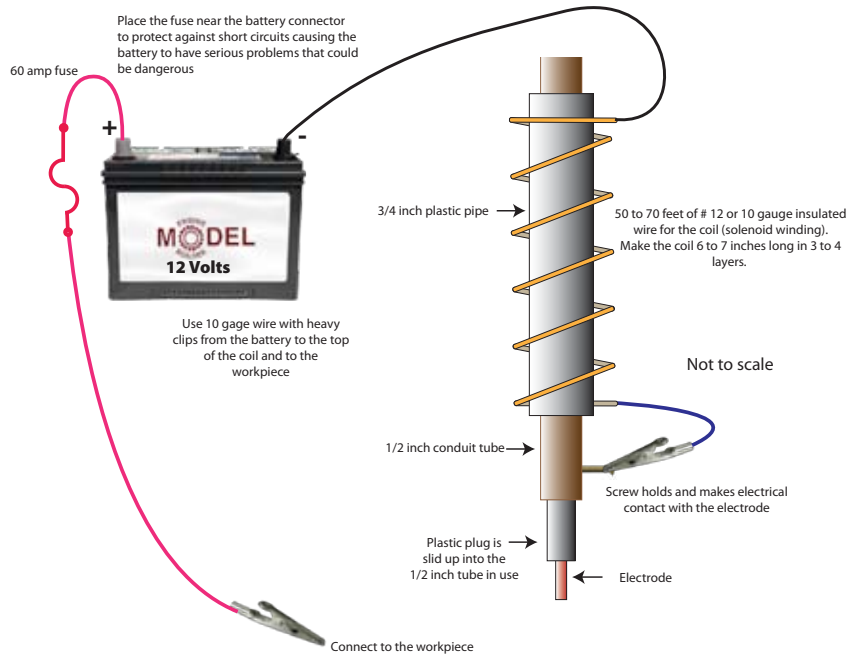


Newsletter # 5

Welcome to another *Model Engine Builder* Newsletter

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Space to 3-hole punch

Model Engine Builder™

Build A Low-Cost 12VDC EDM

By
Lynn Anfinson

Appeared in issue # 26 of Model Engine Builder magazine

The EDM in operation in Mike Rehmus' shop

Why Electrical Discharge Machining (EDM)? I got involved with this when I broke a tap in an engine project. Naturally the last step is to thread the holes. After I calmed down and restrained myself from throwing it at the wall. I set it aside and started contacting friends for a method of removing it. When a break occurs it never breaks square, always at an angle. If you try a carbide drill, the drill will try to walk sideways gouging out the hole. One method is to use a burr to round out a hollow in the tap and then drill. With a 4-40 hole this method would be pretty tough. Another friend recommended EDM. When I protested that I couldn't afford that, he referred me to a *Popular Science* magazine article in the March 1968 issue.

The article described an EDM machine which uses two light bulbs, two capacitors, and a diode to create DC pulses which would erode the metal that the electrode contacted. Fortunately I could retrieve the article at the local library.

I had in my junk pile an old Sears and Roebuck drill press frame, the type you would clamp a 1/4" electric drill into. I devised a screw feed mechanism with a plastic v block to clamp the electrode in. The light bulbs and other components I housed in standard electric junction boxes. One thing you should understand about this unit. It's connected to 110 volts and it can kill you!

When burning your hole the electrode must be surrounded with an insulating fluid, usually a thin oil. The industry, at that time, used kerosene. The oil restricts the spark to the contact area of the electrode. This gets you a clean hole slightly bigger than the electrode. The electrode can be any metal that conducts electricity. Some metals last longer than others. The *Popular Science* article is helpful in this area. Brass works and erodes very slowly compared to the workpiece.

I started burning my hole and several problems immediately appeared. Kerosene stinks up the whole house and my wife ejected me. Actually the back yard is safer. If the sparks ever lift above the surface of the kerosene you have a bonfire. This might happen if the grandson comes running by and bumps the table.

I had to remove about 3/4" of metal which took about an hour. I used a piece of brass tubing because tubing has the advantage of removing less material than a solid electrode thus cutting faster.

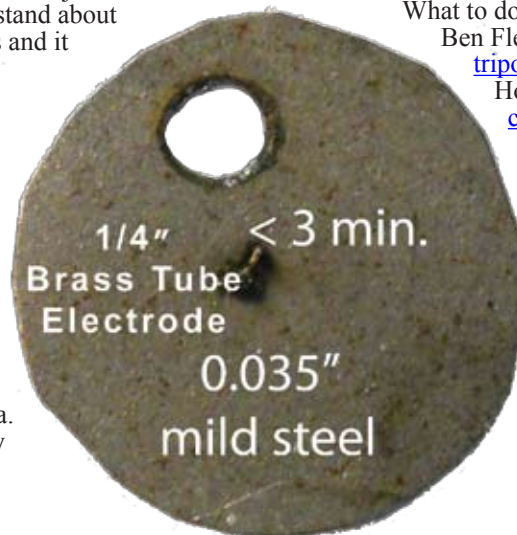
I probably could have cut much faster if I could have fed the electrode automatically. Using the screw feed is an art form, tweaking the knob to get a good burn. Not to mention the back ache from leaning over the table and breathing the kerosene fumes. I subsequently found that the industry had switched to EDM oil which doesn't burn or stink. It also costs \$150 for five gallons.

The other problem was more serious. The resulting hole was tapered. Metal swarf had built up in the oil causing shorts from the side of the electrode to the wall of the hole. This solution is to establish a constant flow of clean insulating fluid must be circulated to reliably burn 'good' holes.

What to do? I searched the Internet and found Ben Fleming's web site: <http://homebuiltdm.tripod.com/> and the Yahoo Group EDM HomeBuilders: <http://tech.groups.yahoo.com/group/EDMHomeBuilders/?yguid=199360847>

Ben offers a book (*Build a Pulse EDM Machine*) and a circuit board. The circuit board controls a servo motor that automatically feeds the electrode. The book and Website offer a wealth of information about EDM, pumps and filters. The Yahoo Group is very helpful too. If you want a professional and reliable rig I recommend it. Depending on how good a scrounger you are, you might save some money.

Suppose, you only need an EDM once or



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twice a year? If you are retired on a fixed income, you're in a real fix. But there's a cheaper solution. I found a YouTube video showing Jeri the circuit girl using a needle attached to a doorbell solenoid to burn a hole in a razor blade with a 5 volt power supply (http://www.youtube.com/watch?v=uUN4_-xplWc&feature=results_video&playnext=1&list=PL3D4AB88C4C9013E1).

A light bulb came on over my head! This was automatic feed of the electrode using only a coil of wire and a DC power source. I later found out that this was an old idea—you may have heard about the 12 volt tool scribe that mechanics use to etch their name on to their tools. This is the same mechanism. I experimented with a number of solenoid coils and a 12 volt car battery. They worked but very slowly so I needed a bigger coil. I needed at least a 12 gauge coil of wire wound on a form that would allow a metal armature to vibrate up and down in. Looking around the shop I noticed a piece of PVC (plastic) pipe that would work and some 12 gauge house wire left from another project. I chucked it up in the lathe and wound two layers of turns 6" or 7" long, about 50' of wire. I made an armature out of a solid piece of steel and put a chuck on the end.

The idea works like this. The armature slides inside the coil of wire and is connected to the bottom end of the coil with a jumper wire. The 12 volt negative lead from the car battery is connected to the top of the coil. The positive red lead is connected to the part we want to drill. An electrode is secured to the bobbin. We let the armature fall and hit the part. Big spark, electricity is conducted through the coil which makes it an electromagnet. The magnetism yanks the armature back up breaking the circuit and collapsing the magnetic field which lets the armature fall again. This will automatically continue until you burn through the workpiece.

When I tested it, the armature with chuck was too heavy to work properly. Looking around the shop again, I found some 1/2" electrical conduit which would fit inside the 3/4" PVC after I turned it down a skosh on the lathe. I used a piece of plastic to make a plug to insert into the conduit and drilled a hole through the plug length-wise. This hole allows the electrode to be inserted into the plug. Next I drilled a hole through the side of the conduit and through the plug. After tapping the hole, I used a screw to clamp the electrode in place and provide an electrical path to the electrode. This gave me a very light assembly. Putting it all together I tested it and was delighted when it started working.

As it burned I found two other problems. There was a hot spot on the top of the coil. I made a new armature which was the same length as the coil when operating which cured that hot spot. After burning for 4 or 5 minutes the whole coil started to get hot. So I added another layer of wire making 3 layers and about 75' of wire 6" or 7" long. Now the EDM runs cool and cuts reliably.

I recently found out that Wire EDMs use deionized water as an insulator. I had been using water myself and had quickly found problems with swarf buildup in the water. I tried to filter it with a pump and fuel filter with no success. Why bother to filter it? I run a hose over from the basement sink and flush the work area with clean water. Then drain it into a bucket or down the basement drain. No expensive EDM oil or kerosene. No pumps or filters.

For 20 dollars or so you could have your own EDM. It won't cut as fast as the 110 volt unit, although you could put two batteries in series and thus cut faster. I'll be at Cabin Fever and NAMES in 2012 so stop by and visit.

Diagram on the following page

There are YouTube videos of me at Cabin Fever 2011 demonstrating the rig. <http://www.youtube.com/watch?v=d9w-P8QAseg> and <http://www.youtube.com/watch?v=KjBjxWWh82E&feature=related>.

Editors note:

The EDM is simplicity itself but there are a few things to consider:

- A 12 volt car battery should be handled with respect. It has a tremendous capacity to deliver current and if an object short-circuits the battery, it could melt, causing a fire and/or the battery could explode, ejecting flammable gas and/or acid. Safety at all times, please.
- A fairly high voltage is developed by the coil when the EDM is operating. Do NOT touch any exposed metal of the EDM when it is operating and stay away from it completely if you have a pacemaker!
- When the conduit tube is in its proper operating position, the top of the tube will be at least even or slightly higher than the top of the coil.
- To create vertical motion of the armature, the bottom of the armature tube has to extend beyond the bottom of the coil. This is because motion is created when the energized coil attempts to center the armature in the coil. When the armature is picked up, the current is interrupted and the armature falls back down before any significant vertical movement occurs.

This is a compelling idea, I built one and it does work as advertised. There are a few areas that could possibly be improved and perhaps our readers can supply new ideas.

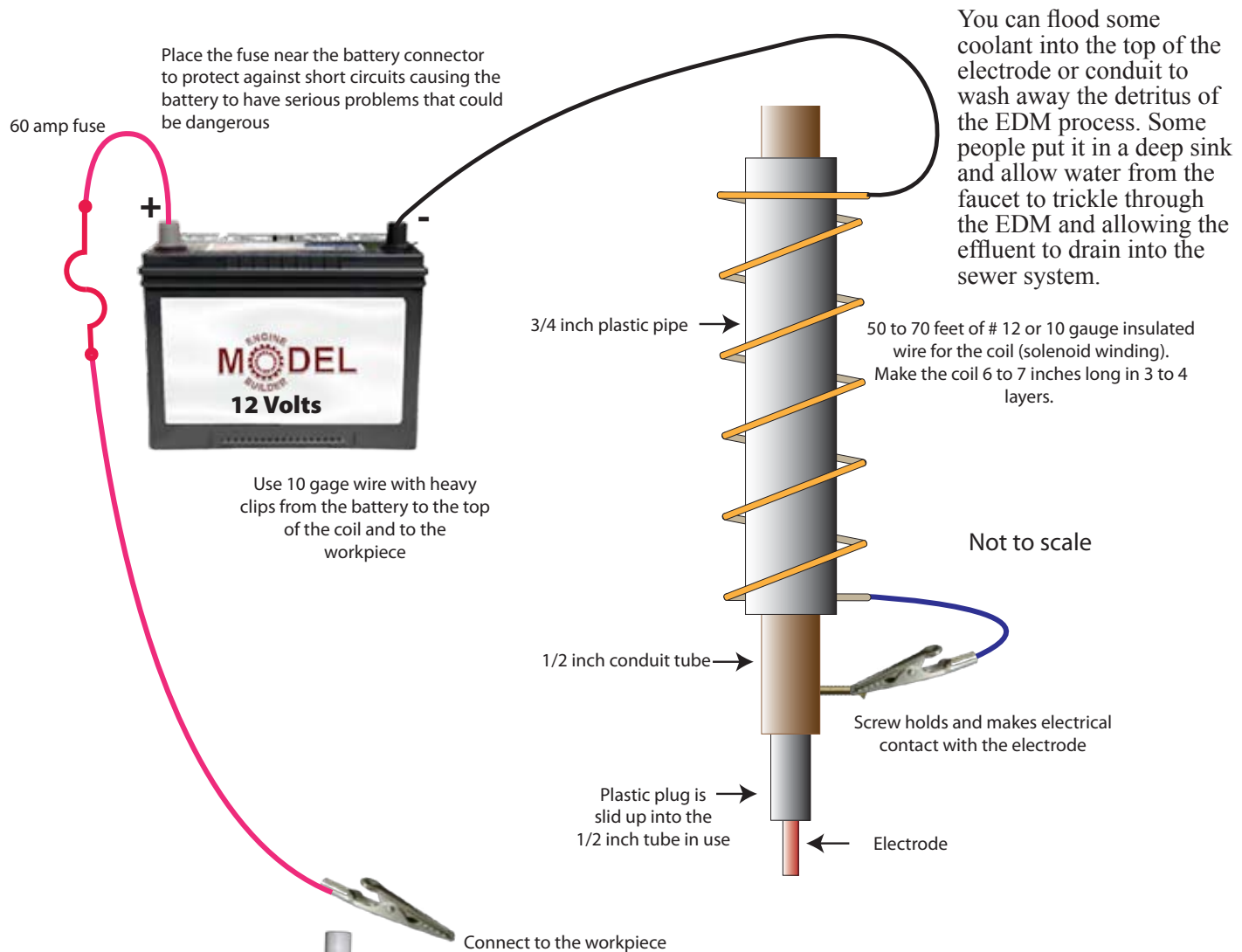
- My thought is that if armature positioning could be made better then when one aims to remove a 0-80 tap, the electrode can be positioned with greater accuracy.
- Could the magnetic performance of the system be improved if the coil were covered with a soft iron sheath?
- Could one use an electric welder as a power supply?
- Reduce the operating voltage to 5 VDC so we can power it from an inexpensive computer power supply.
- Reduce the overall size so it will fit on more machine tools.
- Increase the ability to position the working tip with more precision, allowing its use on smaller screws / drills / taps.

What else would you recommend?

You might wonder why I am publishing this article from the magazine in a free newsletter. The answer is I'd like to develop this idea further and I believe you can help. Contact me at editor@modelenginebuilder.com.



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You can flood some coolant into the top of the electrode or conduit to wash away the detritus of the EDM process. Some people put it in a deep sink and allow water from the faucet to trickle through the EDM and allowing the effluent to drain into the sewer system.

The short circuit connection between the electrode and the workpiece energizes the solenoid which pulls the 1/2 inch steel tube (conduit) up, breaking contact whereupon the tube and all falls back and makes contact with the workpiece again.

Safety Note

- Do not charge a battery in a unventilated room. Explosive hydrogen gas is released during charging of the battery.
- I do not think Gel Cells are appropriate battery technologies for this use. Try at your own risk.
- Put the battery in a battery box with the cover in place so if you drop something onto the battery, it will not short the positive and negative terminals together.



Photographing Shiny Objects - Part 2

By Mike Rehmus

Of *Model Engine Builder* magazine and Bay Area Engine Modelers

Pay attention before you push the button

It is discouraging to take what you think will be the perfect picture only to find that something that you could have fixed had you noticed before the picture was taken, spoils everything. What are some of those things that can ruin or at least detract from the picture? I've made every one of these mistakes:

- Trying to operate the camera without wearing my glasses. My Digital Single Lense Reflex (DSLR) has an adjustable eyepiece so I can see the important information in the viewfinder without glasses. But when I'm trying to operate the camera's dials, buttons and levers, I need glasses to insure I don't miss-set the camera.
- Depending on the LCD screen on the rear of the camera to evaluate picture framing, focus, and detail in the shadows and highlights. Some of the very newest digital cameras have adequate screens but nothing compares to a large screen for displaying the problems with the image. Most cameras have a video output—use it if you can.
- Running out of batteries during the shoot when the charger or new batteries were left behind. Taking a 110 VAC-only charger to a country where 240 VAC is the norm.
- Not taking a memory chip, enough chips, or filling up the only memory chip and having to decide which images are going to be deleted so I can take a few more shots. I remember getting a large portion of a police department out in front of their building only to find out I did not bring a tape for the video camera. Can you spell OOPS . . . And they all carried guns?
- Taking pictures with a dirty lens. Now this usually is somewhat OK, but it does degrade the lens performance.
- Taking a picture where the sun is shining on the front of the lens, causing artifacts in the image which are only apparent after you get back to the studio.
- Trying to take a real close-up of an object while hand-holding the camera. A solid mount for the camera is a necessary tool for many of these types of shots. The advantages are many:
 - There will be no camera shake during the exposure
 - You can evaluate the scene through the viewfinder or on the LCD or even feed the signal to a television set where you can really tell what is going on
 - You can set the focus, which won't be changing because the camera is held in position.
- The camera gets dropped. Many times this is not a good sign nor feeling. Neck straps or wrist straps (at the least) are good at preventing this. As long as the strap is around your neck or wrist, that is.
- Carrying the camera on the tripod and then running into something where the camera graciously absorbs the shock to protect the delicate tripod.
- Using the shutter release to take a critical picture that requires a long exposure, thereby shaking the camera and blurring the image. Use a remote control or the self-timer with which almost every camera is equipped.
- Cameras set wrong:
 - Automatic features set wrong and you wanted manual settings
 - Manual settings in charge and you expected automatic operation.
 - Automatic focus on when you need to focus the lens on a very specific part of the subject
 - Macro mode set when you need landscape mode and vice-versa.
- Not reading the operators manual on the camera before you want to desperately take a picture of a special situation so you don't know what knob to turn or image option selection to make.
- Not taking a bit of time to understand the basic terms and operations in photography. If you can learn to machine metal, photography is a piece of cake (or mind-set).
- Not taking the picture because you are too tired or too busy. This one always comes back to bother me after I've left the scene.
- Not taking the camera with you because it is a bother. This one always bothers me at the scene.

Enough Said. Now onward to the next page



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What is a good picture?

- Subject is properly exposed
- Subject is in focus
- Subject is the correct color
- Subject is completely in the frame
- Contrast is not too great so you can see detail in the shadows and highlights
- Camera was square with the world
- Something of interest

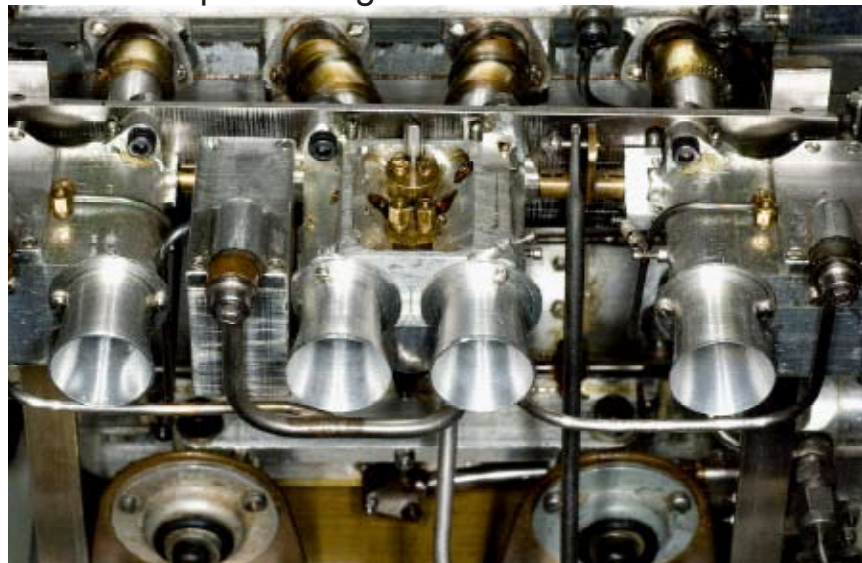
The important things

- Put the camera on a tripod
- Use manual focus
- Select manual exposure if at all possible
- Use a Gray Card (more on this later)
- Check the pictures on your computer or television screen
- Be critical, ask others to comment and throw away/erase bad pictures.

Proper Exposure With Good Highlight & Shadow Detail



Crop the Image to the area of interest



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Subject in focus



Focus on Subject

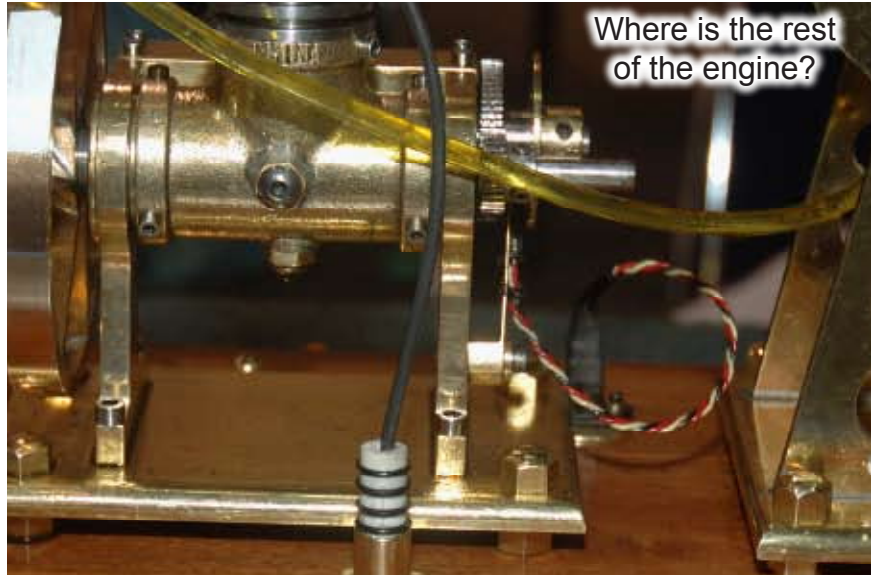


For Some Things It is OK to have the Subject Extend Beyond the Borders

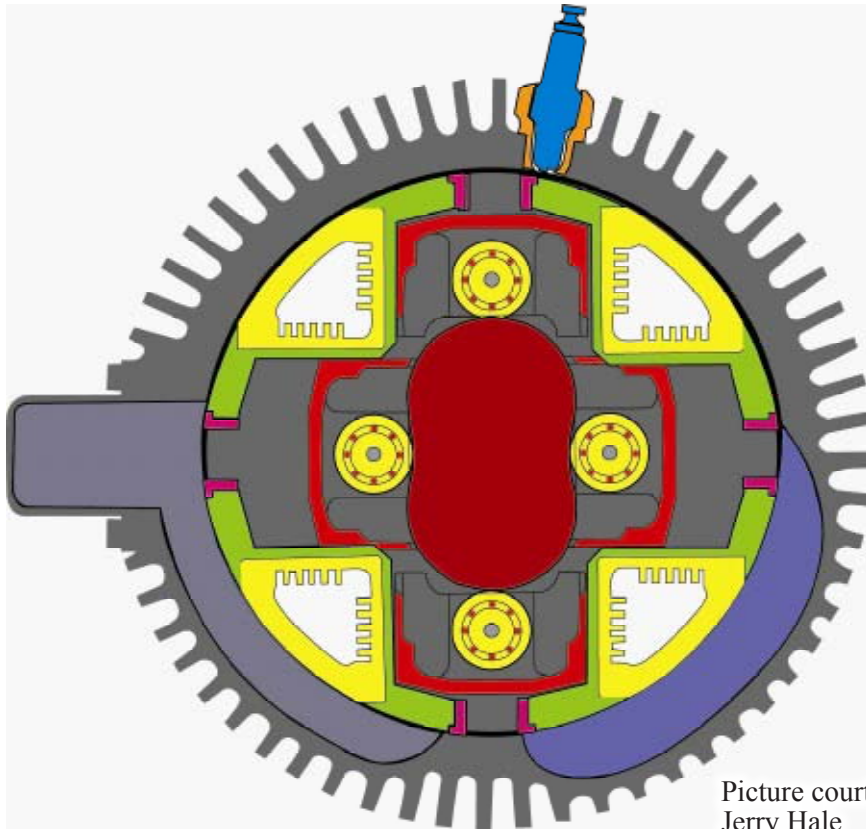


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For Some Things It is not OK to have the Subject Extend Beyond the Borders



You want the entire engine in the frame



Picture courtesy of Jerry Hale

When we cut metal, we think the process through in our minds if not on paper. This way we avoid cutting off important bits or drilling holes before their time.

The same principle applies to taking pictures. Know what you want and have at least a rudimentary idea of how to get it. Then, if the first picture doesn't turn out OK, modify the setup and/or the camera and try again.



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IQBAL AHMED'S 1886 BENZ MOTORWAGEN

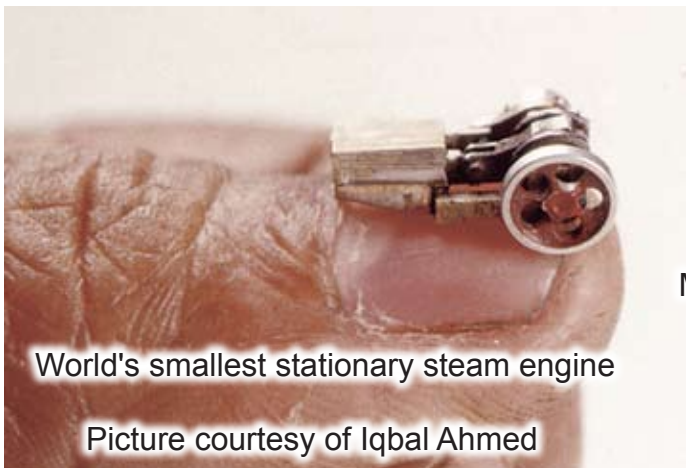
The innovative Benz patent Motorwagen, built in 1886, had a motor, chassis and drive train formed into an integrated unit. Two years later, Karl Benz's wife Bertha drove the Motorwagen 112 miles to visit relatives over roads built for horse-drawn carriages. All of Europe was astounded by a vehicle powered by a gas engine whose gas is produced by fuel gasification by a device carried on the vehicle as described in the Imperial Patent granted to Karl Benz in 1886.

This one-quarter scale fully functional model built by Iqbal Ahmed of Nagpur, India was launched on January 29, 2011, the 125th anniversary of Benz. Iqbal completed the model in only 396 days without any dimensions or blueprints, scaling it only from photographs. All the parts were made on a Sherline table-top milling machine.

Iqbal Ahmed is a self-taught machinist, yet capable of taking on the most challenging of machinist's jobs. Not only has he built superb steam, I.C. and Stirling model engines and small-scale locomotives but he also restores full-sized automobiles and makes replacement parts for office equipment including Xerographic copiers. When I say restore, it isn't the same process that it is for most of us. He cannot telephone an order for a new camshaft or pistons, etc. he has to make them from bar stock, frequently without drawings or even the original parts for a pattern. He would fit right in with any model engineering club in the world and teach us all something.

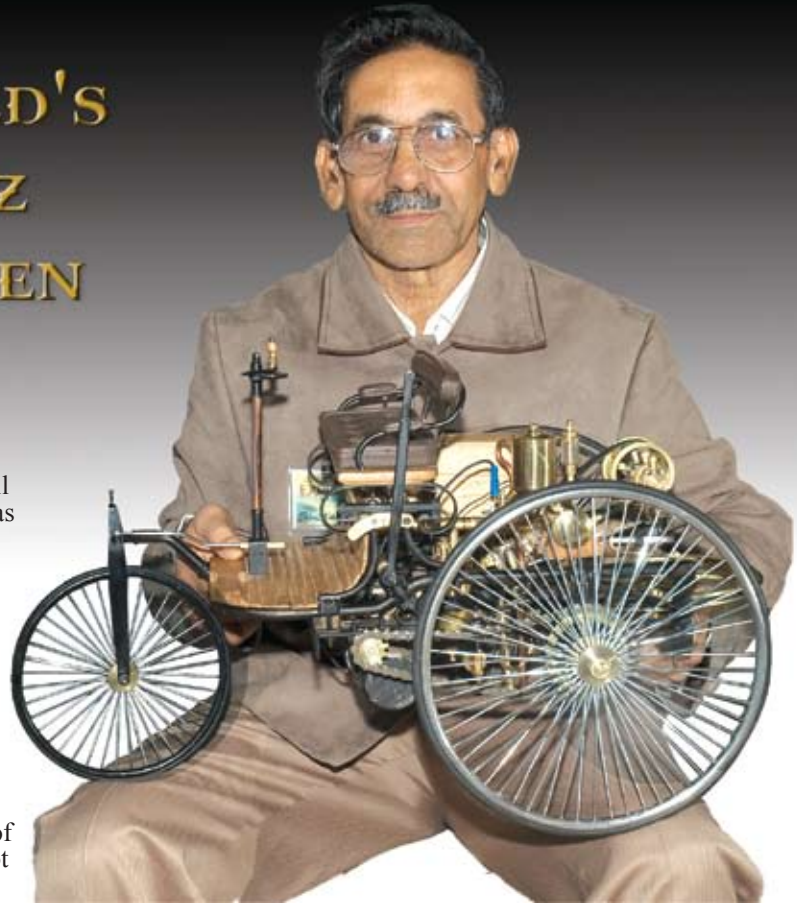
His models hold several world records including the World's Smallest Steam Engine which weighs 1.72 grams (≈ 0.06 oz.) and is 6.8mm (≈ 0.27 in.) high. He steams it for about 2 minutes using 10cc of water (≈ 0.34 oz.) from a small alcohol-heated boiler which, of course, he designed and built.

Iqbal has won numerous prizes in the Sherline Machinist's Challenge contest, setting a record in 2007 by



World's smallest stationary steam engine

Picture courtesy of Iqbal Ahmed



winning both the 1st and 2nd prizes with his miniature Sherline mill and Sherline lathe. Iqbal gave the lathe to Sherline owner Joe Martin for display in the Sherline Museum of Craftsmanship in Southern California. If you are ever in the area, visit the museum. Further information can be found on the museum's Web site at www.craftsmanshipmuseum.com. Pictures of Iqbal's visit to the museum can also be found on the Web site.

To see pictures of Iqbal's 1/4-scale Motorwagen automobile during the building process, please visit <https://picasaweb.google.com/iqmodelverk/1886BenzMotorwagenProject?feat=email> where many more pictures can be found.

If you would like to contact Iqbal, his e-mail address is iqmodelverk@gmail.com.

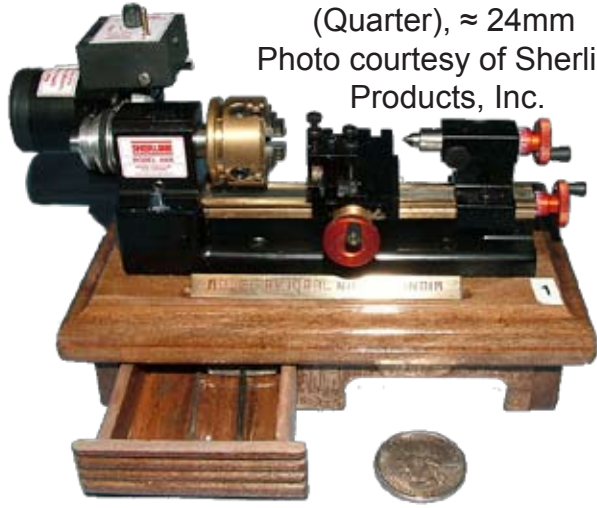


1st Prize Model, Sherline
Machinist's Challenge, 2007
Coin is U.S. 25 cent piece
(Quarter), ≈ 24 mm
Photo courtesy Sherline
Products, Inc.



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2nd Prize Model, Sherline Machinist's Challenge, 2007
Coin is U.S. 25 cent piece (Quarter), ≈ 24mm
Photo courtesy of Sherline Products, Inc.



This Centerfold Article appeared in issue # 25 of Model Engine Builder magazine. To see what other topics were covered in this issue, please go to www.modelenginebuilder.com and scroll the magazine cover thumbnail images down to issue # 25 and click on that.

Obviously Iqbal builds sturdy models too!
This is his Granddaughter, Shafia, using the Motorwagen as a very special toy

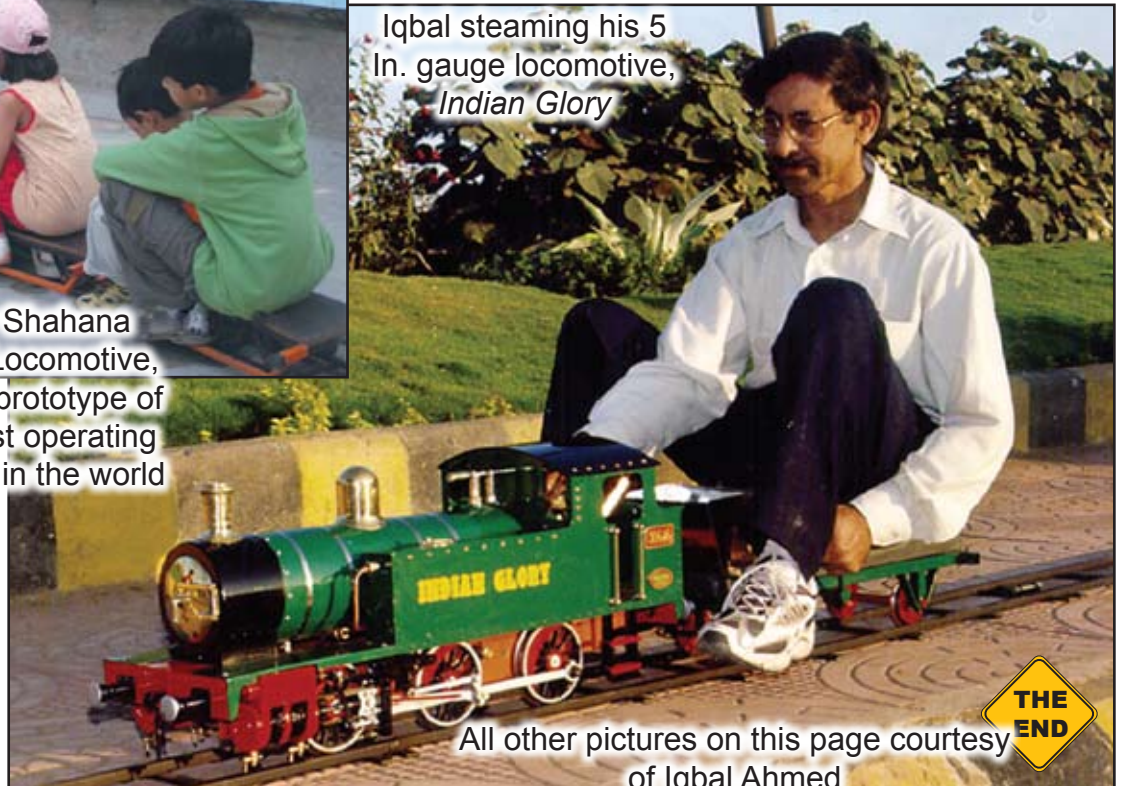


The picture above has to be one of my all-time favorite Model Engineering photographs for so many reasons



Granddaughter Shahana running his 5 In. Locomotive, *Fairy Queen*, the prototype of which is the oldest operating steam locomotive in the world

Iqbal steaming his 5 In. gauge locomotive, *Indian Glory*



All other pictures on this page courtesy of Iqbal Ahmed



Centerfold picture- original is
11 x 17 inches in the magazine

Iqbal Ahmed's 1886 Benz Moterwagen



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Model Engine Builder™

Model Engine Builder magazine Issue # 27

Issue # 27 has some very
interesting articles

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Gail Graham designed a very nice 2-cylinder compression-ignition engine some time ago. Don Brymer, living in Australia, did not have access to all the Imperial dimensioned tools so he converted the design to Metric dimensions so he could use his existing tooling.



Roger Slocum, a super machinist, wrote a great article on grinding wheels and how and when you dress them (among other things). His trouble-shooting chart is a jewel of information when things go wrong. Roger, who advertises in *Model Engine Builder* magazine, can grind the best cams and crankshafts you could hope to see. Owning one is a privilege.



If you are interested in *Model Engine Builder* magazine, Please visit our Web site www.modelenginebuilder.com Great articles, big drawings on separate sheets of 11 x 17 inch paper All back issues are available Get our [Article Index](#)

Vote of Approval

As I approached the lapping of the Humbug cylinder for Issue # 27, I faced an empty shelf with no lapping compound beyond one syringe that a friend, Bruce Satra sent me.

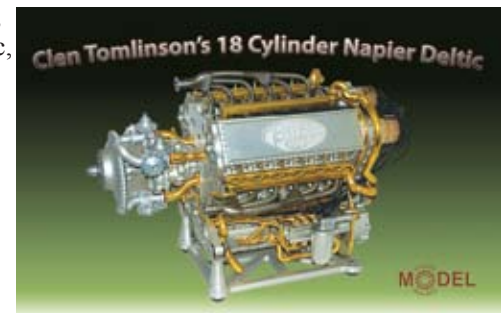
Having never before lapped a model airplane cylinder, I looked for advice on the Internet and from friends. The answers to my question, "What mesh diamond compound should I use?" Varied quite a bit. Putting on my experimenter's hat, I decided I needed a variety of diamond compounds but they cost at least \$20 U.S. each for a lifetime supply of 5 grams and I wanted a fairly wide selection.

Fortunately for me, Bruce had obtained the syringe of compound from a company called Gesswein in Connecticut. Now Gesswein has a very nice selection of tools, many of which are very interesting to anyone contemplating lost wax casting of small models, etc. With a publishing deadline firmly in mind, I ordered a selection of diamond compounds at a fair price only to be told they were out of a few types. Their customer service somehow found enough syringes to fill my order and save the deadline. Hats off to Elaine Corwin at Gesswein.

Visit their Web site to enjoy some very fine tools and supplies: I have no business relationship with them except as a satisfied customer.

www.gesswein.com

Clen Tomlinson's 18 cylinder Deltic, our Centerfold article, is an incredible engine and one of those labors of love that most of us cannot imagine undertaking.



Most model engines that use a radiator do not have a radiator fan that matches the quality of their engine. Dwight Giles, in building the new Black Widow V-8, decided that the cooling system would be as nice as the engine. So he made a custom radiator, radiator fan and coolant hoses. With the publishing of the build article on the fan, *Model Engine Builder* magazine has now covered all three engine auxiliaries.



Piston Rings are interesting to build and there



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have been, over the years, many articles on how to build a good piston ring. Tom Schwartz has taken on the task from the perspective of the graduate mechanical engineer and from his experience at the Boeing Company. This is a new approach using new information to build piston rings.

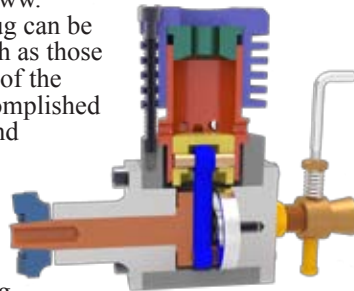


I started writing and making Humbug parts in Issue # 21 and we continue to machine more parts. The project is designed to lead the absolute beginner through the process of making a model airplane engine running as either a glow plug or compression-ignition (diesel) engine.

The reader is expected to know the basics about whatever machine tools are in the shop but not much more.

Designed by Ron Chernich, www.modelengineneers.org, Humbug can be built on desktop machines such as those sold by Sherline and Taig. All of the machining in the series is accomplished on (mainly) a Sherline lathe and (sometimes) their mill.

Just so you know, Sherline furnished their machines to me at no cost as I am making training videos for them including one on building this engine.



Machinist's hand tools do not come with operating instructions. This video will provide that training.

Learn to set up and operate the Sherline Lathe

By Mike Rehmus, Editor of *Model Engine Builder* magazine

A ByVideo Production

Purchase them directly from:

LittleMachineShop 396 W. Washington Blvd. #500 Pasadena, CA 91103 USA 1 - 800 - 981-9663 1 - 626 - 797-7850 www.littlemachineshop.com	Sherline Products, Inc. 3235 Executive Ridge Vista, California 92081-8527, USA 1-760-727-5857 1-800-541-0735 www.SherlineDirect.com
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Events

NATIONAL MODEL ENGINEERING AND MODELLING

May 13, 14 & 15, 2012
Great Yorkshire Showground, Harrogate, UK
<http://www.theharrogateshow.com/>

Western Engine and Model Exhibition



August 24, 25 & 26, 2012
Part of the Goodguys West Coast Nationals
Hot Rod show
Pleasanton Fairgrounds, Pleasanton, California, USA
www.wemeshow.com

Black Hills Model Engineering Show

September 15 & 16, 2012
Fine Arts Building ,Pennington County
(Central States Fairgrounds)
Rapid City, South Dakota, USA
<http://www.blackhillsmodelenginingshow.net>

GEARS

September 29 & 30, 2012
Kliever Armory
10000 N.E 33rd Drive
Portland, Oregon, USA
www.oregongears.org



25th Estevan Model Engineering Show

October 13 & 14, 2012
Wylie Mitchell Building, Estevan Fairgrounds
Estevan, Saskatchewan, Canada
<http://estevanmodelenginingshow.com>

Midlands Model Engineering Exhibition

October 17 & 21, 2012
Warwickshire Exhibition Centre
Fosse Way, near Leamington Spa
Junction of the A425 and B4455, UK
<http://www.meridienneexhibitions.co.uk/our-events-detail.php?id=0000000007>

Do you have an upcoming event? Send information to us at this link:

www.modelenginebuilder.com/contactus.htm

SEE US THERE

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Model Engineering Internet Resources

Click on these to explore the Web sites:

<http://www.homemodelenginemachinist.com/>
<http://modelengineneews.org/>
<http://www.floridaame.org/>
http://groups.yahoo.com/group/Min_Int_Comb_Eng
http://groups.yahoo.com/group/R_and_R_engines
<http://www.practicalmachinist.com/>
<http://bbs.homeshopmachinist.net/>
<http://www.cnczone.com/>
<http://forums.americanmachinist.com/>
<http://www.machinistweb.com/forum/>
<http://www.chaski.com/homemachinist/>
<http://www.machinetools.com/us/forums>
<http://www.modeleng.org/>
<http://sites.google.com/site/kiwimodelengineering/home>
<http://www.sherline.com>

Also look in the Yahoo Groups. A search will probably find at least one group focused on just your area of interest.

Do you have more links? Send them to us via this link: www.modelenginebuilder.com/contactus.htm.

Dear Newsletter Subscriber

We are back!

The heart surgery was a roaring success but the recovery had a few ups and downs. Finally, in the past month, I've been feeling that 10 years younger they promised.

So the 27th issue of *Model Engine Builder* magazine is at the printer and should mail about mid-May.

This also means a more regular newsletter as things return to normal.

Thanks for your patience.

Please tell a friend about this newsletter and recommend they subscribe.

Mike Rehmus, Editor

If you have never seen this model of a Duesenberg by Lou Chenot, please visit the on-line Sherline Museum and take a look at the attention to detail.

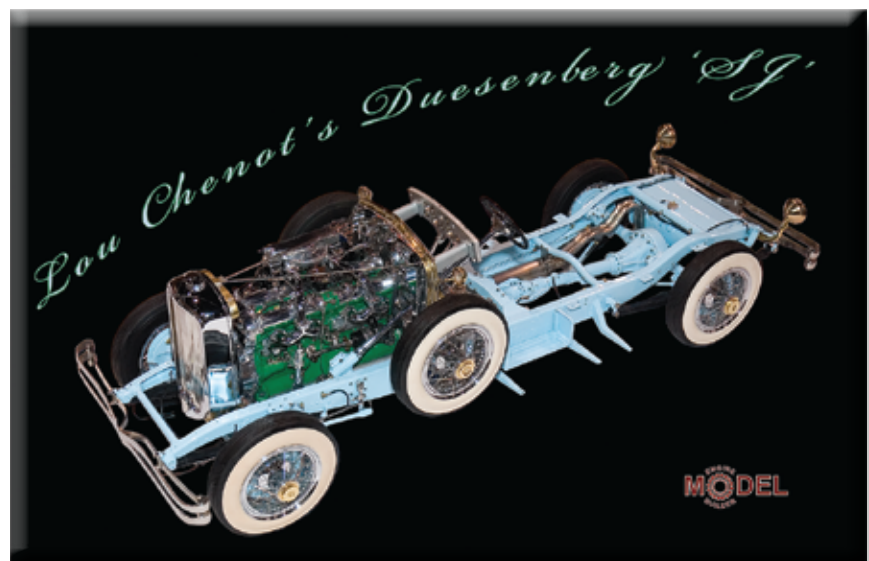
Did I mention that the engine runs? Now the car has the complete body and interior details. You probably will never see a better model.

<http://www.craftsmanshipmuseum.com/chenot.htm>

Model Engineering Clubs

- Bay Area Engine Modelers
U.S.A., San Francisco www.baemclub.com
- Bournemouth & District Society of Model Engineers
U.K., www.littledownrailway.co.uk
- Chicago Model Engineers Association
U.S.A., e-mail: edsmerz@webtv.net
- Colorado Model Engineering Society
U.S.A., e-mail: jbeall303@juno.com
- Florida Association of Model Engineers
U.S.A., www.floridaame.org
- Hamilton Model Engineering Club
Canada, www.hamiltonmodelengineeringclub.com
- Kansas Association of Model Engineers
U.S.A., www.geocities.com/steammodel/index.html
- Model Engine Collectors Association (M.E.C.A.)
U.S.A., www.modelengine.org
- New England Model Engineering Society
U.S.A., www.neme-s.org
- Northwest Model Engineers Association (Chicago)
U.S.A., dyoung1228@aol.com
- Portland Model Engineers
U.S.A., tomten@easystreet.net
- The Society of Model & Experimental Engineers
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