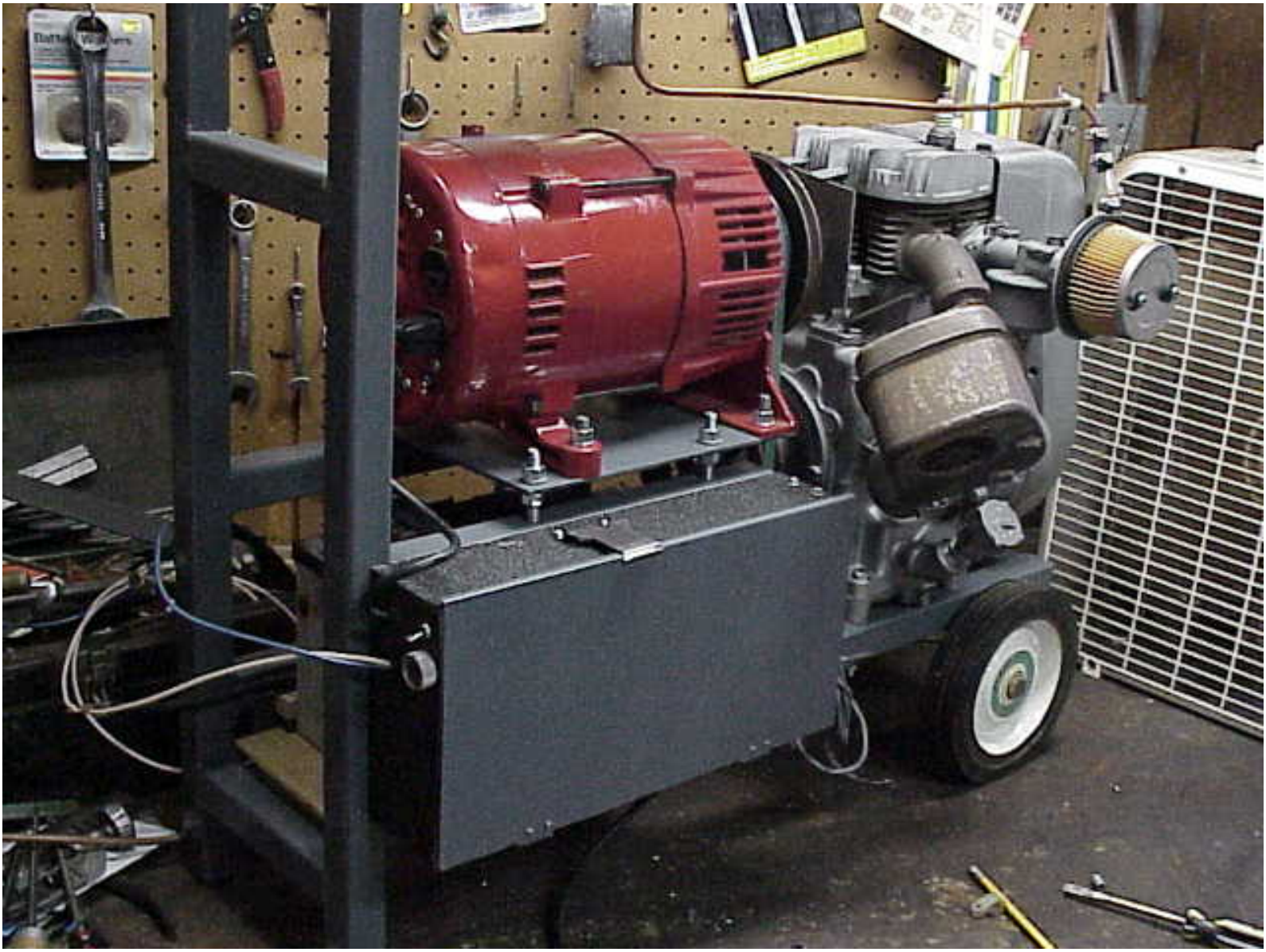
The plate with the hinges are where the generator sets. The (29 inch) drive belt tension is adjusted by raising or lowering the generator plate. Two 3/8" lock nuts go on the studs on the side opposite the hinge.



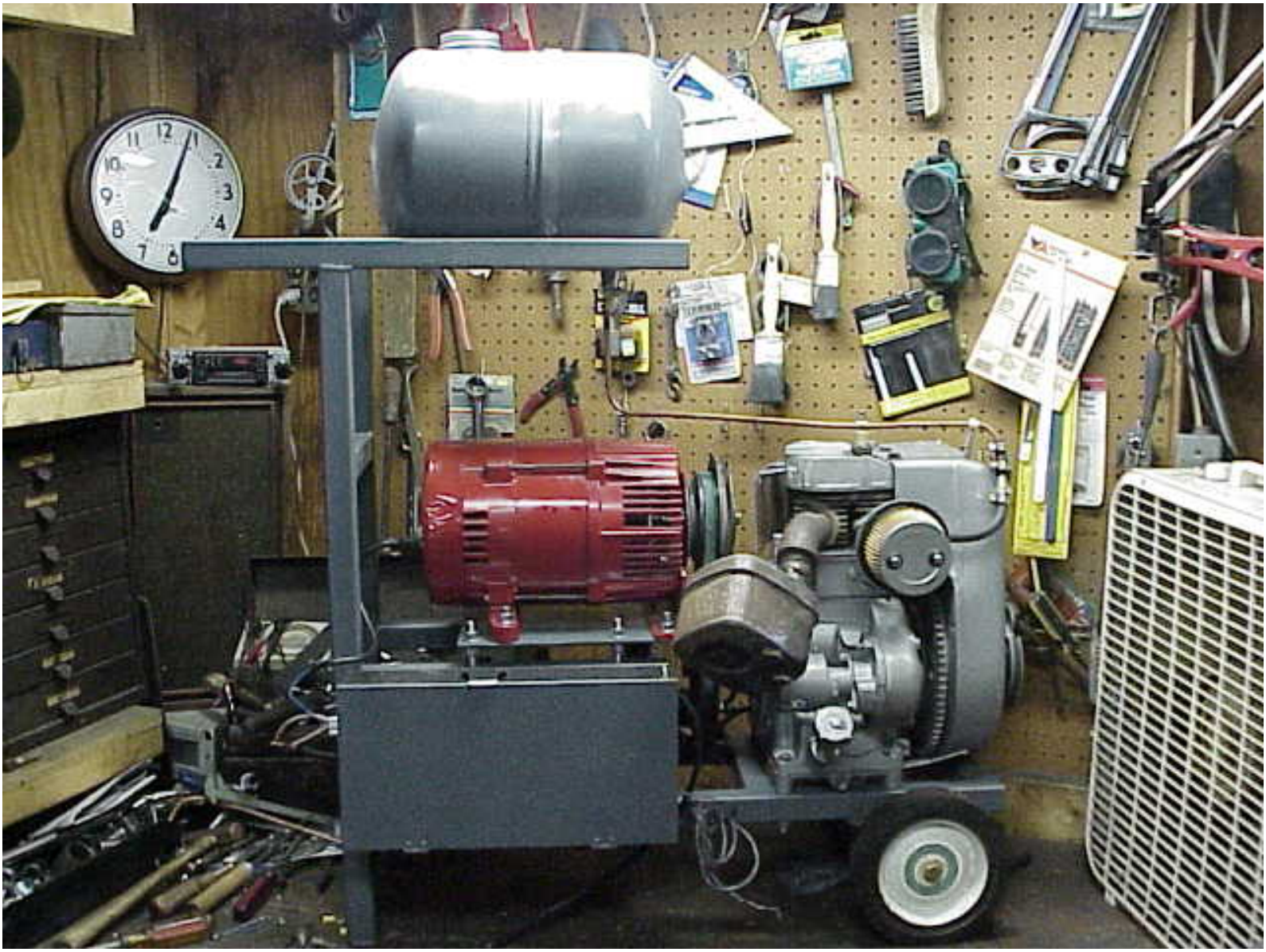
The welded frame before paint...

...and after paint!

Freon tank converted to a gas tank. The fittings were cut off an old gas can and silver brazed to the tank. Standard 1/4" pipe fittings were used for the outlet pipe. Fuel filter is not in the tank, but in the fuel line.



The fun part is attaching the gen and engine to the frame. It's cool when it all comes together! The battery is mounted under the generator and is just visible behind the control box.



Inside the box is the battery charger, starter switch and a cooling fan.

Also inside is a homebrewed solidstate ignition system (SIS) that is triggered by the engine points. Normally the points would switch about 3 amps to an auto ignition coil. This works fine, but can eventually eat up the points as they fire over and over. The transistor ignition system only requires the points to handle .025 amps. Hopefully this will add significantly to the points lifespan.

I have included a switch inside the box that allows me a bypass in case of a failure of the SIS. Then the system operates as previous; switching the coil via the points.

21 June 2001

Chrysler alternator and a Briggs & Stratton 3.5 hp

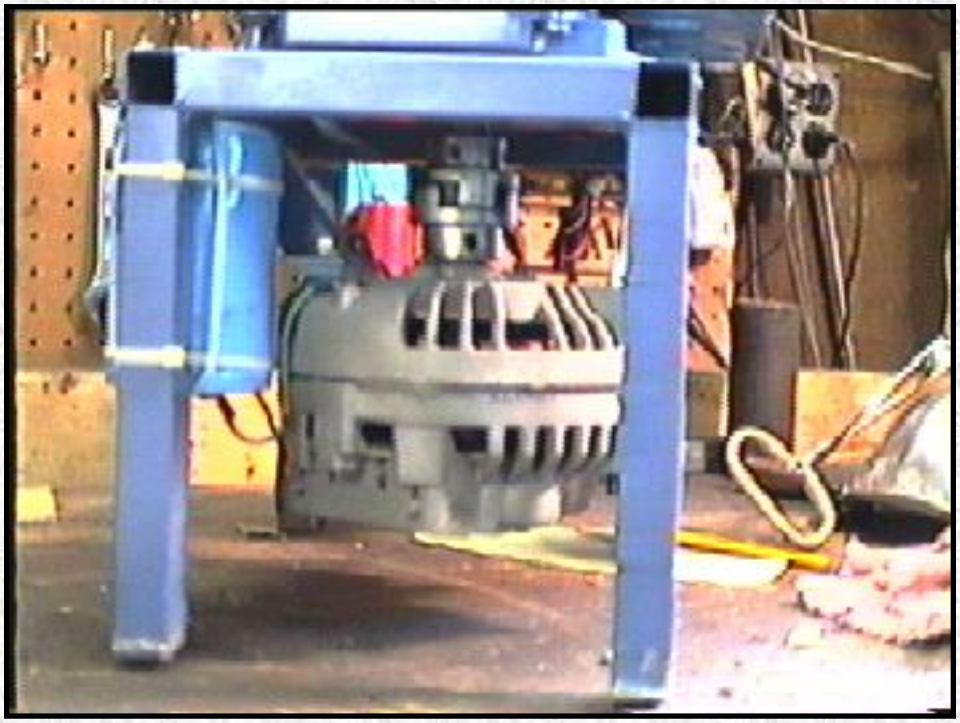
13.8vdc at a BIG **50 Amperes**!

Here is my answer to a need for power at car-type voltages. This is a combination of Chrysler and B&S technology and a

little homebrewed regulator. A standard automobile voltage regulator could be as easily used, but I wanted to be able to get the voltage exactly at 13.8 vdc, just like a car battery. Most automobile regulators run between 14 and 15 volts, which is a little "hot" for my purposes.

It is very straight forward and could be easily copied by anyone with a little mechanical skill.

Side view of the alternator, voltage regulator and Lovejoy coupling.



Front view of the alternator. Note the 89000uf filter capacitor (Blue cylinder behind the front left leg) used at the output to filter the output voltage.

The purpose for this generator is to operate ham radio equipment in the field. Radio static was a problem, however, I

was able to shield the sparkplug wire with braid from coax. The braid was grounded inside the shroud near the magneto coil and on the sparkplug body. I have a Voltmeter and Ampmeter on the handle, along with a little videocamera battery and momentary contact switch to energize the field. The battery is charged as the generator runs.

The output is through 15' pieces of #8 wire with battery clamps on the ends.

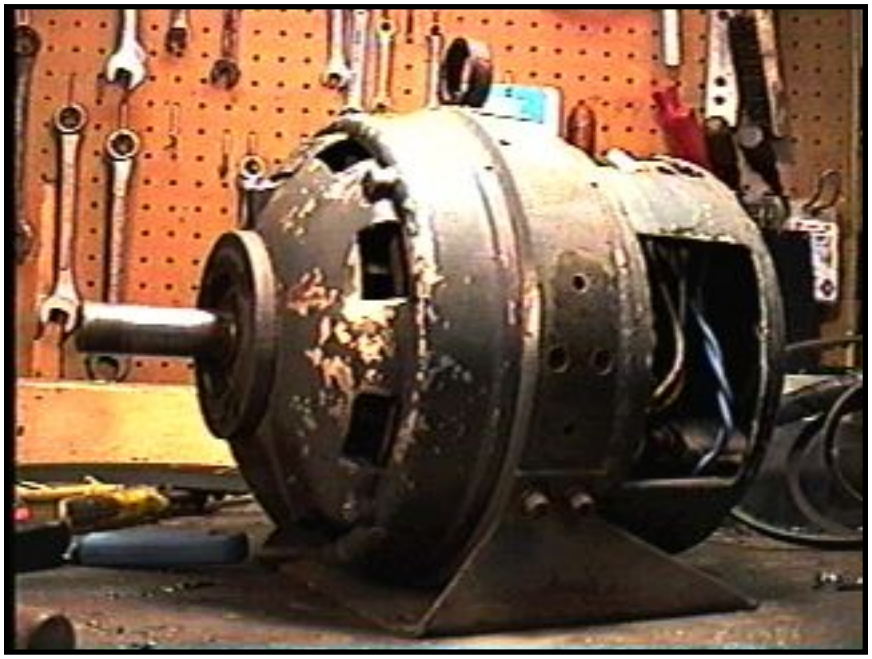
How well does it work?

I wanted to try it out and see what it would do. Running the car off of it would surely tell if it was a good set-up or not. Well, being the technically minded person that I am, the first thing I did was to HOOK IT UP TO THE BATTERY BACKWARDS... A few brilliant sparks later, I was convinced that it passed the test, as unintended as that test was...

Having proved that it was idiot proof, I found that it would do 50 Amps with about .5 volt drop from 13.8 v. Most of that drop was across the #8 cables. I then ran some radio gear off of it, chatted with a few other hams in various states and a few in England, that confirmed that there was no generator whine or static on my signal. Works great!

Surplus Generator

120 VAC 1500 watts at 1800 RPM

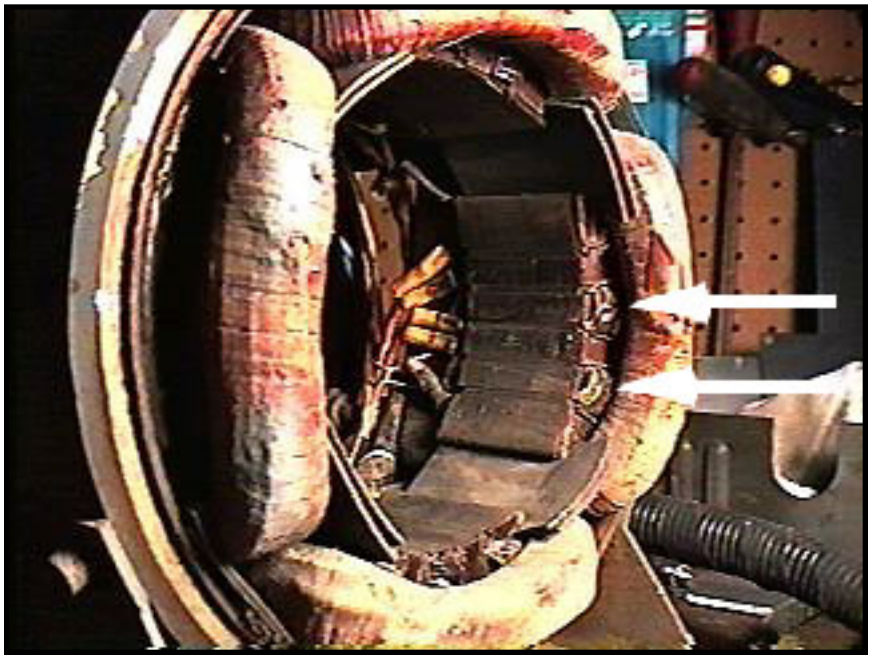


In this generators original configuration, it was driven by a 3 horsepower, single phase, 124/240VAC 60 hz, electric motor. The outputs were 12 VDC at 25 amps and 120 VAC, 400hz, at 10 amperes. The motor and generator were mounted on a steel frame and weighed in at about 150 pounds. Definitely Navy surplus, as one of the grease fittings called for Navy type grease.

I really didn't need 120VAC at 400hz, nor did I need 12VDC, as I've got generator for that. The alternative was to rewind the rotor to put out 120 VAC at 60 hz. Opening up the generator I found that it was a four pole design with pole pieces at 90 degree intervals.

Notice that the field poles are the "shoe' type and not the "slot wound" type. These act as simple electromagnets with North, South, North, South magnetic polarities. They just supply a magnetic field for the rotor. In this design, the power is taken off of the rotor, not the stationary poles. (Other designs take the power off of the stationary poles and the field poles revolve, as in an auto alternator.) Shoe poles make great electromagnets, but are very poor as far as being to get any useful power out of. The "slot" type stators are much better at being able to put out useful power.

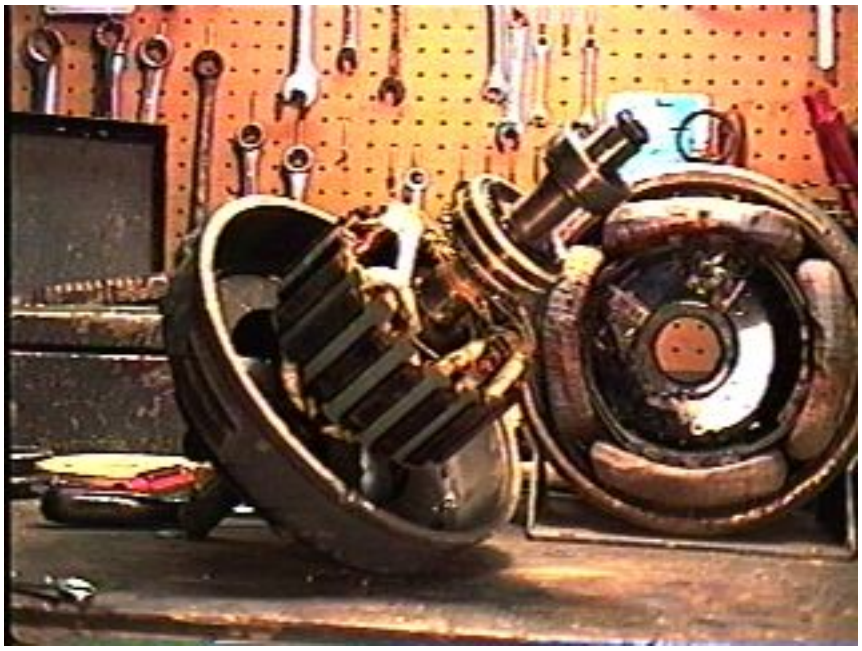
This design is somewhat unique in that the shoes are not only shoes, they have slots within the face of each pole shoe! Take a close look at the pole here:



Notice where the arrows are pointing. This is where the 120 VAC at 400 hertz was taken from. Each of these windings were in series with the other slot windings in each pole shoe. I now use these windings as the power source for the field magnets and as such they run the voltage regulator. As I stated before, slot windings are a very efficient at providing power, while shoes make excellent electromagnets. So here we have a unique example of pole shoes with slot-type power output windings in the faces.

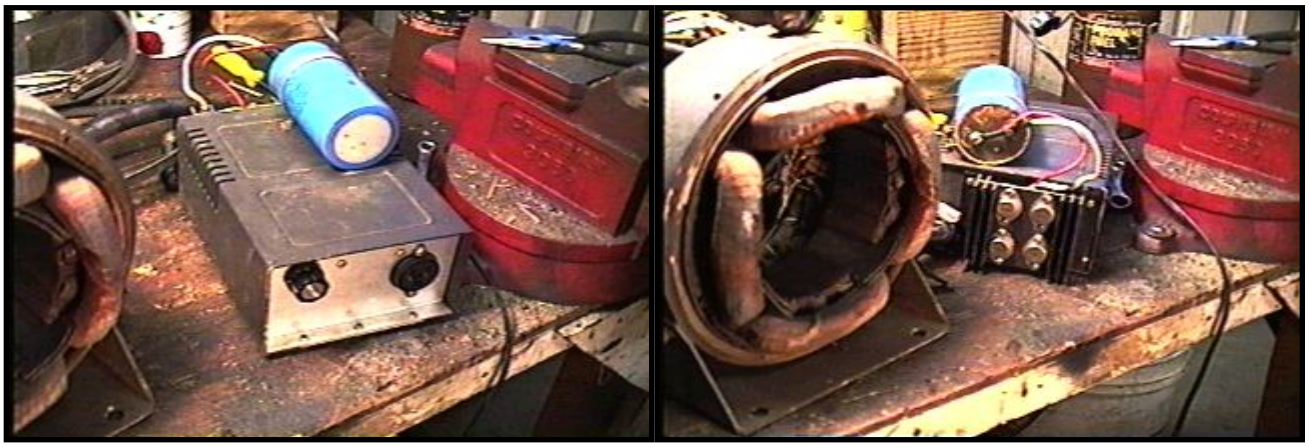
Rotor

Now the rotor needed rewinding. Originally it had a DC commutator and was wound with some pretty hefty wire. I cut that wire out and cleaned the slots. Some AC generators use slip rings to get power from the rotor and that was the plan for this one. To prepare for the slip rings I insulated the commutator with a sheet of flexible fiberglass and epoxied two rings on.



They can be seen in this picture just below the rear sealed bearing. The wiring of the rotor was a little difficult and it took me quite a while to figure out a good method to use. The #18 wire was just too heavy to neatly wind into the slots. Also, the coils had to be all in series and in the proper phase. Phasing means that one coil is wound clockwise while the next coil is wound counterclockwise, giving a N S N S polarity around the face of the rotor, just like the field poles polarity. I finally ended up making a continuous loop of wire about 6 feet long with about 40 some turns. This was accomplished by putting two large nails in an eight foot, two-by-four and winding the wire back and forth between the two nails. After covering the wire bundle with polyurethane floor varnish and some fibertape, I gently placed it into each slot, while the varnish was still a little tacky. Then the next big job was to cut each wire and solder it in series with the next wire in the bundle. This was to produce one series winding out of the whole bundle. (Yes it was series before, but it was not possible to place it in the rotor slots connected that way.) Coating the windings with varnish helped seal the windings and the tying of the coils helped to secure them. After that tracing and soldering "fun" I connected the two ends of the loop to the two slip rings.

It actually worked the first time I fired it up. I had to do a little work on the homemade voltage regulator. It is mounted in a separate box (old 5 1/4 floppy drive box) and is basically the same as the other regulators I've used in my other generators.

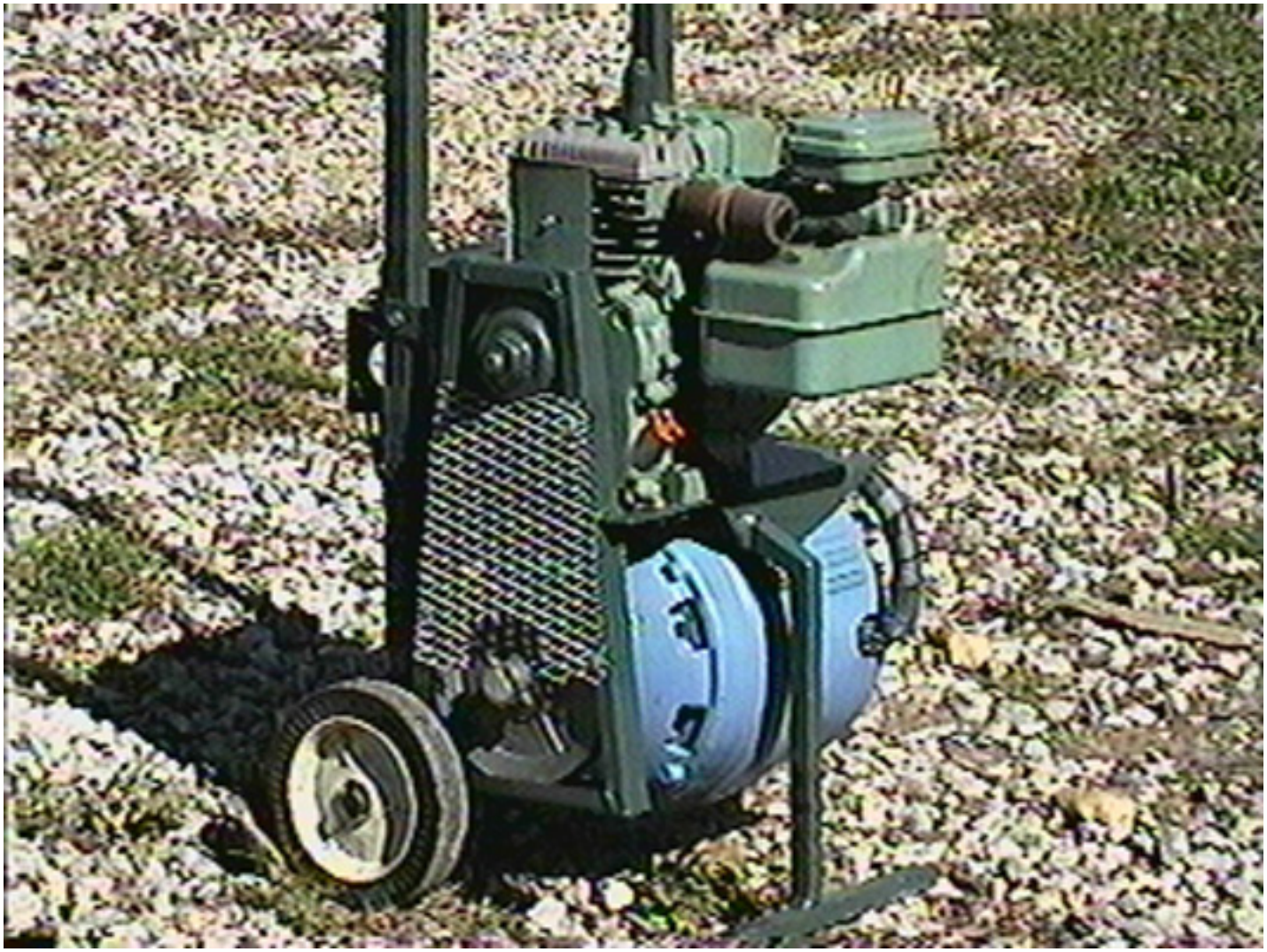


I have 4 pass transistors on the back of it heatsinked. The regulator has to power the 4 poles as electromagnets so it passes a lot of current. I think it is about 6 to 8 amps.

Update!

This generator now has an engine! I finally got around to making a frame and mounting the generator, regulator and engine. The engine is a 3 horsepower Briggs and Stratton that I rebuilt. NJ8V and I knurled the piston as an experiment and it worked out pretty good! Total power output is about 1000 watts maxium. The pulley ratio is such that the engine turns at 3200 RPM and the generator turns at 1800 RPM, producing 120 VAC at 60 hertz.

Here is a general right side view.



In this view, the belt guard is visible, while the generator is below the engine stand.

Here is the left side with the regulator box clearly visible on the

far right.

This has been a fun project, about 2 years in the making! I really like this manner of mounting a generator and engine. The whole system is just like a dolly (or "hand truck" as they are called) and makes it real easy to carry around to where it is needed. The tires are left overs from an old lawn mower.

Ignition static was a problem and I had to shield the spark plug wire with copper braid from some R/G 8 coax. I made a little metal "boot" to go over the spark plug and it really cuts the static. As I've said before, I am a ham radio operator and I like to operate out in the field. This generator is just looking for a radio adventure to the field!

Very 73 de NS8O Updated Oct 12, 1998

E mail me! Greg

Dayton Portable AC Engine-Generator

Model 1W532 1700 Watts 115V 60 Cycles 14 Amps

3600 RPM Generator No. 2M094

with a Briggs and Stratton 3.5hp Model 9 circa 1949

The Dayton (House brand-name for Grainger products) generator was originally connected to a Clinton engine with a common endplate and a common crank/drive shaft. When I got the gen-set (thanks to my brother, Robb!) the engine was completely ruined. The previous owner had left the oil plug off and the sparkplug out. Needless to say, the weather took its toll. I was able to cut out the endplate and save it for the front of

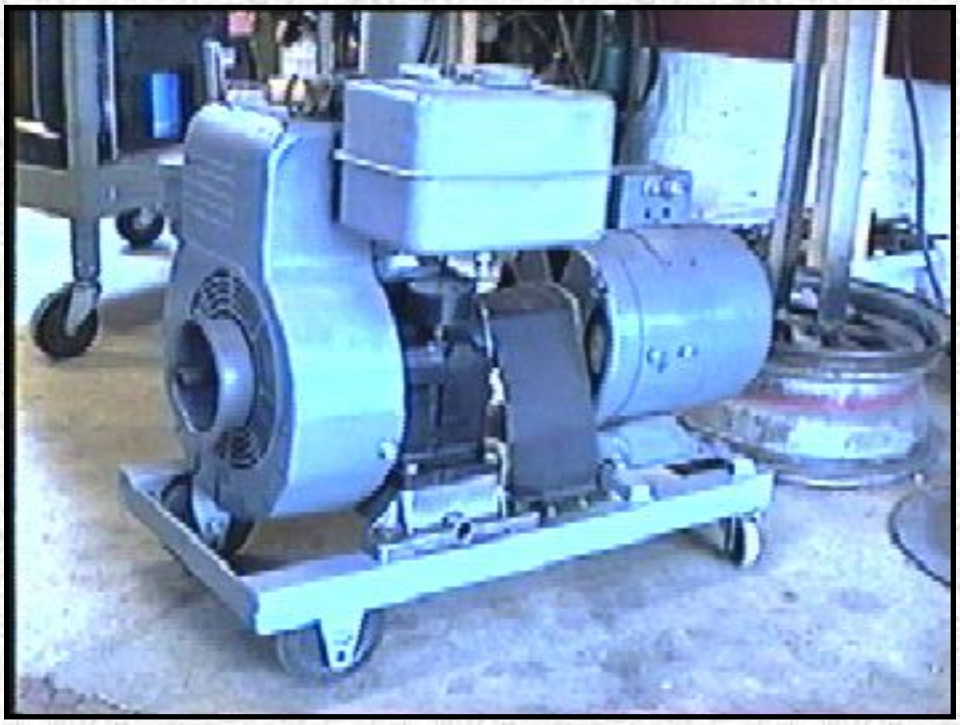
the generator. Dewey was able to lathe out a bearing holder to replace the tapered bearing that was on the original with a sealed bearing. The field coils in the generator needed to be dryed. I fed the coils with a few volts of AC till they were warm and left that overnight to drive out the moisture. I revarnished and taped the damaged part of the coil.

Soon after that I got the Briggs and Stratton model 9 at the same junkyard that the genset came from. It had sat in a lot of water and damaged the shroud, but the internal parts were like new! So, after a lot of work, it runs beautifully!

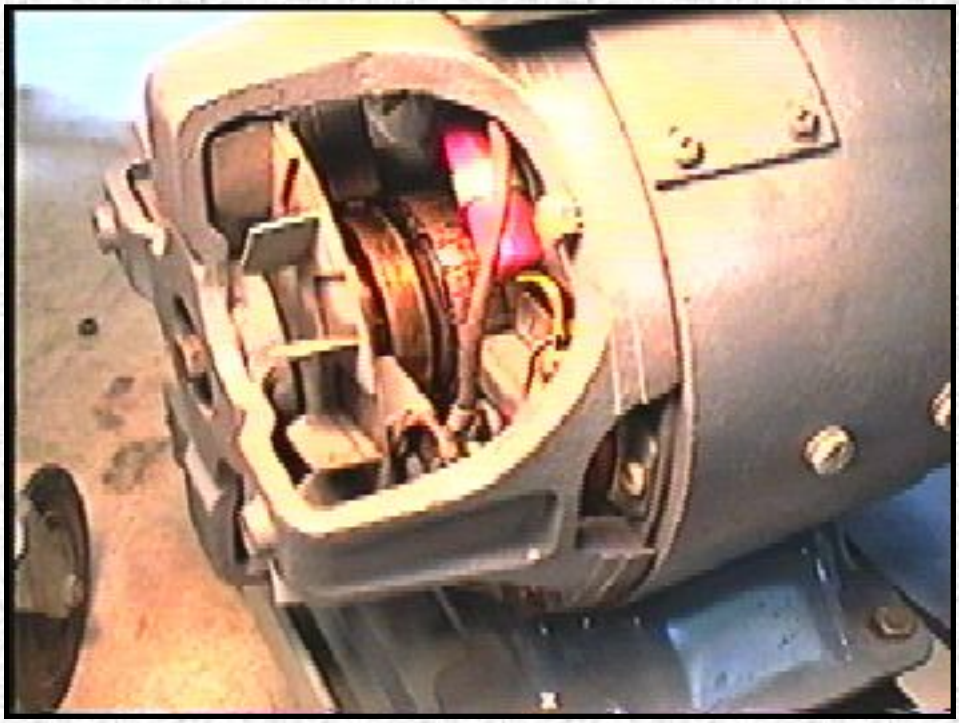
I welded up a frame along with casters to make moving the unit easier. Note the mounting base on the generator. I salvaged this from an old electric motor. It was necessary to weld this to the generator frame, as the original mounting was a single shock absorber type mount that would not work without the rigid connection to the Clinton engine endplate. A Lovejoy coupling connects the generator and the engine.

Sound levels are always a concern with gensets. I found the best muffler to use for small engines is the one that Briggs and Stratton have been putting on newer mowers. It is the large rectangular/rounded object on this side of the engine, above the carb. I brazed up an adapter to mount it on the engine.

Other side view

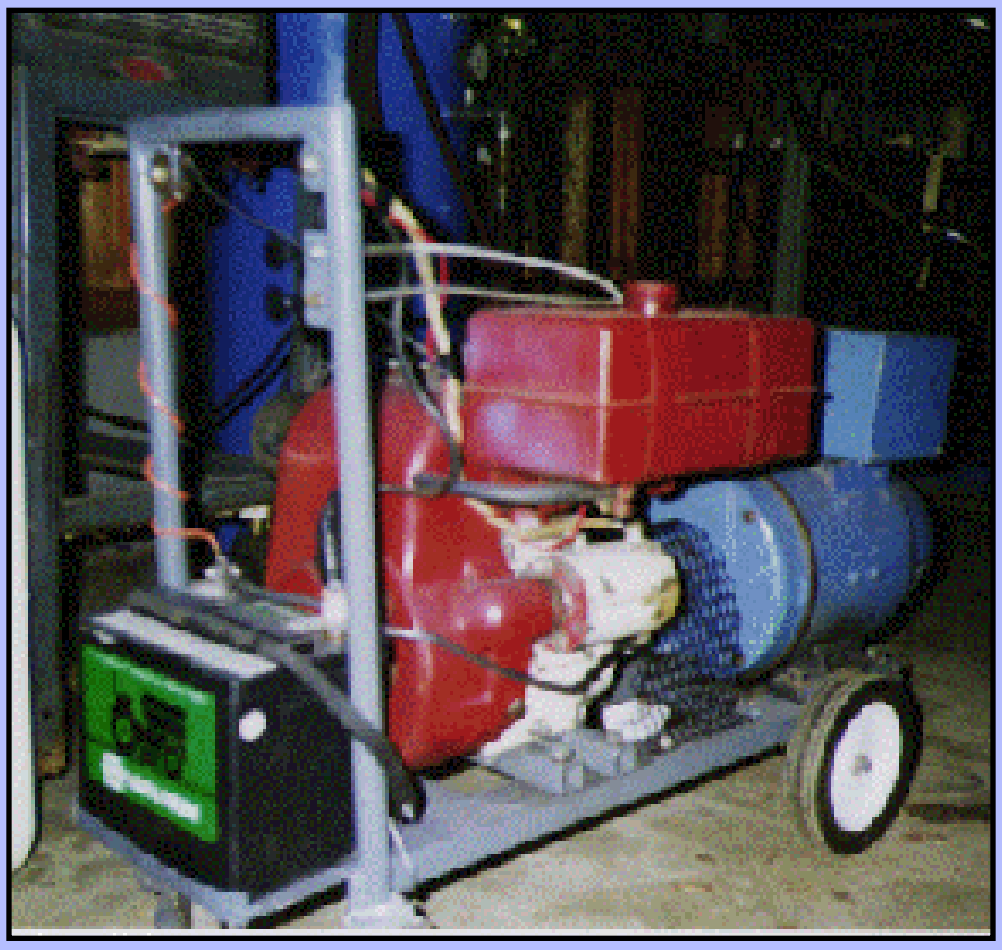


The AC jack on the generator is actually an electrical workbox that I welded to the old mounting plate. The previous box was smashed. There are two big electrical connections on the back of the plate. I thought that they were for battery charging, but upon a closer inspection of the label I found that the connections were for a STARTING battery! Apparently the generator acts as a starting motor when 12 volts is placed across these terminals. Yep, it really works!



Here are the "innards" of the generator. (Rear shroud removed) Note the AC slip rings (only one is visible), the DC commutator, fan and noise supressor capacitor.

5KW Kohler Generator



The generator that is hooked to this Tecumseh 6 horsepower engine was originally mounted on the faceplate of a Kohler engine. The engine was not hooked to it when I found it at a local junkyard. As a matter of a fact, the rotor and back section were in two different spots in the junkyard! The front plate of the generator, see in the above photo, was supplied and mounted by NJ8V. It was a electric motor faceplate. He manufactured an amazing little alignment ring

to center the plate onto the generator housing. The ring is now known as "The Power Ring" and is highly classified in the Jethro Bodine, Double Naught Spy Files. (Remember when Jethro on "The Beverly Hillbillies, wanted to be a 007 type spy? Jethro is my mentor...)

I can only get about 4 kw out of this tired Techumseh engine, it served on my ol' Wheelhorse riding mower for years. It is on its second rebuild...I'm looking for an 8 or 10 hp engine to eventually replace it, although it has been very dependable. The key to getting these old engines running right is to set the points to open at.085 inches of piston travel before top-dead center. That way the magneto fires just before TDC.

This is my biggest generator and will run the air conditioner (9,000btu) , a TV, and most importantly, the coffee pot! NC8V and I used this one field day, and it ran perfectly for the whole 24 hours, using about 5 gallons of gas. The load was only one 150 watt transceiver.

An Easy to Build and Operate Induction Generator

Believe it or not, nearly everyone you know has at least one induction generator and probably more. That's right! You say that is impossible... well, read on!

Within every home in America there are motors that can be operated as generators. They may not be labeled as generators, but they will function just the same. These motors are often called "squirrel cage motors" and are in washing machines, dryers, water pumps and other devices too numerous to mention.

Typical electric squirrel cage motors

Besides being numerous and cheap, they will generate AC voltage of the purest sinewave. They use no brushes and do not produce any RFI.(Radio Frequency Interference) A motor converted to an induction generator will power flouresent and incandesant lights, televisions, vcr's, stereo sets, electric drills, small power saws and other items.

OK, what is so great about it? There is nothing complicated about the conversion, no weird rewiring, no complicated math...nothing! There are no brushes to wear out.

They can not be overloaded; if too much of a load is applied to the generator, it simply quits generating. Removing the load will usually cause the generator to start again. Speeding up the motor will help if it doesn't start right away.

Yes, but... are there problems? Well, there is no active voltage regulation, but keeping it within a tested load rating can keep it within any voltage parameters that you set. I feel that a voltage range between 105 and 126 volts is perfectly reasonable.

A motor converted to an induction generator will not start another squirrel cage motor unless that motor is about 1/10 of the horsepower of the induction generator. In other words, a 1 horsepower motor used as an induction generator will start a 1/10 horsepower or less, squirrel cage motor. **It is best to NOT use an induction generator to drive motors. The added inductance of the motor will cancel out the capacitive reactance of the capacitors and cause the generator to quit producing electricity.**

The generator will not start under a load. Not a problem! You shouldn't attach any load to a generator until it is at running speed. This is actually kind of a fail-safe

feature.

So far, that is about all of the problems that I've found and I consider those minor.

How do you convert one?

By adding capacitors in parallel with the motor power leads, and driving it a little above the nameplate RPM, (1725 RPM ones need to turn at approximately 1875 RPM, and 3450 RPM ones at 3700 RPM) the motor will generate AC voltage! The capacitance helps to induce currents into the rotor conductors and causes it to produce AC current. The power is taken off of the motor power leads, or the capacitor leads, since they are all in parallel.

This system depends upon residual magnetism in the rotor to start generating. Almost all the motors I've tried begin generating just fine on their own, with the appropriate capacitor connected of course! If it doesn't start generating, try speeding the motor up. That will usually get it going. However, it is extremely rare to find one that doesn't start.

If a motor doesn't start generating on the **very first try**, then apply 120 vac or even 12 or more volts DC to the motor for a few seconds. That will usually work to magnetize the rotor and your generator will **start by itself from then on.**

It is important to not shut the generator down with a load connected to it. This tends to demagnetize the rotor and can cause it to not self-energize. That is, the motor will turn, but it will not produce voltage. It is not a serious problem since the rotor can be remagnetized by following the instructions in the paragraph above.

I've only found one motor that would not consistantly generate (out of a dozen or

so that I've tried over the years) and it was one with a bunch of wiring coming out of it; it may have been a multi-speed AC motor. I had a 120 volt AC relay in the circuit that temporarily added a 200 uf **starting** capacitor across the permanent 160 uf running capacitor (Using the Normally Closed contacts) to get it generating. When 120 volts was produced, the relay contacts opened up and removed the 200 uf from the circuit. That worked, but it was not dependable. I just gave up on that one.

The capacitors used must be the type designated as "running" capacitors and NOT "starting" capacitors. Starting capacitors are used for a very short time, usually less than a second or two, and would be destroyed by being connected across the AC line continously. Running capacitors are designed to be connected while the motor is powered.

NOTE: Make sure the caps say, "NO PCB's". PCB's aren't used anymore for capacitor construction because it was a dangerous chemical composition. If the caps are old, and you are not sure, don't use them. Be safe!

It is necessary to experiment to find the best value of capacitance to get one working. Start with about 150 to 200 uf for motors 1 horsepower and under. More capacitance equals more voltage output. The final value should be able to produce about 125 VAC when it is putting out 60 hertz with no load. Then plug in100 watt light bulbs until the voltage drops to what ever lower limit you set. Mine will do about 1050 watts before dropping to 105 VAC.


Typical Running Capacitors...GOOD! .....Starting cap...Bad!

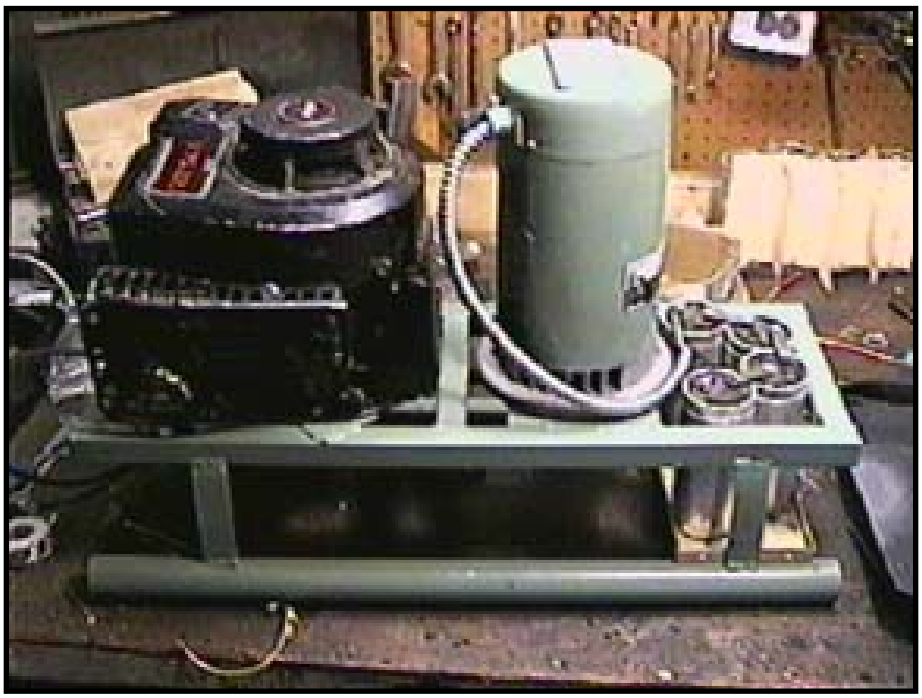
In the following example, I used a 1 horsepower motor from a Sears water pump that I bought at a junk yard for $10.00. This motor was capable of operating off of 115 or 230 volts at 13 or 7 amperes respectively.

Typical waterpump motor

Motor: A. O. Smith 1 Horsepower : 115 / 230 VAC : 13 / 7 AMPS : 3450 RPM

Capacitor: 200uf 330vac. This was made by paralleling 4 capacitors that were 65uf, 35uf, 50uf and 50uf. All of these were rated at 330vac or better. All test results are from this capacitor set. (**NOTE**: The final version of this generator has 225uf of capacitance.)

Output Capability: This Induction generator has an no load voltage of 125.9 VAC at 60 hz. The generator successfully powered 1050 watts of lightbulbs with a voltage drop of 10.9 VAC to a full load voltage of 105 vac. During the power test, the generator was driven by a 1.5 horsepower electric motor and there was a loss of RPM when the load was increased. I attribute some of the voltage drop to this lack of driving power.



The ex-motor, now an induction generator is driven by a well used 3.75 HP B&S lawnmower engine. A total of 950 watts of lights were ran for about 15 minutes

with the generator only getting warm. The voltage went from 126 volts open to 110 volts AC under this load.

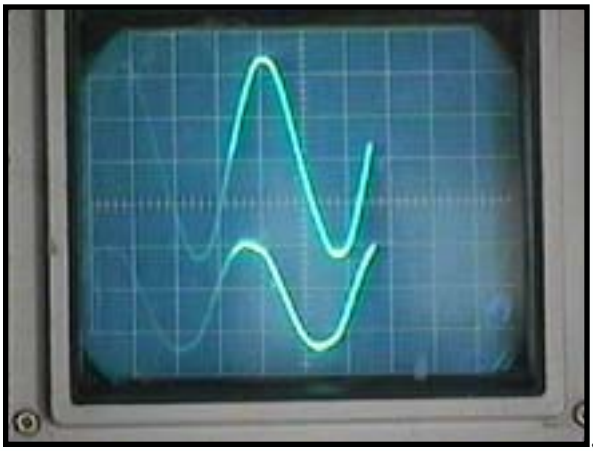
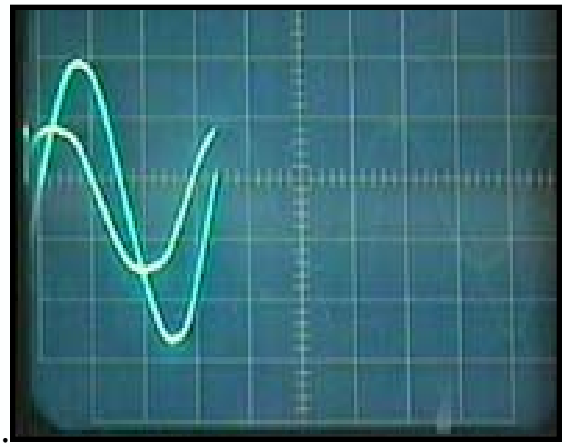
Notice the capacitor set-up. Here I am trying a suggestion found in an old article, which stated that it is possible to use DC electrolytics connected in series, + to +, and - to - in an AC circuit. I have 4 capacitors rated at 850 uf, 400 VDC in series, for a total of 225 uf @ 1600vdc . The connection is like this:

AC Lead to motor 0----+||------+||------||+------||+----0 AC Lead to motor

Click here for schematic.

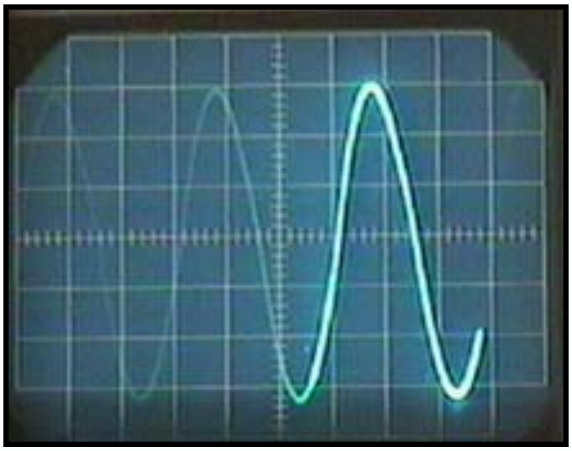
Will it work? They seem to be doing just fine, with no sign of heating at all. If they fail or deteriorate, I'll post the info here on the web page.

New!New! I used this generator for 12 hours continously in the NC8V field day in very hot temperatures and adverse conditions on the weekend of June 26, 1999. The capacitors did ***NOT FAIL OR CHANGE*** in the least. So I can recommend this use of DC capacitors as a viable option. Of course standard disclaimers apply!

Top Trace: 60 hertz / Bottom Trace: Capacitor phase shift. Overlaid waveforms.

These traces show the phase shift within the capacitor/inductance combination. The inductance is from the motor windings. Traces were made by feeding a 10 v p-p 60 hertz voltage through a 47 ohm resistance to the capacitor/inductance combination. The top trace in the left picture is the input voltage to the resistor while the bottom trace is across the capacitor/inductance.



Waveform at 950 watt load.

Note the enlarged gasoline tank. I made this modification in mid June of 1999. This generator was used at the NC8V field day event and performed perfectly where it ran approximately 12 hours. This one gallon tank allows the generator to run for 4 and 1/2 hours without refueling.

Notes on gasoline engines:

Make sure you get a reliable gasoline engine. Nothing is more frustrating that to have to fight with the engine while you need electricity!

Nearly all the B&S engines that are used on lawn mowers with a direct connected mower blade depend upon this blade to act like a second flywheel for the engine.

They have a primary aluminum flywheel inside the engine cover. The aluminum flywheel does not provide enough inertia to work without the blade. The symptoms are backfiring, jerking starter rope and difficulty in starting. You will probably have to change the aluminum flywheel to a cast iron one. The cast iron ones are pretty common in horizontal engines that are used in rototillers, etc. Usually junk yards or small engine shops will have them. (Also, make sure the magnet matches the one on the original flywheel; they have either one or two magnetic poles which are very obvious by sight.) However, if the generator rotor has enough mass, it may have enough inertia to keep the engine running fine with an aluminum flywheel. Just experiment.

Go with solid state ignition if possible. Ignition points were fine in their day, but the solid state magneto's are great!

Make sure the speed governer works and that the engine is cleaned and serviced reguarly.

The small gas tank on these B&S will give you at least an hour of power. If you need longer running time, then find an engine with a larger gas tank. A gallon tank will give you lots of time with a small engine, probably over 4 hours or so before refueling. Check oil levels at each gas refill, etc.

If you experience static on radios or TV's that you are powering by your generator: Sometimes ignition static can be a problem. Rubber boots should be placed over the sparkplug wire so that there is no wiring uninsulated, and then simply cover the sparkplug wire with braided wire and ground it near the magneto coil. Also clamp it around the sparkplug metal base. That will cure it.

Static can be caused by the generator rotor bearings. (I have yet to have that problem!) But, just in case you do: Simply mount a little contact brush against the shaft of the generator rotor and that will successfully ground it and eliminate the static.

Once again I've got to thank Dewey King, NJ8V, for his never ending patience and help with the mechanical hurdles! His expertise in machining leaves me bewildered.

All disclaimers apply. I can in no way guarantee that you'll have the same success, but they do work. Be careful too! There is a lot of good ol' AC here and it can be dangerous. I'm not responsible for anything you do!

Misc.

A. This motor exhibits an internal resistance of about 1.5 ohms of AC resistance and .5 ohms of DC resistance.

B. The capacitor current is approximately 11 amps. Remember, this current exists whether there is a load or not. However it is not 100% "real power", but it is capacitive, with the current out of phase with the voltage. The current, I, leads the voltage, E, in this case. The reason this current exists is to keep the generator "excited" by inducing current into the squirrel cage rotor conductors. Calculations seem to put the exciting power at around 55 watts.

C. The reactance (Xc) of the capacitor (200 uf) at 60 hertz is 13.3 ohms.

D. The reactance (Xl) of the motor is (3.8 mh) at 60 hertz is 1.4 ohms

E. The capacitance and the inductance, being in parallel, does exhibit a resonance. This frequency is 183 hertz.

F. The engine needs to turn this generator at about 3700 rpm to give 60 hertz output. **(If your motor is a 1725 RPM one, then you'll need it to turn at about 1875 RPM)**

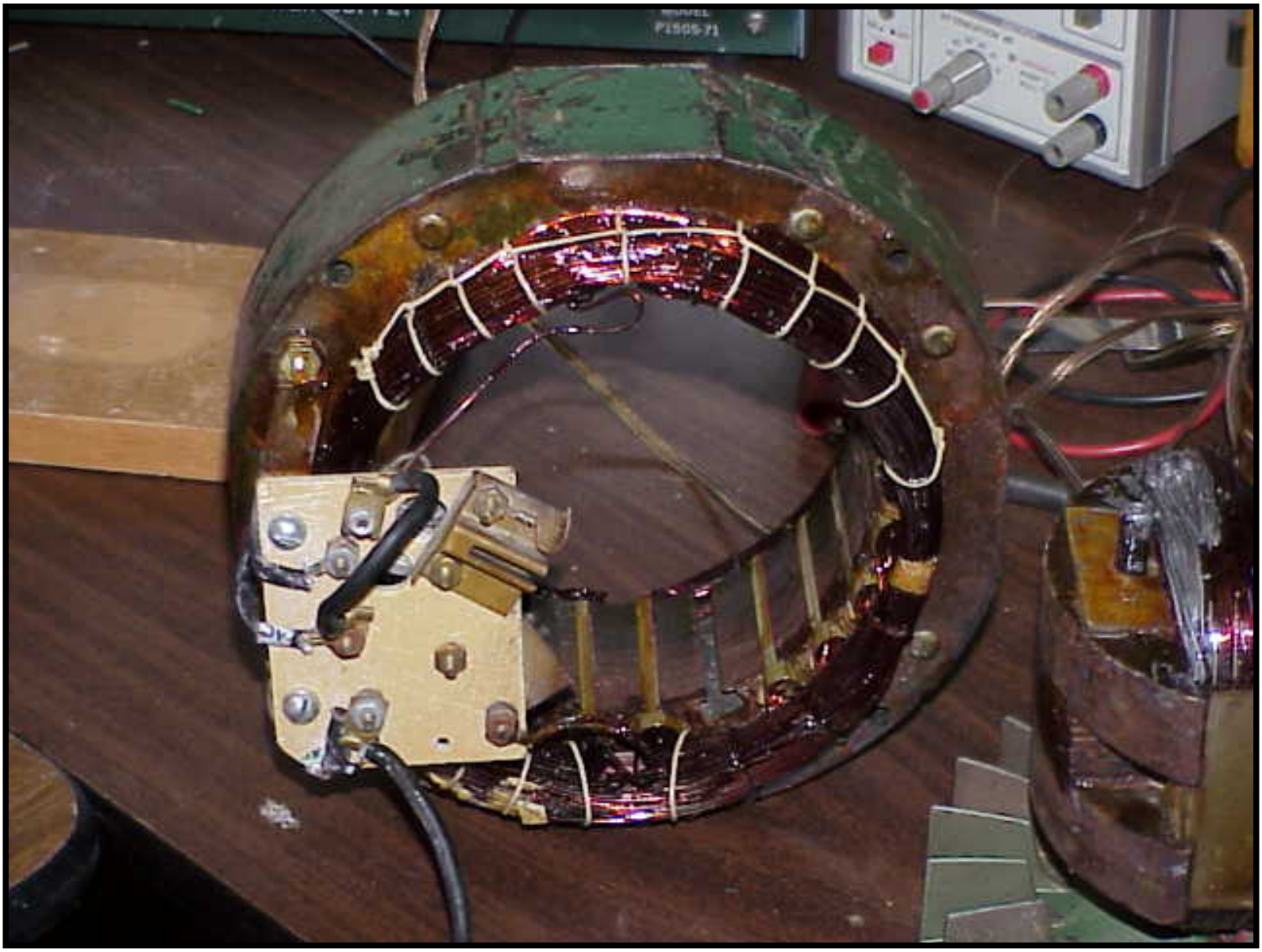
G. I don't have a clear understanding of exactly why this works... but it does!

Return to home

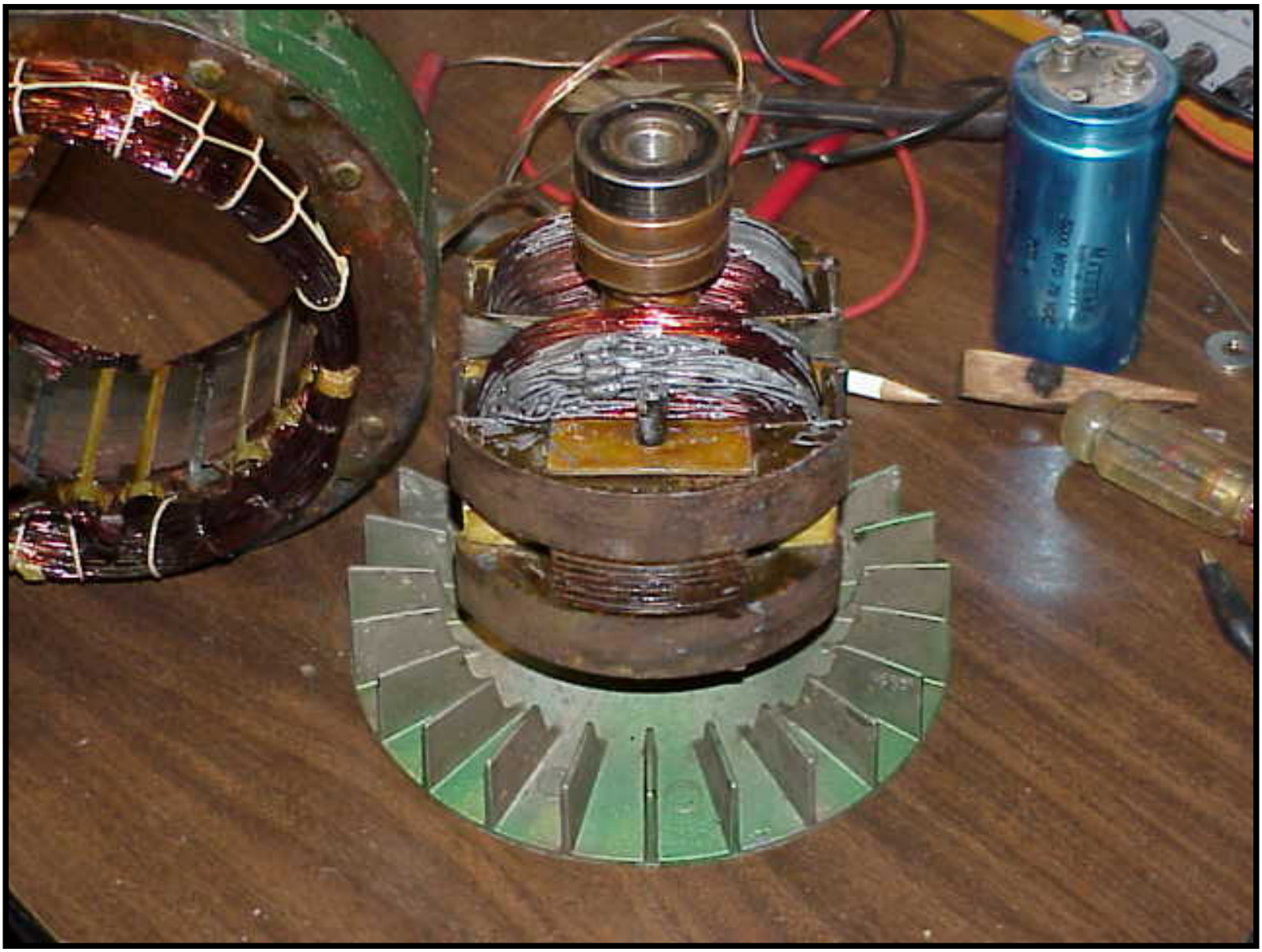
Modified Dec 8, 1998

Dayton 1.5kw Generator Project

Tecumseh engine that has a fairly obvious problem with the case... and generator endplates



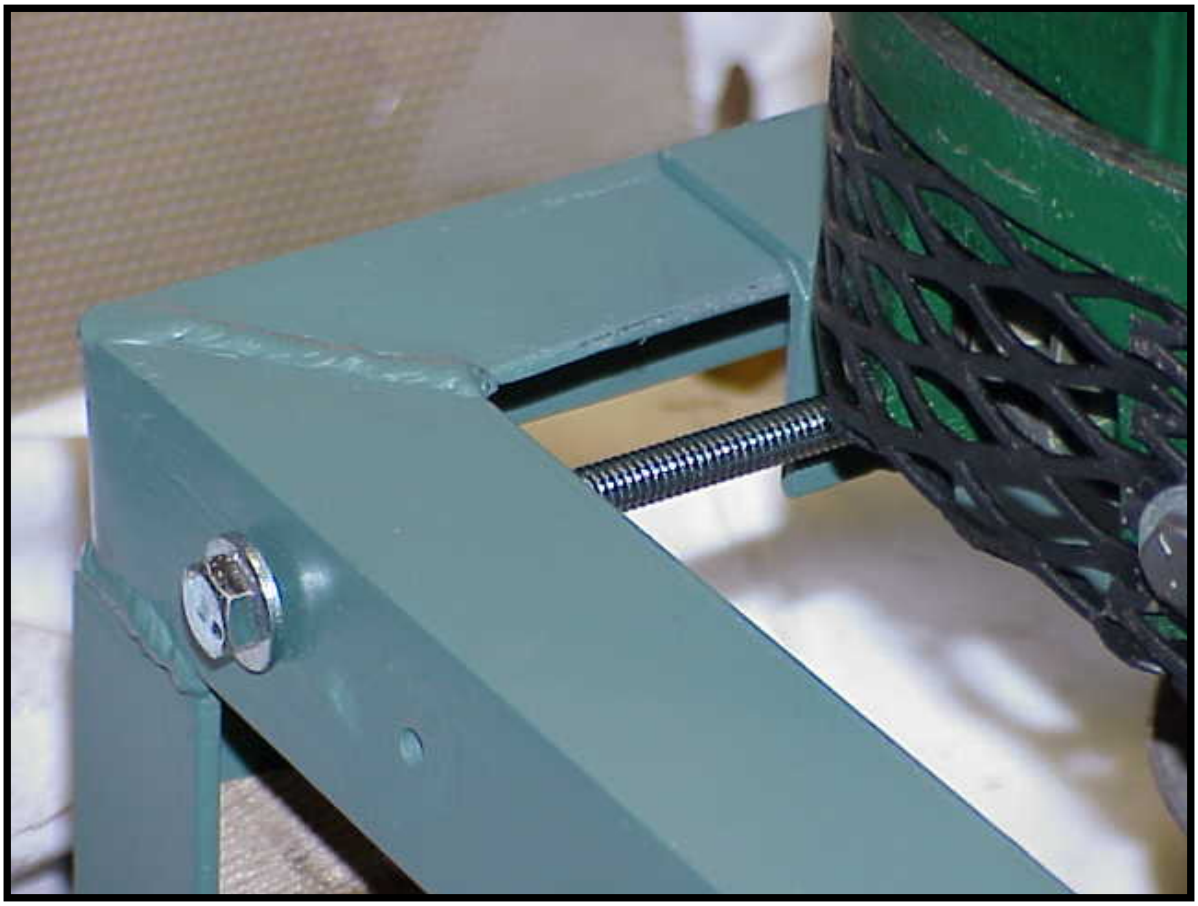
View after repair of windings



Note outboard bearing housing on front in this picture.

Generator on its new mounting frame with a B&S 5 horsepower Quantum engine.

View showing generator slider for belt adjust.



Bolt used to adjust tension on the drive belt by pulling generator slide away from the engine.

Finished product. Note that I finally found a use for that empty freon tank! It was a tank that held 30 lbs of R-134A. Now it holds about 3.6 gallons of gasoline, giving me at least 12 hours of run time.

Once again, a hardy thanks to NJ8V for helping machine a pulley assembly and the drive shaft of the generator for the cause!

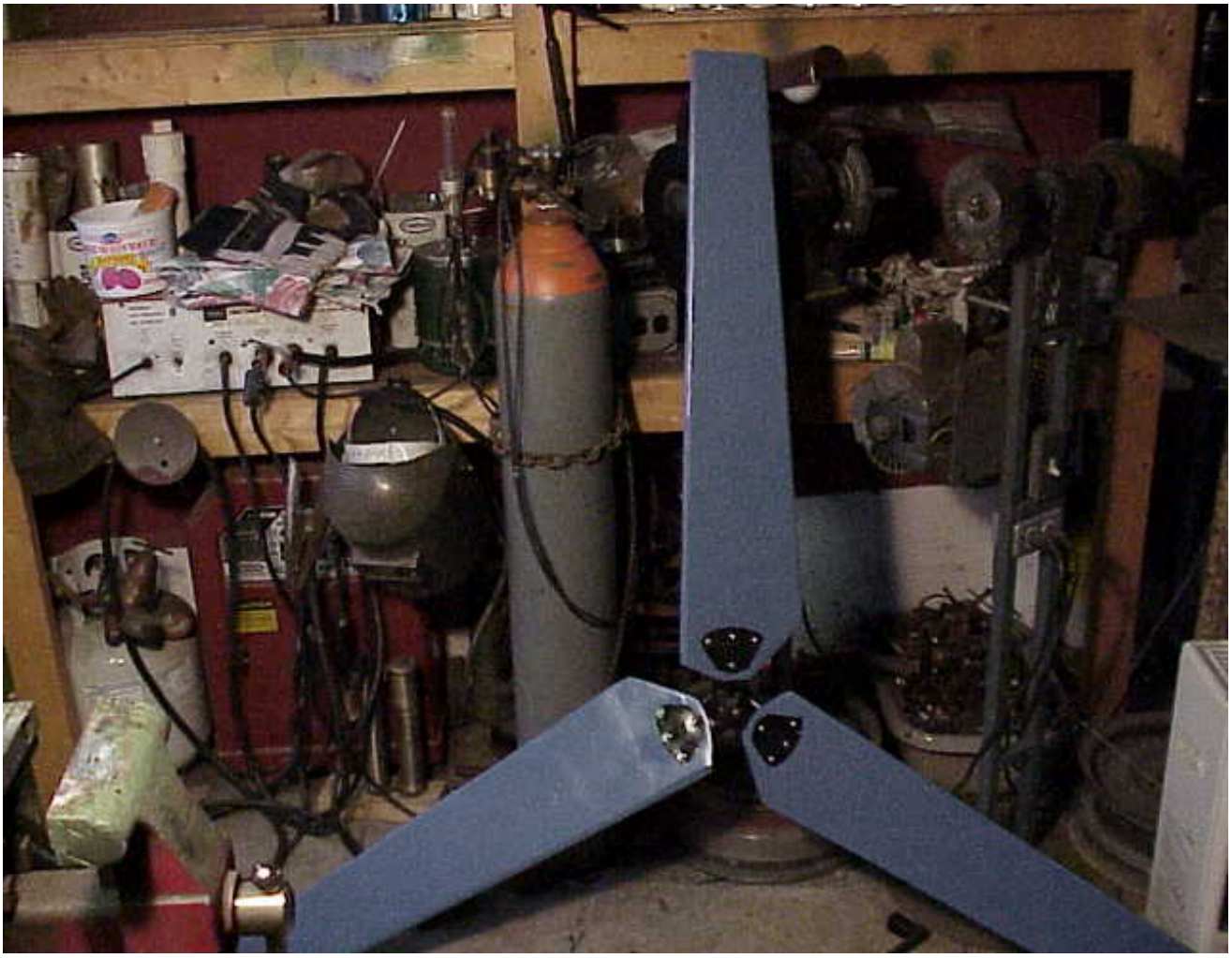
Generator fever; it is a terrible thing.

Oct 12, 1999

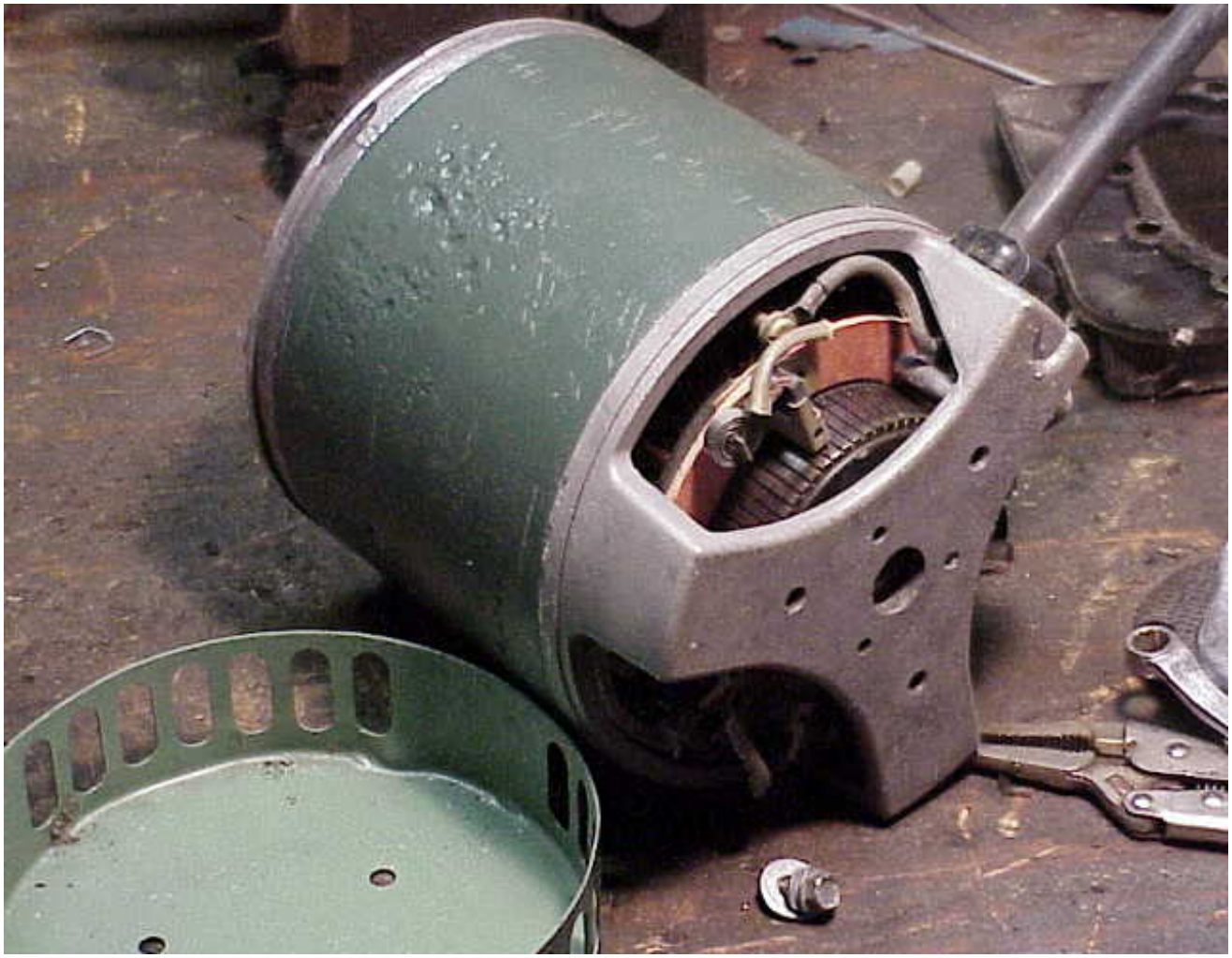
Renewable Energy Experiments

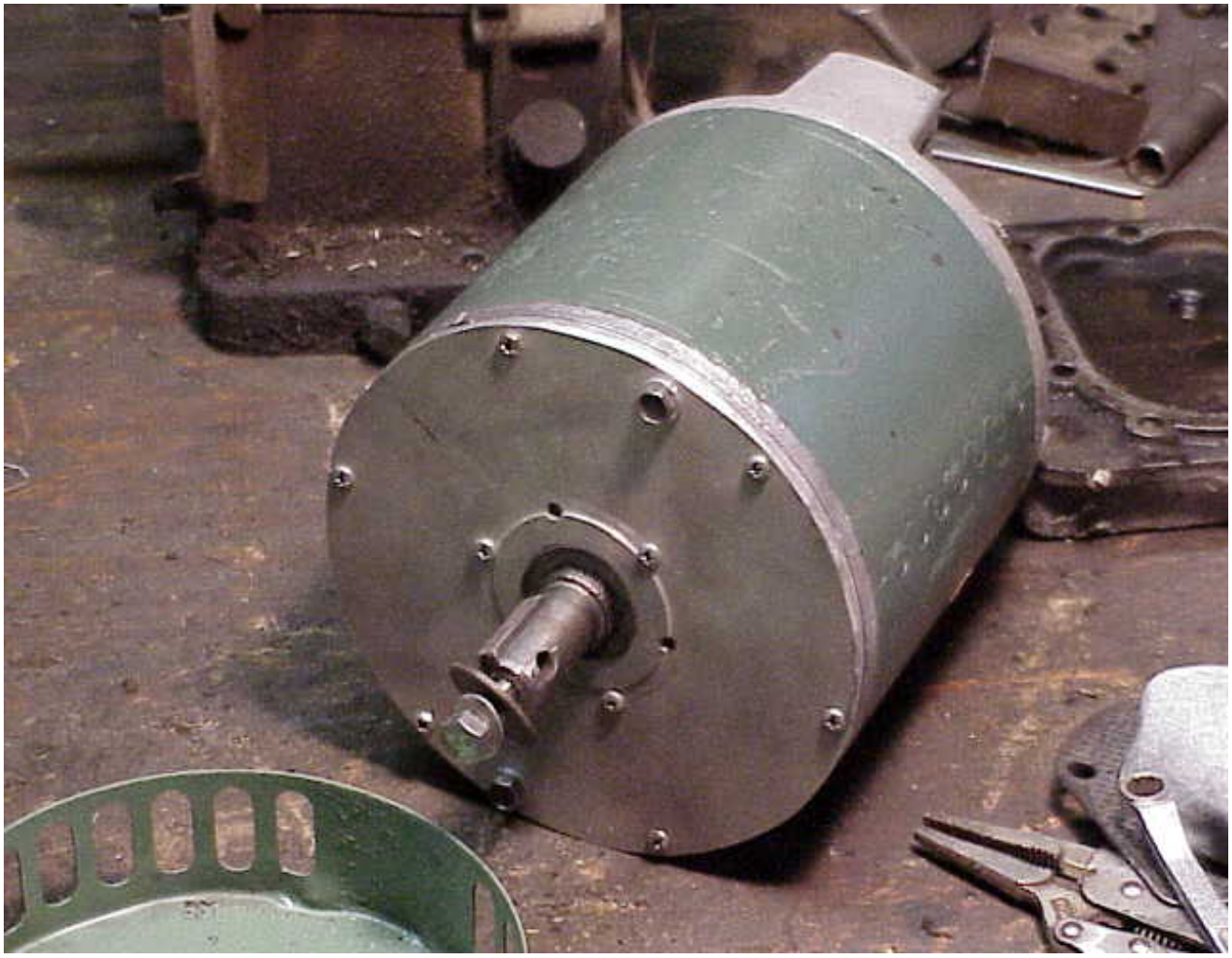
I've always had interests in the area of renewable energy. Alas, I live in a very low wind area so my wind generators have never produced a lot of energy. There are no streams on my property with which to experiment on microhydropower. But nevertheless, I enjoy experimenting with the machinery.

Here is a three blade rotor that I have made. It is 6 feet in diameter and made of pine. It is intended for slow speed operation, 250 rpm or less. I had it connected to an 85 watt DC permanent magnet alternator through a chain drive set up. The rotor was too big for the little alternator and it would overpower it!



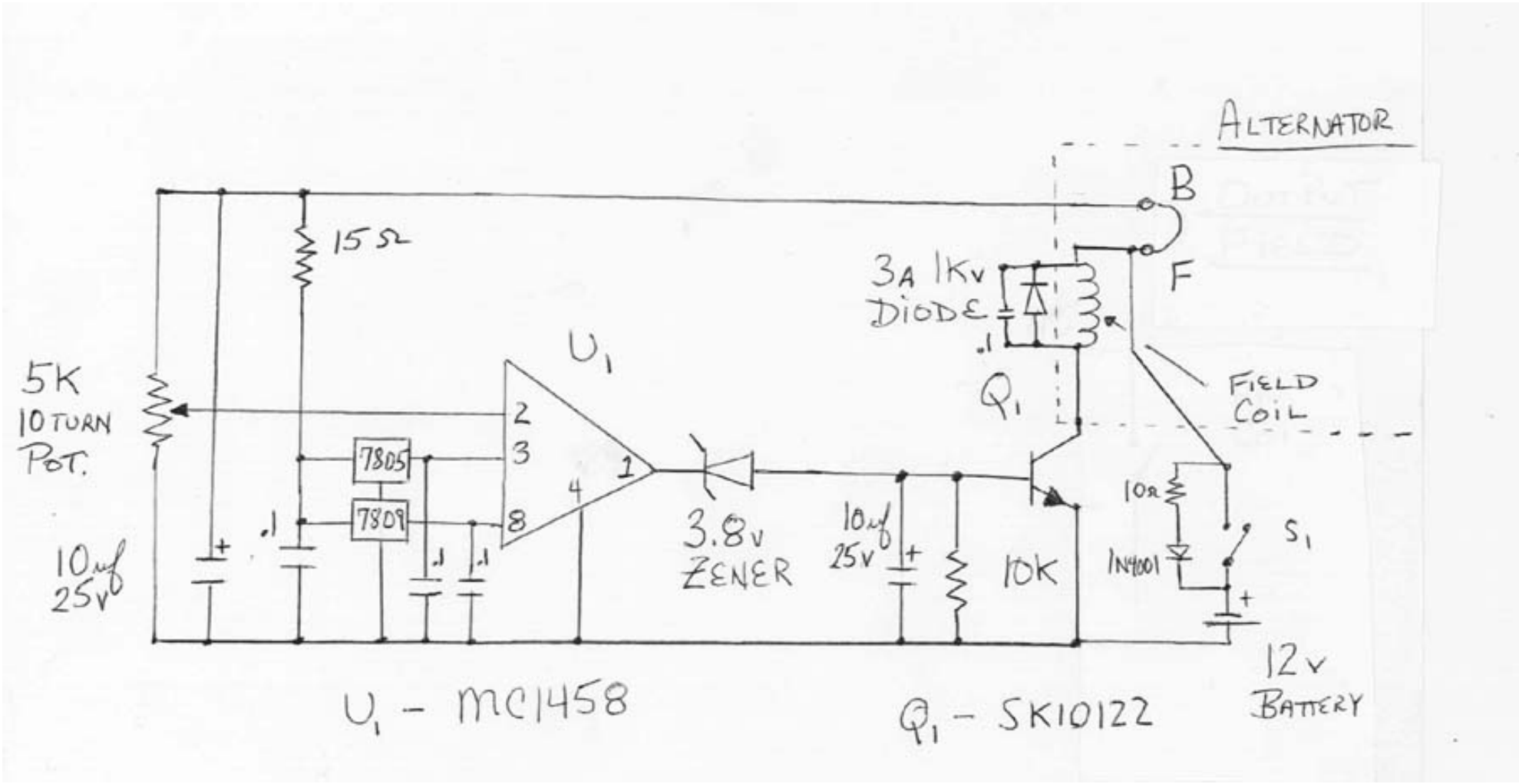
Pictured below is a DC permanent magnet generator that I have rebuilt. I got two of them from a junk yard and was able to make one good one. The above blade is made to fit directly onto the shaft of this motor. Notice the rust pits in the case, they were in pretty bad condition. It will produce about 5 volts DC at 60 rpm. To produce 14 VDC, such as used in charging batteries, it takes about 162 RPM. The internal resistance is measured at 3.9 Ohms.

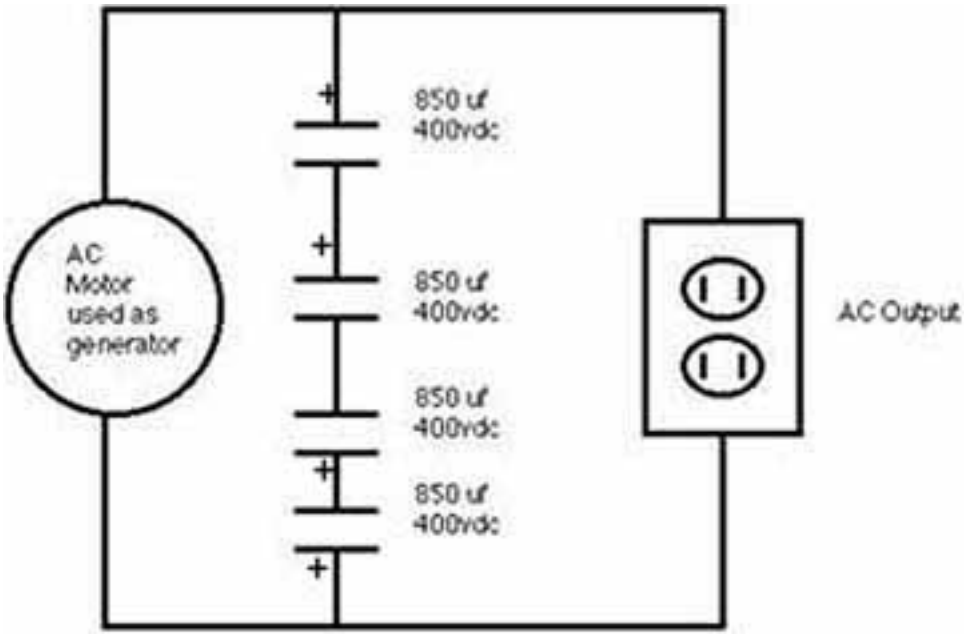




Notice the front plate that I had to manufacture. The large piece of aluminum is about 3/16 inch thick an about 7 inches in diameter. The black circle that is around the shaft is a rubber seal to keep water out of the bearing. The next circle in the plate, with the three screw heads visible, is the bearing holder. The motor is from Imperial Electric and seems to have been used on cleaning equipment. It is rated at 120 vdc 30 amps, when used as a motor. I'm not sure but I think it is a 1 horsepower motor.

Back to the generator page!


ALTERNATOR
B
F
15Ω
3A 1KV DIODE
.1
Q1
FIELD COIL
5K 10 TURN POT.
U1
7805
7809
.1
.1
.1
2
3
4
8
1
10µf 25V
3.8V ZENER
10µf 25V
10K
10Ω
IN4001
S1
12V BATTERY
U1 - MC1458
Q1 - SK10122


AC
Motor
used as
generator
+
850 uf
400vdc
+
850 uf
400vdc
850 uf
400vdc
+
850 uf
400vdc
+
AC Output

Field Day 1999

at the NC8V Caboose

Here is the faithful caboose, looking a heck of a lot like it did last year. The big difference was in the inside. Jan, NC8V's XYL, had finished painting in there just that week. She also fed the crew and went above and beyond the call of duty to help out the cause. A big **"THANK YOU"** to you Jan!!!!

The three element beams' reflector has a noticable "list" due to a little bit of rough erecting. However, that didn't seem to bother its operation. We amassed

1125 QSO's in 24 hours of operation covering 80 through 10 meters in both CW and SSB modes. Operators were: NC8V, W8MHV, N8XWO, AA8EB, WD8RIF, WD8JLM and me, NS8O.

Special note and a virtual "Gold Star" goes to John, N8XWO, who tended the generators during the night, without fail! John also provided the big deep cycle battery that ran the equipment. He had it charged via a solar panel before we started which gave us the 100 points for the natural power source. Thanks John!

Inside of the caboose, showing NC8V on the left operating, with N8XWO logging.

My favorite view of the site! Note my two homemade generators under the tarp shield. The Navy surplus one with the two handles is on the left and the Induction Generator on the right. The lamp stand was there to provide light at night. During the day, it provided an indication that the generator is still running by seeing if the light is on. The generators charge a big 12 volt battery powering the radio equipment. This way if the generator runs out of gas, the radio still will operate. We used about 5 gallons of gasoline for the entire 24 hours of generator operating time.

(Photos courtesy of W8MHV)

Thanks to all for the great time!