



# The NEMES Gazette

NEW ENGLAND MODEL ENGINEERING SOCIETY INC.

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## Editor's Desk

Victor Kozakevich

The high school robotic competition known as FIRST was recently held in Boston, bringing a West Coast celebrity to town. A few years ago, Dean Kamen asked Apple computer co-founder Steve Wozniak to be a judge. Most people know who Steve Jobs is, because of his incessant promotion. But "Woz" as he's often called, preferred the hands-on side of the company. Curious and inventive since childhood, he's still very much in touch with the kid inside him, dabbling in things from rock music to high tech ventures. So needless to say he's very much a hero to the kids involved in robotics. For example, he hacked the software in his Segway scooter so it could go 60 miles per hour (Kids, don't try this at home!).

I would imagine all those involved in FIRST are glad to see such a celebrity bring a little color to the games. Perhaps he can be a symbol of the qualities that Americans once had more of, but have been slipping away in recent years. I'm thinking of a sense of wonder about some of the marvelous ideas and technologies that surround us. Not the sense of "I wonder how much it costs to buy that?", but rather: "I wonder how that works, and can I make it better?"

## Next Meeting

Thursday, April 6, 2006

7:00 PM. Meetings held at:  
 Charles River Museum of Industry  
 154 Moody Street  
 Waltham, Massachusetts

## Membership Info

Annual dues of \$25 (via checks made payable to "NEMES" and mailed to our membership secretary) for the calendar year are due by December 31<sup>st</sup> of the prior year.

Missing a Gazette? Send mail or email to our publisher.

Addresses are in the left column.

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## ***President's Corner***

Norm Jones

### **The Meeting**

Featured speakers for the April meeting will be Alan Earls and Robert Edwards, who will present the history of Raytheon Company, which has for many years been a driving force in the technology and economy of this area. Their talk is based on photographs and stories from "Raytheon Company: The First Sixty Years", co-authored by Earls and Edwards, and published in 2005. The book reveals the struggles that were overcome to start the company in 1922, to maintain it through the depression and post- World War II era, and ultimately to expand it into a world-class industrial giant with over 80,000 employees. The amazing number of ways in which Raytheon has benefited society, including early radio and television contributions, word processors, marine and weather radars, air traffic control systems, life saving medical electronics, invention of the microwave oven, guidance computers for the Apollo moon landings, etc, will be illustrated.

Alan Earls is a professional technical journalist with over 20 years experience in covering business and technical subjects, and has authored books on Polaroid, Digital Equipment, Route 128, and the U.S. Army's Natick Lab. Robert Edwards is a 43 year veteran Raytheon engineer and Engineering Manager, who has worked in the field of microwave tubes for radar, microwave ovens, and missile systems, and foreign technology. Much of the material presented is from the extensive Raytheon Company Archives in Waltham, where Edwards is a volunteer.

### **Perseverance Finally Pays Off !**

Some of you may recall seeing my latest model engine project, a small sterling cycle engine (photo in The NEMES Gazette February 2006) at our model engineering show on February 18, 2006. This is one of those engines that will run

just fine at home but not at a show! It did eventually run at our show with a little coaxing from Les Russell and myself.

Over the course of the last month I remade various parts a number of times! I wish I knew exactly which fix eventually made it run more reliably, but I don't. Lapping the cylinder definitely helped. I should have made a real lap in the first place. By the way, you can borrow my lap if you would like to build one of these engines. I changed the piston from graphite to aluminum in the hope of getting a better fit, but at the expense of now having to provide lubrication. Rudy Kouhopt recommends charcoal lighter fluid because of its low viscosity. The bushing on the displacer piston rod is also new. I tried graphite but did not get a good seal on the outside. The latest one is made from brass. I ended up using a piece of drill rod (same size as the piston rod) as a broach to get a good fit. I couldn't locate the envelope of needle laps that I bought from J & L Industrial Supply a number of years ago. I hope to get some info on how to make one from one of you at the next meeting. I also made a new set of cooling fins of larger diameter and wider spacing. The flame height is now ¼" high. The fins are warm to the touch after a few minutes of operation but that doesn't seem to matter. I also made the clearance, with the power piston bottomed out, 0.005" down from 0.019". This engine will not tolerate any binding at all!

The engine ran last night (March 22) for about 10 minutes at approx. 1600 RPM on one eyedropper of alcohol. Will it continue to do so? I'll let you know. In the meantime, I plan to bring the engine to the April meeting along with some copies of the plans to give away to anyone choosing to make their own!

See you on April 6

*Norm*



## ***The Meeting***

Max ben-Aaron

### **March meeting**

Over the past years we have been very fortunate with respect to the weather. The weather forecast for this meeting night was dismal - a snowstorm with high winds and blowing snow. Our speaker was concerned about the weather and wisely decided to opt out and reschedule the talk rather than risk coming down from the north shore in very hazardous conditions. In actuality, though, the conditions were not as bad as the forecast promised.

Venerable President Norm Jones, Max ben-Aaron and Larry Keegan did their best to keep the (relatively) small audience amused.

Norm brought in some measuring instruments and talked about their use, because, although we have members who are excellent machinists, we also have members who are beginners and appreciate some tuition in the basics of machine shop operations.

Max ben-Aaron described the joy of machining parts to replace defunct plumbing parts that are no longer available.

Larry Keegan raised some questions about physics and engineering that he would like to have answered.

Although this wasn't the best of all possible outcomes, we did have a meeting. Thanks to all the loyal members who always show up, no matter what . . .

*Max*



## ***Treasurer's Report***

Richard Koolish

Balance as of February 17, 2006	8189.76
Gazette printing	-142.92
12 memberships @ \$25.00	+300.00
Sale of shirts and aprons at show	+178.00
Income from food at show	+440.11
Balance as of March 17, 2006	8964.95

### Model Engineering Show Report

Table rental	-284.13
Cost of food	-160.00
Donations for food	+600.11
Sale of shirts and aprons	+178.00

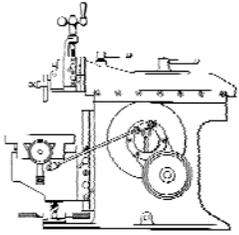
Net income to club	334.98
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## ***NEMES Gazette Editorial Schedule 2006***

Here are the closing dates for Gazette written contributions in the coming months:

<u>Issue</u>	<u>closing date for contributions</u>
May	4/21/2006
June	5/19/2006
July	6/23/2006
August	7/21/2006
September	8/25/2006



## ***Shaper Column***

Kay Fisher

### **Adding Limit Switches**

This month's contribution comes from fellow NEMES member and friend Bob Neidorff. I asked Bob if he would create a safe schematic for adding limit switches to a shaper. Coincidentally, I was as a very good stage in rebuilding my Logan shaper to implement his plans. The following is from Bob:

### **Adding Limit Switches to a Shaper or Other Tool**

"Here's electrical advice on safely adding limit switches to your shaper or any other power tool. I'll leave it to your ingenuity to determine how to mount the limit switches.

### **Selecting Components**

To safely deal with the power line, you must isolate the human from the power line so that there is no risk of electrocution. We'll use two common devices for this: a relay and a power transformer.

For this job, there are two practical types of relays. One is a mechanical relay (also called a contactor). The other is a solid state relay. These both behave the same way. When power is applied to either relay, the relay will turn on and complete the circuit from the power line to the motor.

Solid state relays have a few advantages. They are small, quiet, don't wear out, and can be controlled by low voltage, low current signals. Note that the input to a solid state relay has a positive and a negative terminal and must be wired correctly. Mechanical relays also have advantages. They can take occasional abuse without failing and they are available in multiple pole varieties.

Grainger is a good source for relays. One good candidate solid state relay is Figure 1, Grainger #6C903; Omron G3NA-225B-DC5-24; \$21.42.

This relay turns on with any input between 4V and 32VDC, consumes under 7mA, works with any output current between 0.1A and 25A and any voltage between 19VAC and 264 VAC. The relay is adequate for any motor up to 3 HP.

[www.grainger.com/Grainger/www/itemDetailsRender.shtml?xi=xi&ItemId=1611785082](http://www.grainger.com/Grainger/www/itemDetailsRender.shtml?xi=xi&ItemId=1611785082)



**Figure 1: Omron G3NA-225B-DC5-24 Solid State Relay**

Grainger also has mechanical relays. For example, Figure 2 Grainger #4JY24 Dayton # B101HXX-12D; \$64.00. This relay is a very high current relay that has a coil rating of 12VDC at 800mA and a contact rating of 100A @240 VAC resistive or inductive so it is good for any motor up to 5HP.

[www.grainger.com/Grainger/www/itemDetailsRender.shtml?xi=xi&ItemId=1613549071](http://www.grainger.com/Grainger/www/itemDetailsRender.shtml?xi=xi&ItemId=1613549071)



**Figure 2: Dayton B101HXX-12D Mechanical Relay**

A smaller mechanical relay from Grainger is Figure 3 #5Z550; Dayton #5Z550; \$13.84. This relay has a coil rating of 12VDC at 200mA and is rated for motors up to 2 HP.

[www.grainger.com/Grainger/www/itemDetailsReuder.shtml?ItemKey=5Z550](http://www.grainger.com/Grainger/www/itemDetailsReuder.shtml?ItemKey=5Z550)



**Figure 3: Dayton 5Z550 Mechanical Relay**

The easiest way to get the advantages of a power transformer is to use an old AC adapter (Figure 4) that puts out between 6V and 12V DC at 100mA or more. Some people call these "wall warts" because they look like an ugly bump on the wall. There's no need to modify it or disassemble it. It already contains the circuits required to turn high-voltage AC into safe low-voltage DC. Make sure that the power adapter output rating is appropriate for the input rating of the relay that you select. For example, the very high power 4JY24 mechanical relay has a coil that requires between 10VDC and 12VDC at 800mA but the Omron solid state relay needs between 4VDC and 32VDC at 7mA.



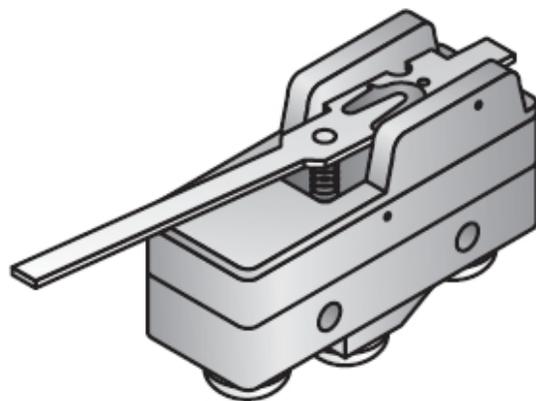
**Figure 4: Typical AC Adapter (wall wart)**

For limit switches, you need SPDT mechanical switches. These come in many different sizes,

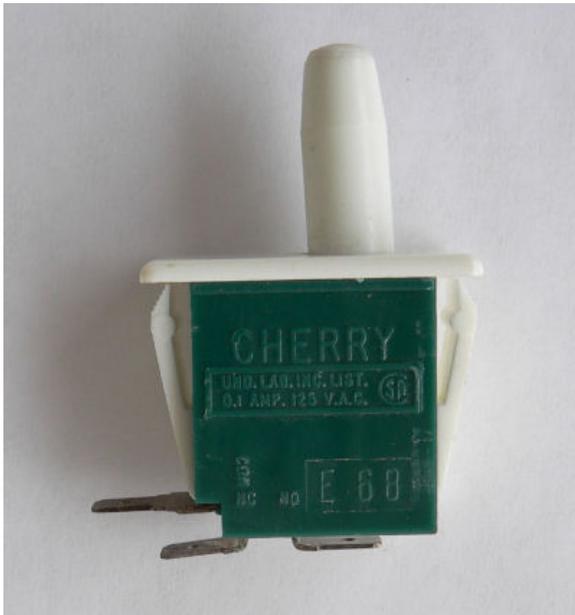
shapes, and mounting configurations. Industrial roller limit switches (Figure 5) are a good choice. They are rugged, easy to mount, and have a very well controlled trip position. Another good choice is leaf spring micro switches (Figure 6). The spring-steel leaf can be bent to adjust the switch operating point and will also flex to prevent damage if the machine travels too far. You can even use the micro switch found in a computer mouse or the interlock switch (Figure 7) from surplus machinery. If the switch is double-throw, it can be adapted to the job.



**Figure 5: Typical Industrial Roller Limit Switch**



**Figure 6: Low Cost Leaf Spring "Micro Switch"**



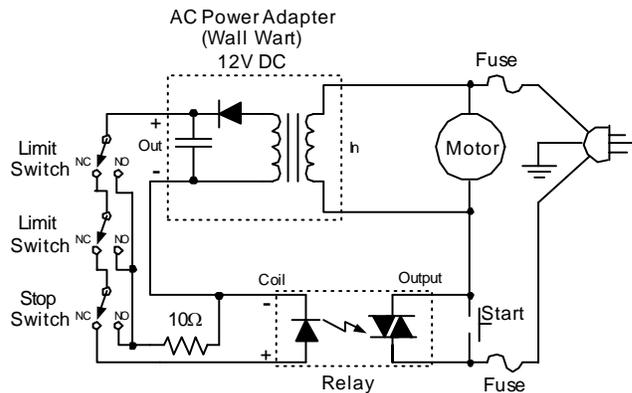
**Figure 7: Two Different Types of Interlock Switches**

There are also other ways to sense table position, such as proximity switches and optical switches. These sensors are most commonly used with computer controlled equipment where a low-level logic signal from the sensor is fed to a low-voltage controller (PLC or computer). Optical and proximity switches can be extremely small and sensitive, but for shaper or other power tool use, mechanical switches are preferred.

### Wiring Diagram

Figure 8 is a simple wiring diagram for the limit switches, power switches, solid state relay, and AC adapter. Push buttons are used to turn the motor on and off. This has the added advantage that if power fails, the motor will

switch off and remain off until you push the “Start” button again.



**Figure 8: Schematic Diagram of Motor Control with Limit Switches**

This diagram shows the AC Power Adapter as a transformer, diode, and capacitor. All of these parts are built into the power adapter, so you don’t need to select or wire these individual components.

In this circuit, the “Start” button is a momentary-action pushbutton switch that must be normally open and rated for power line voltage. The “Stop” button is also a momentary-action pushbutton switch that must be SPDT. The “Stop” button can be a high voltage or low voltage switch.

The 10 ohm resistor discharges the capacitor in the AC adapter quickly when the off or limit switch is pressed. A ½ watt or larger resistor will work for this purpose.

Good motors are expensive. I strongly recommend putting a fuse on each side of the power line to protect the motor from a stall condition. A low cost fuse may also save your shop from a fire.

### Mechanical Considerations

When the table pushes on one of the limit switches, power will be removed from the motor so the motor will coast and eventually stop. Depending on the load on the motor and the inertia of the motor, the motor might continue to rotate for a few more revolutions or a few hundred more revolutions. This means that the table will continue to move some distance past the point where the limit switch is activated.

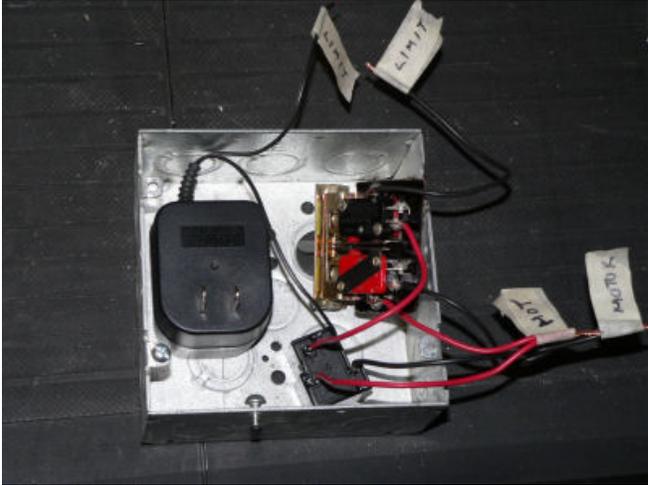
The limit switch must be installed in such a way that it will not be damaged if the table passes the switching point. For example, roller limit switches can be installed so that the table rolls past the switch rather than pressing right into it. Also

consider the shaper and the work itself to make sure that the table still has some room to travel past the limit switch.

When installing limit switches on a lathe or a mill, the same considerations apply. In some cases, the table or tool is driven by a different motor than the spindle. In these cases, the limit switch can stop the table or tool travel but the spindle could remain powered.

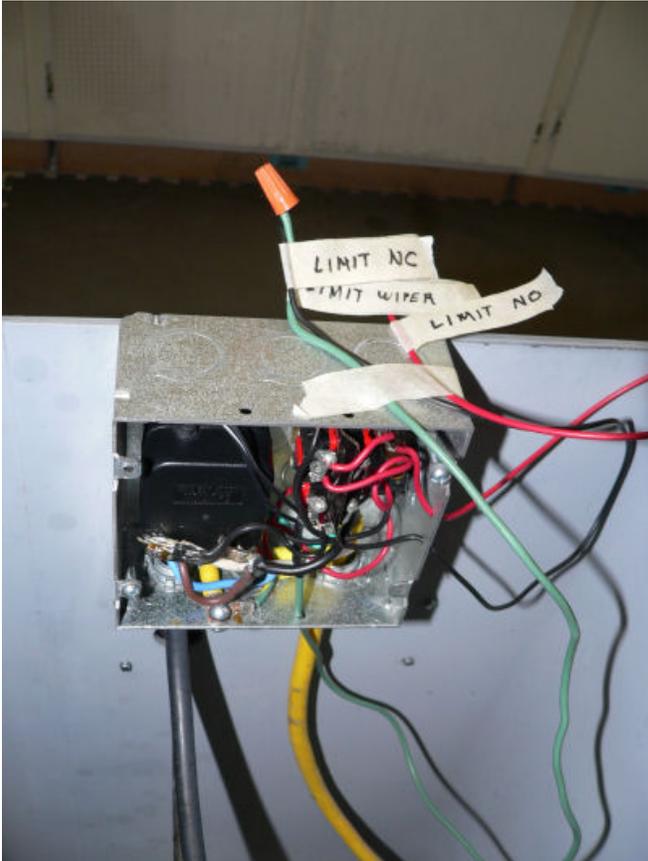
In most cases, the limit switch will be placed a short distance past the edge of the work, so that the motor stops with the tool off the work. Other times, you want to stop a cut with the tool in the work, for example, to create a shoulder. Repeatedly stopping a cut at exactly the same point in the work will build up a wall of burrs. This wall will grow higher and wider with each pass, so each successive pass will put higher stresses on the tool. On a mill, this won't be a problem because the cutter will remove the burr from the face of the cut. However, this is a real problem on the lathe, and is normally solved by cutting a relief groove at the end of the cut or by moving the limit switch a small distance closer into the work after each pass. A similar approach may be beneficial on the shaper."

Thanks Bob for that great and very useful schematic. But the thanks has to go even further. After several email exchanges, Bob sent me an electronics care package with a hard to find dual pole dual throw spring loaded start stop switch and some limit switches.



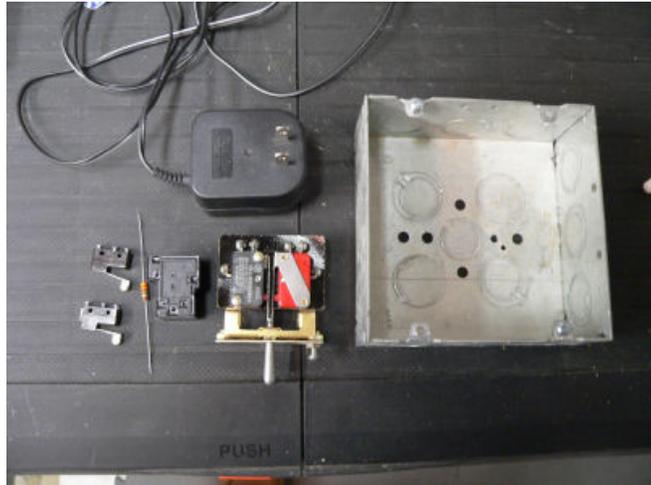
**Parts in Box** Photo by Kay Fisher

Above was the proposed layout of the wall wart, switch (which also acts as the mount for the whole arrangement) and relay.



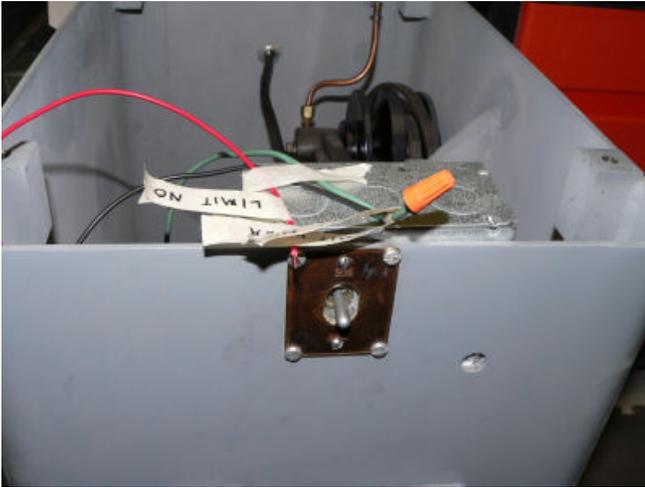
**Wired and Ready for Test** Photo by Kay Fisher

Testing the circuit the first time failed because of a wiring error on my part. Testing the second time failed because of the capacitance of the wall wart which lead to a change in the schematic which added the 10 ohm bleeder resistor.



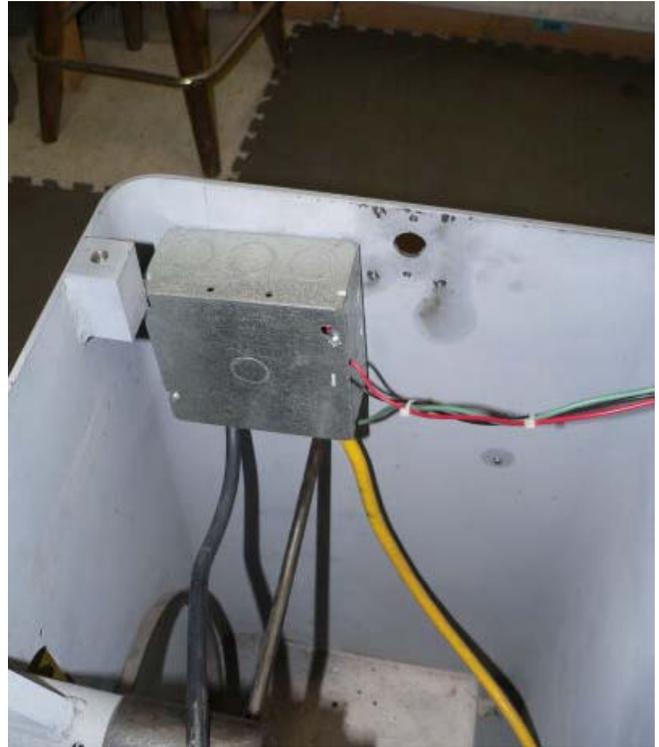
**Electronics Kit** Photo by Kay Fisher

My next-door neighbor gave me a circuit box of just the right size and a AC adapter. I found a relay at Fry's Electronics for \$5.00.



**Switch Mounted Incorrectly** Photo by Kay Fisher

Above you see a picture of the switch box mounted unfortunately in the wrong hole in the front of the shaper. This hole is for the vertical crank and the unused hole to the right is where I should have mounted it. But it worked!



**Box Mounted Correctly** Photo by Kay Fisher

Above, I moved the electrical box to the correct position.



**Adding Insulation** Photo by Kay Fisher

After several coats of liquid electrical tape and a plastic spacer to hold the transformer securely I thought I was ready to button it up.



**Extra Holes!** Photo by Kay Fisher

Now I just have to fix those holes I drilled (and elongated) for the switch plate and the power switch.

# Shop Tips



**Bondo Mistakes** Photo by Kay Fisher

A little Bondo, sanding, spotting putty, sanding, primer, more spotting, sanding, primer and paint and the old hole looks as good as new.



**Front Finished** Photo by Kay Fisher

Now the shaper has the limit switch circuit installed and waiting for the rest of my rebuild before I get to mount the micro switches in the knee.

Thanks Bob for the great info on safely installing limit switches.

Keep sending me email with questions and interesting shaper stories.

My email address is:

[KayPatFisher@yahoo.com](mailto:KayPatFisher@yahoo.com)

Kay

## SafeStop Switch

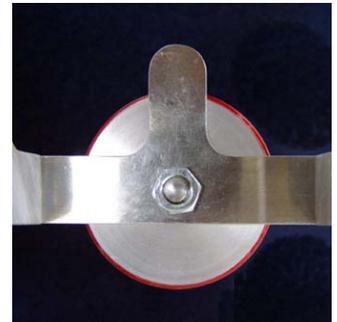
Bob Beecroft

Using the new-to-me Powermatic cabinet saw has been a great pleasure to date, but an accident waiting to happen had to be dealt a preemptive strike. The stock on/off switch is hard to reach; far under the table edge, and is a normal up/down toggle switch with guards on either side. This switch is difficult to find and switch ON, but the need to switch it **OFF** in a hurry (or **not**) is difficult at best.

Scrounging around in the spares box I found an old 3-phase on/off switch. Certainly this old switch would not pass muster with the OSHA inspector, but with an upgrade, it's a huge improvement; far safer and mounted near the edge of the table, it just might please OSHA. Other machines in the shop are likely to get the same treatment in the near future.



Stock Switch



Underside button mount



Clown nose off button



Pivot point at top of box

I mounted the old switch in an outdoor type enclosure, using a blank faceplate with holes bored in it to clear the buttons. I made up a couple of arms to attach to the sides so a large 'off' button would be easy to hit.

I didn't have any large red buttons, so glued a stack of red plastic PVC sheet to  $\frac{3}{4}$ " thick, each layer an eighth inch. I cut it roughly to size on the bandsaw, then drilled it for a  $\frac{5}{16}$ "-18 stud. Next it went in the lathe to turn it to a nice diameter, then freehand cut/sanded it to the button shape with it mounted in a drill motor, running it against the disc sander. (Maybe I'll make a ball-turning tool someday). A few coats of paint, a little sanding, and presto, a big red 'off' button!

I started with just a threaded hole in the side of the box for the pivot at the top. That wasn't good enough. I mounted the box in the mill and used a  $\frac{3}{8}$ " endmill to bore a pair of holes straight through. Next I cut a couple of  $\frac{3}{4}$ " long pieces of  $\frac{3}{8}$ " rod, drilled & threaded them 8-32 inside, and JB Weld epoxied them into the box. That made a nice, smooth & accurate mount for the arms to swing. The unthreaded portion of the AHCS acts as a bushing between it and the aluminum arm. Yes, I did think of using an Oilite bushing, but sanity prevailed!

Next up, remove the old switch and make a mount for the new one close to the edge of the table and in easy reach.



The finished "SafeStop Switch"

Pushbutton Start/Stop switches are available at <http://surpluscenter.com>  
a single phase example is part # 11-2962-A

[Bob@TheAeroSmith.com](mailto:Bob@TheAeroSmith.com)



## ***Web Sites of Interest***

Sign up for the NEMES mailing list at:  
<http://groups.yahoo.com/group/nemes>

NEMES member Fred Jaggi is working on a project that requires several precision hollow copper spheres. He was pleased to discover a friendly New England manufacturer of copper spheres ranging from 2" to 15", plus other spun products, in Esmond, RI.

<http://www.necopperworks.com/copperballs.html>



## *For Sale*

### *Tools needed*

My son is a full time farmer in the western part of the state. On March 20th, one of his barns burned to the ground. The barn contained all of his tools. The fire also burned a truck he was working on including the good and bad engines. If anyone has any excess tools or knows someone who has retired from the hobby or DIY scene, this hardworking farmer would appreciate the donations. He needs everything: sockets, wrenches, hammers, table saw, drill press, grinder, welder, acetylene torch, etc. You guys know what it takes to keep farm machinery running. He also needs a 6' and 10' roll up doors.

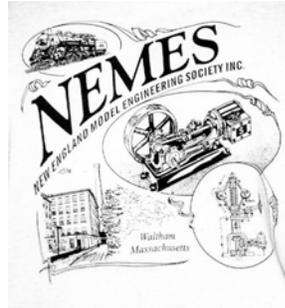
All items will be greatly appreciated.

Bob Bober 508-872-4165

### *Shaper Work CD*

Put out in 1944 by the New York State education Department this 326 page manual is chock full of valuable tips and information on using the King of Machine tools....The Shaper. Covered is everything you need to know about the care and feeding of the shaper, use of the shaper, even how to sharpen tools for the shaper. Scanned and saved in Adobe Acrobat format. The CD now has a lot more info on it, and the price has increased accordingly. \$10.00, shipping included.

Errol Groff  
180 Middle Road  
Preston, CT 06365 8206  
[errol.groff@snet.net](mailto:errol.groff@snet.net)

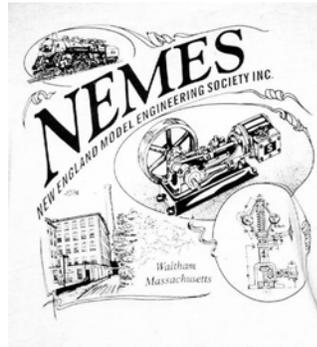


## *NEMES clothing*

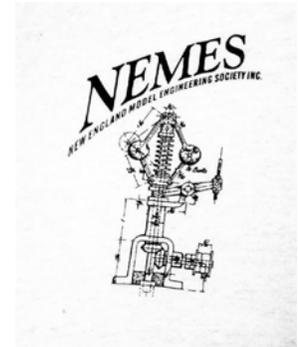
### *NEMES Tee Shirts*

NEMES tee shirts and sweat shirts are available in sizes from S to XXXL. The tee shirts are gray, short sleeve shirt, Hanes 50-50. You won't shrink this shirt! The sweat shirts are the same color, but long sleeve and a crew neck. Also 50-50, but these are by Lee. The sweat shirts are very comfortable!

Artwork by Richard Sabol, printed on front and back:



Rear



Front

Prices:

	Tee Shirts	Sweat Shirts
S - L	\$12.00	\$22.00
XXL	\$14.00	\$24.00
XXXL	\$15.00	\$25.00

Add \$5 shipping and handling for the first tee shirt, \$1 for each additional shirt shipped to the same address. Sweat shirts are \$7 for shipping the first, and \$1.50 for each additional sweat shirt.

Profits go to the club treasury.

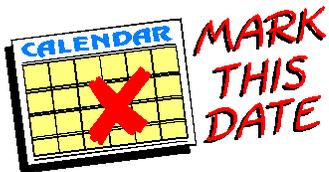
Mike Boucher  
10 May's Field Rd  
Lunenburg, MA 01462-1263  
[mdbouch@hotmail.com](mailto:mdbouch@hotmail.com)

## *NEMES Shop Apron*



Look your best in the shop! The NEMES shop apron keeps clothes clean while holding essential measuring tools in the front pockets. The custom strap design keeps weight off your neck and easily ties at the side. The apron is washable blue denim with an embroidered NEMES logo on top pocket.

Contact Rollie Gaucher 508-885-2277



## *Upcoming Events*

Bill Brackett

To add an event, please send a brief description, time, place and a contact person to call for further information to Bill Brackett at [wbracket@rcn.com](mailto:wbracket@rcn.com) or (508) 393-6290.

*Bill*

April 6<sup>th</sup> Thursday 7PM  
NEMES Monthly club meeting  
Charles River Museum of Industry 781-893-5410  
Waltham, MA

April 16<sup>th</sup> 9:00am The Flea at MIT  
Albany Street Garage at the corner of Albany and Main Streets in Cambridge  
<http://web.mit.edu/w1mx/www/swapfest.html>

April 22-23 NAMES Expo  
Toldeo, OH  
<http://www.modelengineeringsoc.com>

April 29<sup>th</sup> Southern Maine Scale Modelers Show  
Rochambeau Club South Street Biddeford ME  
Plastic models of cars aircraft etc.  
Ron Garland 207-324-3117

May 4<sup>th</sup> Thursday 7PM  
NEMES Monthly club meeting  
Charles River Museum of Industry 781-893-5410  
Waltham, MA

May 7<sup>th</sup> NHPOTP engine show  
RT 113 Dunstable MA  
Robt Wilkie 207-748-1092

May 21<sup>st</sup> 9:00am The Flea at MIT  
Albany Street Garage at the corner of Albany and Main Streets in Cambridge  
<http://web.mit.edu/w1mx/www/swapfest.html>

May 23-24 9:00-5:00 and 25 9:00-3:00  
EASTEC at Eastern States Expo  
West Springfield MA  
<http://www.sme.org/eastec>  
800-733-4763

May 27-28 Bernardston Show  
Rt 10 off Rt 91 Bernardston, MA  
Vickie Ovitt 413-648-5215

May 28<sup>th</sup>  
Fiddleheads Classic Auto & Antique Aeroplane Show  
Owls Head Transportation Museum  
Owls Head ME  
<http://www.ohtm.org/>