
The NEMES Gazette

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The Newsletter of the New England Model Engineering Society

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Our next meeting is at 7:00 PM on Thursday
1-Mar-2001 (first Thursday of every month) at
The Charles River Museum of Industry
154 Moody Street
Waltham, Massachusetts

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The Editor's Desk

By Kay R. Fisher

In the for sale section last issue we had a want ad for an air compressor with no contact name. It was from Larry Twaits and the ad is repeated this month.

I wish I could tell you it was well planned but in fact it was just a coincidence that we were able to get Bob Neidorff's article on stepper motors in the same issue as the coverage of Ron Ginger's presentation on CNC.

Kay



The President's Corner

By Ron Ginger

February Meeting

I was very pleased at the February meeting when Rob McDougall announced the other club officers had decided to make me an honorary lifetime member. I do appreciate the thoughts, and all the comments I get from members about how

much fun they have had from this club. I have also thoroughly enjoyed the group, and look forward to many more years with the group.

Thank you all for this recognition.

Cabin Fever Report

I'm sure Steve will have some more to say about Cabin Fever, but I have to make a few comments.

First, I thought it was a great weekend in all respects. The weather was fine, the group was great company, the bus and driver were excellent, and the new location is just perfect. Well, the hotel might have been a bit better, and we did find a better dinner on Saturday, but all in all the arrangements were just fine.

Our machining demo worked out well. Recalling my old marketing and advertising days, I could put a great spin on this, but I think we did OK. We did it because we wanted people to see chips being made, and we did accomplish that. There was almost always a good crowd around. Thanks to Errol and his students, we had a nice supply of whistles to hand out, and I saw several big smiles from little folks that got one. And we did make a few whistles.

Thanks also to Bob Cummings of New England Brass and tool for the stock, and to John Szot, the Prazi importer. John was extremely helpful, and went well out of his way to help us get the machines and solve a couple of problems. We did relearn the lesson that it is hard to do big work on small machines!

Meeting Speakers.

With just a little bit of arm twisting, Max ben-Aaron has agreed to help with the scheduling of our future meeting speakers. This is going to be a great help to me, and I'm sure we will be able to continue our list of great speakers. Max has a couple of leads to work, but I'm sure he will appreciate any help from any other members. If you have any idea of a speaker you would like to hear, let Max know, and maybe he can work it out. If you have a personal contact that you can follow

up, just let Max know to schedule a date so we don't wind up with 2 speakers for one meeting.

My sincere thanks to Max for this help.

NAMES

I guess we are not going to be able to arrange a bus trip. Only about 12-14 people are interested, and we just can't make a bus work for that small a group. There have been discussions of a sort of "van pool" arrangement, so maybe something can be worked on a smaller scale.

Meeting Security

We have been asked by the museum director to lock the main entry door about 7:15, and keep it locked until everyone leaves. This will lead to a couple of changes. If you arrive after the door is locked, you may enter through the Internet Center until 8:00. If you leave early, please ask someone to follow you to the door to re-lock it when you are out. The door can be locked without a key. We must all help with this, as the cost of a security person would make our meetings prohibitive. The museum is providing a great value to us in the use of this space; we must cooperate with their requests.

Estate Sales

We have on several occasions discussed the problems of holding estate sales for fellows like us that seem to collect large amounts of heavy "stuff". As I mentioned at the meeting, I was recently contacted to try to help with a sale for a woman whose father recently died. In this case just one daughter survives him, and she has no idea of how to dispose of a very large collection of tools, machinery and stock. Four of us met with her to review the shop and discuss some possibilities. She is reviewing her options, calling some dealers, and looking for ways to clean out a large collection.

One thing this does make clear, we all ought to give some thought to our estates. Maybe a kind of "buddy system" where a friend is familiar with our shop, and known to our family as available to help out with setting prices and arranging a sale. I know my wife would not have a clue to the value of

things in my shop, or how to dispose of them. I'd much rather see my collection sold to fellows I knew, for a reasonable price to my wife, than to see some scrap dealer cart off the whole lot.

It is a topic we all would rather not think about, but one worth at least a bit of planning.

Ron



Random Ramblings

By Max ben-Aaron

I would hazard a guess that the members of NEMES are, collectively, a very ingenious bunch and that almost every one of us is an inventor. I might even go further and say that many of us are nurturing at least one idea that we think might result in a marketable product. The marketing of products is difficult, but the marketing of ideas is nearly impossible. There are companies that promise to market your ideas, for a fee, but most of them are scams. The quarter that you might have mailed in, in response to the classified ad in "Popular Mechanics" for an "inventors idea kit", when you were in the seventh grade, has done more damage, to more people, more often, and in more ways than you could conceivably imagine.

There are three great hurdles to marketing an idea yourself:

Firstly, anybody who claims to be an inventor is looked upon as some sort of crackpot. Think of the "nutty professor" as a stereotype. In the popular mind, an inventor is the sort of person who wants to equip coffins with cell-phones to avoid the possibility of somebody being buried alive. (You would be amazed at the number of patents devoted to this topic...)

Secondly, there is the problem of explaining what the idea is and at the same time protecting it.

Thirdly, companies are in mortal terror of being sued for allegedly stealing your idea, so they don't even want to hear what your idea is. In most of the cases I have come across, the first question is: "Do you have a patent?"

Although there are many individuals who made fortunes from ideas that they patented, the odds against you or me doing the same are enormous. It is highly unlikely that you will ever recover the \$3000-\$4000 that a patent will cost (never mind being ripped off for renewal fees).

Don Lancaster, in "The Incredible Money Machine" wrote: "Unless you are well within a Fortune 500 context, any and all involvement in the patent system in any way, shape or form, is absolutely certain to cause you the net loss of time, energy, money and sanity. Besides ending up a totally useless and utterly unnecessary psychic energy sink."

Many years ago there was an urban myth that the way to protect an idea was to write the idea down and seal the description in a registered letter, sent to yourself, that you filed away unopened when it came. Actually, the Patent Office provides a better way with their "Document Disclosure Program" which provides evidence of the date of conception of an invention.

A paper disclosing an invention (called a Disclosure Document) and signed by the inventor(s) may be forwarded to the USPTO. The Disclosure Document will be retained for two years, and then be destroyed unless it is referred to in a separate letter in a related patent application filed within the two-year retention period.

Note well that "the Disclosure Document is not a patent application. The date of its receipt in the USPTO will not become the effective filing date of any patent application subsequently filed."

The Disclosure program does not diminish the value of the conventional witnessed, permanently-bound and page-numbered laboratory notebook or notarized records as evidence of the conception of an invention, but it should be a more credible form of evidence than that provided by

mailing the disclosure to oneself or another person by registered mail.

A fee of \$10.00 in the form of a check or money order made payable to "Commissioner of Patents" must accompany the Disclosure Document.

A brochure giving all the necessary details, and sample Disclosure Document Deposit Request Form can be obtained from the USPTO General Information Services Division, Phone 800-PTO-9199, Fax 703-305-7786, or by e-mail to: <http://www.uspto.gov/>.

Mb-A



The Meeting

By Stephen C. Lovely

The Meeting, February 3, 2001

The February meeting got under way with a discussion of the Cabin Fever trip that a busload of us had made recently. NEMES was responsible for the live machining demonstration at the show using two machines donated by Prazi. The Prazi lathe was nice, but not really big enough to make the body of the whistle that was being made. Larry Twaits made a special cutter on his Quorn to cut the notch in the whistle body, and Ron Ginger brought his CNC Sherline lathe to engrave "Cabin Fever 2001" on the whistles. In terms of showing a bunch of people how chips get made the demo was a big success. Lots of folks watched as the Prazi Lathe and Mill cut metal. In terms of making whistles it was less productive. Ron says that by the end of the show he does think we managed to finish at least one whistle. We did have whistles to pass out to the

kids though, as Errol Groff and his students provided fifty whistles to pass out to the attendees at the show. The demo worked out pretty well for a first attempt, and next year we should be able to do better by picking a product to make that is more appropriate to the equipment we'll be using.

The show was the best show that Ron Ginger has ever been to. The mechanics of the show were good, with plenty of room for the displays and the vendors. The Quality Inn where most of us stayed was mediocre. The people who didn't get reservations in time and went to the overflow at the Hampden Inn had a much nicer hotel, but they didn't have any food available there. By 10 AM on Sunday they had sold 4500 buttons for admission to the show, and they had sold out sometime Saturday afternoon of the 2001 button supply and had to dip into the supply from earlier years. The new location was bigger and better than the previous location, although it also was more expensive to rent. I think it's safe to say that the Cabin Fever Show has gotten bigger and better every year and that next year promises to be even better than this year. I know I'm planning on attending next year and I expect most of the people on the bus are planning on getting there again next year too.

It doesn't look like there will be a bus trip to Detroit for the NAMES show – at the February meeting only twelve had signed up for it and quite a few more are needed to make it a viable trip. Victor Kosakevitch suggested that the club should consider a trip in the summer, such as a trip to the Kinzer show with a stop at Steamtown as well. There was a favorable response so it's a matter of someone looking into the details and setting it up to see if enough people will sign up to make it happen.

Bill Chernoff of Shooting Star mentioned to Ron at Cabin Fever that he was wondering about setting up a tour of the Fellows Gear Shaper plant in Springfield Vermont on the Friday before the October show at the Precision Museum. In the past Ron hasn't had much luck getting tours set up, but there's no limit to the activities that the club can do, it just takes someone to make it happen.

Don Strang said that you could call ahead to Starrett to set up a tour. They do tours for up to 10,

but he says that 3 is probably a better number as with 3 everyone can get a good look at everything.

We have a new policy with the museum; from now on the door needs to be locked after the meeting has begun. You will still be able to get in through the Internet center up until it closes at 8 PM. Ron is going to see if we can rig up some sort of signaling system so if someone arrives late they can signal for someone to come down and let them in. We also will need to be sure not to park in the parking lot for the building residents. If the building management were to decide we are causing problems and need to get a police detail to manage the parking situation it would probably cost more than the clubs finances could support.

Our Club show will be held on Saturday February 17th, which will be history by the time this arrives in your copy of the Gazette, but it is an important way that the club helps to support the Museum by increasing the attendance for the day of the show and bringing in people who might not otherwise be aware that it is there. So if you didn't get there this year, plan to come next year.

The club has another batch of tools that we may need to help liquidate. It sounds like a big shop. Ron Ginger, Roland Gaucher, and Jim Paquette will be going to look it over. Ron will let us know more if he needs more help.

The January issue of the Gazette was mailed in an envelope. It cost 55 cents to mail because it had so many pages, normally an issue would go in an envelope for only the single ounce rate of 34 cents. The members at the meeting seemed to feel that the envelope had gotten the issue to them in good condition and that the envelope was a worthwhile way to mail them. The club also agreed that it would reimburse Kay Fisher \$3 a month to pay the fees for the web site he has set up to provide all the back issues of the Gazette on line.

Rob McDougall talked to the scraping guy at Cabin Fever. He does workshops to teach people how to scrape, and Rob asked him about coming to do one here for NEMES members. The question was how many would be interested in attending a ½ - ¾ day session of 10-15 people for \$50 each?

Quite a few people seemed to be interested, so Rob was going to check into it further.

Rob announced that Ron Ginger had been made an honorary lifetime member of NEMES, and presented him with a nice plaque. It was blank, and so Rob took it back to get engraved appropriately. Ron commented that it sounded like we were setting it up so he couldn't quit. He's enjoying the club very much though and is expecting to be doing it for a long time.

Ron has been saying forever that he doesn't mind running meetings but that he needs help to set up the programs and such, especially now that his new job has him traveling more than ever. Max ben-Aaron has stepped forward to organize the meeting programs. So, if you think of something that you think would be a good talk at a meeting, get a general agreement to do it from the speaker. Then get the subject and contact info to Max and he will schedule the talk for a specific meeting. If you have an idea for a talk but not a speaker, let Max know that too.

Ron Ginger was the main speaker for the evening, talking about his experience with setting up CNC systems on machines in his shop. Ron got interested in CNC when Roland Gaucher bought a real commercial CNC mill with Acurite controls. Ron took a look at it and decided it was definitely a cool toy and that got him involved. The result is the CNC controlled Sherline mill that was engraving on the cylinder at the Cabin Fever Show.

For CNC you need a good machine to start with. Ron bought a Grizzly mini-mill to convert to CNC. At \$495 it's not a bad machine, but he has it for sale now – it's not enough bigger than his Sherline mill to be worth keeping as a second mill.

On the Internet there is a mailing list devoted to CAD-CAM CNC that has been extremely active for a year or so now. The typical start there is to buy an older commercial NC or CNC machine, to junk the existing control system, and to replace it with a new CNC system. Others are getting a machine and replacing the existing lead screws with ball screws. What ever route you decide to take to set up a CNC machine though you need two things:

1. You need a good machine.
2. You need ball screws for their low friction and lack of backlash. (you can use an acme screw with spring loaded backlash elimination)

A lot of programs say that they have “backlash compensation” built into the software, and mathematically it works just fine. The problem is that you end up putting a divot in the work while the compensation is working. Cutting rectangles on the machine axes it works fine. Problems crop up when you try to cut diagonal lines and circles.

How to get rid of backlash? The number one way is to get ball screws. The number two way is with Moglice. After the talk at a meeting about Moglice Ron saw a booth at Eastec for a company called Philadelphia Resin, which has a product, similar to Moglice, but cheaper. He used it to make the leadscrew nuts for his Sherline mill and so far they are working perfectly. For the Grizzly he used the same and was unable to get the resin to move in the cast nuts – so you need a smooth screw to cast the nuts. However you do it, you need to get rid of the backlash.

Once the lead screws are set up without backlash you need to get the motors mounted to turn the screws. On his Sherline Ron mounted the motors directly to the lead screws themselves. For larger mills you need to mount the motors so that they connect to the lead screws with pulleys so that the motors get enough leverage to move things.

The two motor options for driving a CNC machine are steppers and servos. A stepper motor has a number of steps per revolution. It moves one of these steps for each electronic pulse it receives from its drive circuits. Different size stepper motors have different torque ratings. As long as the torque rating is not exceeded the stepper motor will stay on its “step.” This means that with no power to it the motor will not move. It also means that the driver has to ramp the motor up and down its speed in order to keep from exceeding the torque rating and losing track of where the motor really is. Servomotors are plain old permanent magnet DC motors that have an encoder built into them that sends back position information on where the motor

is. Servo motors can’t lose their step, because they don’t have a step to lose, but in general the circuitry to drive them is more complex than the circuitry to drive a stepper motor and must be properly matched to the motor in use for things to work correctly.

There is a tendency for people to think they need servo systems because they worry that their stepper motors are going to get lost and then make bad parts. This is not true if properly sized stepper motors are used. For a mill drill sized machine a 180 ounce-inch rated motor is marginal. If you don’t try to push your stepper motor system beyond its limits it will not lose a step. The original NC Bridgeport Mills had stepper motors and they worked fine.

Steppers are nice because they show up surplus a lot, and they are easy to drive. Any stepper driver rated at 2 amps will drive any 2 amp stepper motor. The big thing is that there is no feedback. If you stall the motor it will lose position.

A servo with feedback will know that it didn’t move as far as you told it to go, but that’s not necessarily an advantage. If the motor doesn’t have enough torque to make the move it won’t do it any more than the stepper motor would have. If it does have enough torque for the move you need to be careful because you can snap an end mill right off or do goodness knows what to all that nice equipment when you crash it.

Servo control electronics are a lot more complicated than stepper controls, and although the servos can give you more torque and power they also cost a lot more.

Stepper motors have pretty standard wiring. Current is the important factor with a stepper drive. If you send too much current through them you kill the magnets in the motor. Drive them at high voltage, and chop off the pulse to limit the current. For a 20-volt stepper drive the voltage on the motor is only 2 or 3 volts.

A new device available from Gecko Drive is making Ron reconsider some of his previous feelings about the balance between steppers and servos for the home CNC conversion. It is a servo module used to drive 80-volt servomotors with the

step and direction signals normally sent to a stepper motor. It is widely adaptable in terms of the motors it can drive and Ron thinks he should be able to connect almost any servo to it. It only costs \$99 and may have Ron trying some of the cheap servomotors that show up surplus without any of the control electronics to use them. He had previously figured these were useless to him.

When a servomotor gets to where it's going the current to it is shut down and there is no torque holding it in position. The result is that servos tend to oscillate when they are stopped as they drift off from the desired location and the feedback causes a correction to be made. In contrast, when a stepper system gets where it is going then the pulses stop and it is locked in position with its maximum torque. When a stepper stops it is stopped. Because current flows in a stepper motor even when it's not moving they tend to run hot. Stepper motors have to be ramped up and down in speed – you can't change their speed too fast or you risk losing steps.

Steppers work reliably and repeatedly within the rated load and speed. Lots of commercial units have been sold and used reliably for years.

In conclusion, though steppers are cheaper and servomotors used to be outrageously expensive the Gecko is changing things.

Once you have a machine that has drivers and motors connected up, you need to program it to get it to actually do something. You need to make the motors move. Mathematically there are no problems moving in 4 or 5 coordinate axes. If you are doing that you need to have a real time system controlling things so that the axes move together. Microsoft Windows is not a real time OS, and it is not good for controlling motors on CNC machines. Maxnc and CNC Pro are two programs available (about \$125 each, Ron prefers CNC Pro) for controlling the motor drivers. They run under DOS and will run your machine from g-code input. Whether you are running a Sherline mill or a Bridgeport mill, the software is the same. Another software choice is EMC, which is available free from the federal government (National Institute of Technical Standards). EMC runs on Linux, which is an operating system that is not from Microsoft.

An old 90 or 150 MHz Pentium has plenty of horsepower to run the CNC software.

The final piece is to tell the tool where to go. For this you can write g-code by hand, or you can use a program. Bobcad and Vectorcad are inexpensive programs that can do 3D contoured parts. Programs can run into the thousands of dollars. Input to the programs can be plot files or DXF files.

For more info, a very focused and good source of info is the CAD_CAM_EDM_DRO email list. It's from egroups.com, which is now part of [yahoogroups](http://yahoogroups.com).

Ron has made a few useful parts with his CNC machines, but mostly has been tinkering and enjoying watching the hand wheels turn themselves.

scl



Treasurer's Report

By Rob McDougall

As of 01/31/2001

Balance as of 12/31/00:	\$2,361.24
Dues Received	1,720.00
Cabin Fever Deposits*	1,680.00
Interest Income	1.26
Less	
Gazette expense	
- Copies	-73.80
- Stamps	-57.98
Guest Speaker	-50.00
Cabin Fever Bus Fare*	-2,125.00
Balance as of 01/31/01:	\$3,455.72

* The net result for all expenses related to the Cabin Fever Bus Trip was a profit to the club of \$21.45. (Final collections are in but did not post to the check account until after the end of the month.) Rather than reimbursing this to participants I have taken the liberty of donating it to the corporate coffers. **Special Note:** If you have not sent me your dues yet, please do so by March 15th, after that, we will have to remove you from the membership list. (See your address label – it will either say “paid” or “Unpaid”.)

Rob

Stepper Motors

By Bob Neidorff

Stepper Motor Construction

Stepper motors are motors designed so that the output shaft can be advanced (stepped) incrementally through a small fixed angle. This is accomplished by energizing its windings in sequence, the right number of times or steps. The stepping motor is a position device; it is ideal for open-loop positioning and for digital control where drive pulses can be derived from a microcontroller for simple and low-cost control.

There are four main types of stepper motors: Variable Reluctance Stepper Motors, Canstock (or Tin Can) Permanent Magnet Stepper Motors, Disc Permanent Magnet Stepper Motors, and Hybrid Permanent Magnet Stepper Motors.

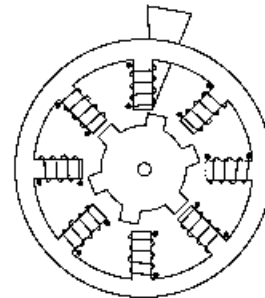


Diagram of a VR Stepper Motor

Variable Reluctance Stepper Motors:

The oldest, and least expensive stepper is the variable reluctance or “VR” stepper motor. This motor uses a non-magnetized, soft-iron toothed rotor and many wound stator poles. (*Rotor* is the rotating part of a motor and *stator* is the stationary part of the motor.) When the stator windings are energized with DC, the poles become magnetized. As the rotor teeth are attracted to the energized stator poles, the rotor moves.

VR motors suffer from low torque and are not commonly used.

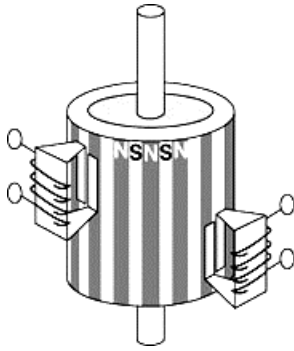


Diagram of a Canstock Motor

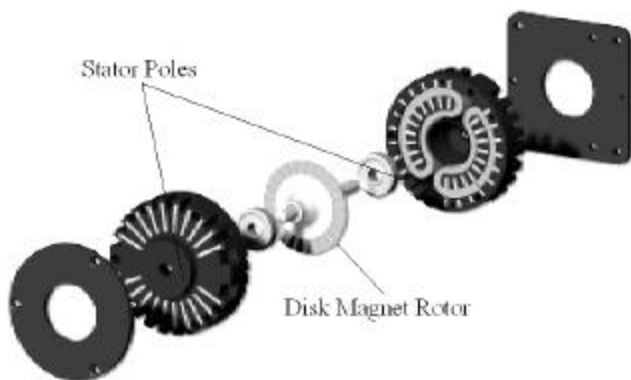
Canstock and Disc Stepper Motors:

The Canstock or Tin Can Stepper Motor is a simple permanent magnet motor with low cost and low resolution. Typical step angles are 7.5° and 15° per step, which corresponds to 48 and 24 steps per revolution. Finer positioning can be achieved using half-stepping or microstepping techniques, but these techniques don't offer the torque or precision of full stepping. The Canstock Stepper Motor has greater torque than the VR Stepper Motor and is very commonly used in printers and other devices which require moving a shaft by a fixed step.

Pictures of Various Canstock Motors



Canstock stepper motors are easily identified. They look like two thin sheet metal cans welded together, hence the nickname "tin can" stepper motor.



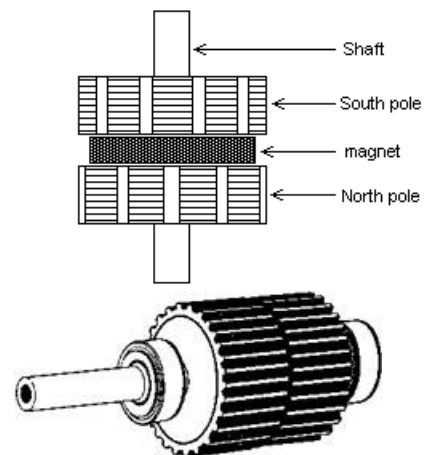
Construction of a Portescap Disc Stepper

The Disc Stepper Motor is identical to the Canstock motor except that the rotor is disc shaped rather than drum shaped. Disc stepper motors can have extremely low-mass rotors, giving very high acceleration rates.

Hybrid Stepper Motors:

For machine tool positioning, the Hybrid Stepper Motor is the most popular choice. It offers finer steps and very good torque.

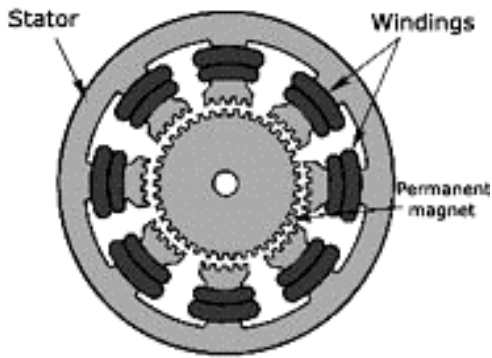
Canstock steppers require a very complex magnet to get fine stepping. Hybrid steppers achieve even finer stepping with a much simpler magnet. The rotor of the hybrid stepping motor uses a pair of soft iron "gears" sandwiched to either face of a simple permanent magnet, with teeth on one gear offset from the other. This acts like a rotor with many alternating North and South poles.



Construction of a hybrid stepper motor rotor

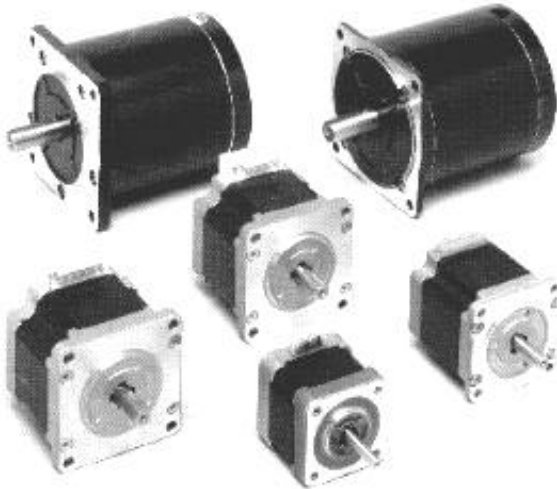
Notice how the magnet is a very simple disc, but the "gears" can be extremely complex. The more teeth on the gears, the finer the steps. Typical step angles for the hybrid stepper range from 3.6° per revolution to 0.9° per revolution, corresponding to 100 to 400 steps per revolution. As with canstock motors, the step size can be reduced further with half-stepping and microstepping.

The stator of a hybrid stepper motor is conventional, in that it has very few wound poles. However, the poles are divided into little sub-poles to match the rotor gear teeth.



Cross section of a hybrid stepper motor

When digging through a pile of surplus motors, the hybrid steppers will be easy to spot. They either look like smooth cylinders with an aspect ratio near 1:1 or they look like square castings separating a laminated core.



Pictures of various hybrid stepper motors

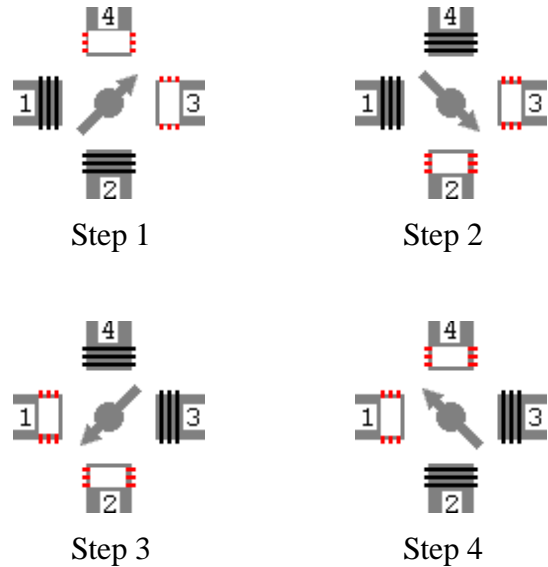
Non-Stepping Motors

Two motors that are extremely similar to stepper motors but are not really steppers are brushless DC motors and VR motors. Brushless DC motors are constructed like canstock motors with a permanent magnet rotor and a wound stator. However, the poles of the brushless DC motor are more rounded than the poles of the stepper. Likewise, a VR motor built with rounded poles will not be a stepper motor. These rounded-pole motors are superb for high-speed operation because they don't have distinct poles to give sharp fluctuations in torque and don't have brushes to add friction.

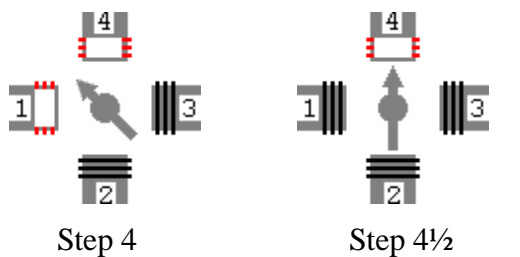
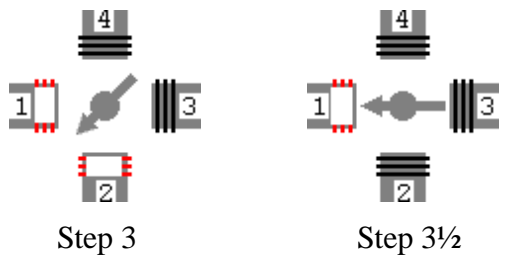
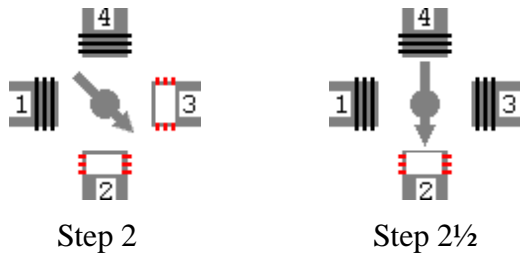
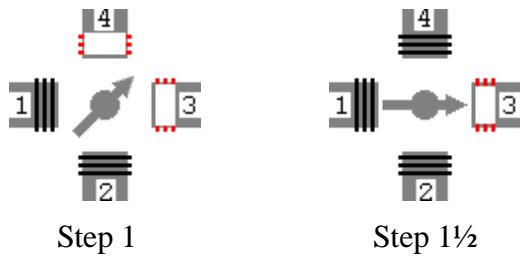
When combined with position feedback like an optical encoder, these motors can also be used for precise positioning. However, making a closed-loop position feedback system like this is much more complex than positioning with steppers, so most home builders choose steppers instead.

Half Stepping and Microstepping

The normal stepping sequence energizes two poles at once, and rotates the motor by turning off one pole while energizing a second. In this sequence, the rotor is always pulled by two poles at a time, giving the highest possible torque.



For half stepping, the motor alternates between one pole on and two poles on, giving step positions in between each main position. Half stepping has many advantages over full stepping. The most obvious advantage is finer control over rotor position. Another important advantage of half stepping is smoother rotation. This means smoother surface finish and longer tool life during cutting operations, for example. A third advantage of half stepping is that the motor can accelerate and decelerate faster because the inherent resonances of the stepping process are reduced. A minor disadvantage of half stepping is that the holding torque is non-uniform.

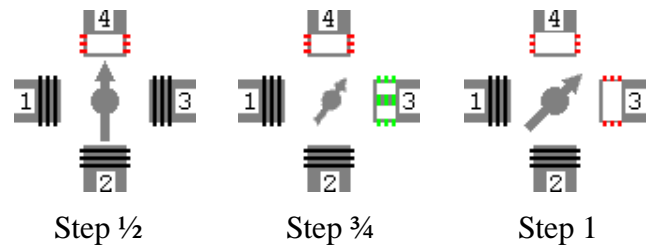


Stepper motors are always driven by electronics. It isn't practical to have a mechanical commutator to select which pole to energize. There are many different integrated circuit stepper motor controllers and drivers available. Some are extremely simple and work in conjunction with a microcontroller. Others are quite sophisticated and accept commands like acceleration profile and position desired.

Once you invest in electronics for control, you might as well use electronic power devices, such as power MOSFETs or Darlington Bipolar Transistors to switch current to the windings. These power devices are very fast switches and allow you to drive any winding on or off under logic control. They also allow you to drive a winding partially on

by quickly switching that winding on and off while controlling the percentage of time that the winding is on.

In the above sequences, the first rotor position shows poles 3 and 4 on and the rotor pointing half way between pole 3 and pole 4. In clock nomenclature, this point is 1:30. If pole 4 were driven on while pole 3 was driven with a 50% duty cycle switching signal, the rotor would point to a position closer to pole 4, perhaps at the 12:30 or 1:00 position. By adjusting the duty cycle of each pole, virtually any rotor position can be achieved. This precise positioning technique is called microstepping. Microstepping has all of the advantages of half stepping, such as more precise positioning and smoother rotation. Unfortunately, the exact rotor position does not have a linear relationship to pole switching duty cycle or pole current, so complex calculations or look-up tables are required to get the most precision out of microstepping. As a more practical compromise, people often use a stepping sequence with two or three points between each half-step.



Stepper Resources

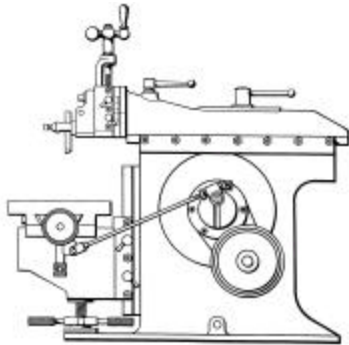
Where can I get stepper motors and controllers cheap? Old computer disk drives are a good source of stepper motors. Old dot matrix printers are another good source of stepper motors. Stepper motors are often sold at surplus electronic stores and mechanical suppliers. For example:

- Electronic Surplus Store in Manchester, NH
- All Electronics <http://www.allelectronics.com/>
- Herback & Rademan <http://www.herbach.com>
- Marlin P. Jones 800-432-9937
- Surplus Sales <http://www.surplussales.com>

There are also some very sophisticated ICs available which do more than just step. Here are some products to investigate. There are many others out there, too.

- MXC314 Aurotek Multi Axis Stepper Controller
- MXC305 Aurotek Single Axis Stepper Controller
- FT609 FerretTronics Stepper Controller

Bob



Metal Shapers

By Kay R. Fisher

Last month we talked about vertical cuts. I should mention that you always take a vertical cut by advancing the vertical tool slide down not by cranking the table up. On most small shapers there is no automatic vertical feed so you do this by bumping the ball handle once on each cut. Usually about 1/8 to 1/4 of a turn. When I got my first shaper I took all my vertical cuts by cranking the table up. When I watched Rudy Kouhoupt’s video I was shocked to see that I had been doing it wrong all along. I thought I was the only person in the world that didn’t understand this but recently I found another.

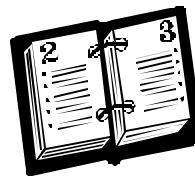
This brings up another interesting question. Should I always fasten the table support rail? Yes, you should. But used shapers frequently come missing this part. Ever wonder why? Because when working with small light cuts or soft material like aluminum there just isn’t much difference whether the support is connected or not. Without the support you can damage your shaper with heavy cuts.

In “the good old days” the shaper was the workhorse of the metal shop. Some have said that a good shaper can remove more metal in less time than any other machine. I believe before high-speed steel tools were introduced this was probably true. As my friend Max ben-Aaron is fond of saying in

reference to shapers — “If the chips don’t come off hot and smoking you aren’t working it hard enough.” To illustrate the point a bit further Don Nichols of CAMS (Chesapeake Area Metalworking Society) recently submitted this interesting anecdote:

“From an ex co-worker, who had taken over running the machine shop in our team (at an Army scientific lab), and who had previously worked in the main machine shop on post, which had some serious sized machines. He was given a particular job to do, and decided that the shaper was the ideal tool for that particular task. Nobody else had used any of the shapers for a long time, but he clamped the workpiece in place, and fired it up. This was a serious sized shaper, and he was never one to let a machine loaf. The shop had been re-arranged a few times since the shaper was last used, and the big hot chips from this machine landed directly on the foreman's desk, and started setting fire to the paperwork which was there. It was solved with a movable partition, but this does show just how long it had been since that shaper had been used.”

Kay



Calendar of Events

By Bill Brackett

March 1, 2001 Thursday 7PM
 NEMES Monthly club meeting
 Waltham, MA
 Charles River Museum of Industry 781-893-5410

April 5, 2001 Thursday 7PM
 NEMES Monthly club meeting
 Waltham, MA
 Charles River Museum of Industry 781-893-5410

April 15 Sunday 9AM
 MIT flea market Albany and Main St.

The MIT flea market is the third Sunday of every month from April through October. For 2001 that’s

April 15, May 20, June 17, July 15, Aug 19, Sep 16 & Oct 21.

Corner of Albany and Main St. Opens 9AM, usually has a line up to get in at 9. Admission is about \$4, a \$1 off if you bring a copy of the flyer from the last month.

May 19, 2001 Jim Paquette Open House

There will be an Open House at Jim's shop again this spring. The date has been set for Saturday, May 19. Hours will probably be 9:00 am to 2:00 pm. If you have any suggestions, comments etc. please contact Jim at uxbtoolman@netzero.net. Start saving goodies for sale or trade.

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@ultranet.com or (508) 393-6290.

Bill



For Sale

Air compressor

Six cubic feet/min, oil-less type, 110v, Sears. Very limited use, probably less than two hours run time. Works great but noisy. \$150 or trade?

Larry Twaits (978) 897-3324

Machine Tools

Monarch 10EE lathe with accessories. Single phase. \$7,000. Rivette 2010 lathe with accessories, 440V three phase. \$5,000. Bridgeport with J head, 36" table. \$1,800. Moore #1 Jig borers. Three phase. 2 each. \$500. Alexander copy mill. Single phase. \$1,500. Alexander Pantograph. \$1,200.

Fred Armbruster (207) 351-1558

20" Hindley Shaper

5 Horsepower 220V 3 phase. 5' high, 4' wide, 6' long. Estimated weight 4,000 lb. Best made mechanical shaper in the country. Fully automatic. **FREE!**

Tom Peletier (978) 537-9572

Wanted Craftsman Lathe Docs

Does anyone have a copy of the parts/instruction manual for a Sears Craftsman 6" lathe-the Atlas type w/ 1"x10 spindle? Will pay for copying costs or will copy and return.

Howard Evers (508) 987-0654

Web Sites of Interest

United States Patent and Trademark Office

<http://www.uspto.gov/>

Houston, Texas Home Metal Shop Club

<http://web.wt.net/~hmsc/>

The Industrial Age Workshop (Robert "Mac" McIlvaine's home page) and US representative for Erten International's ERT Machining Center

<http://www.industrialageworkshop.com/>

Stepper motor references

<http://www.globalsources.com/MAGAZINE/EC/TWATCH/STMOT01.HTM>

<http://www.globalsources.com/MAGAZINE/EC/TWATCH/STMOT02.HTM>

<http://www.globalsources.com/MAGAZINE/EC/TWATCH/STMOT03.HTM>

<http://www.eio.com/jasstep.htm>

<http://www.cs.uiowa.edu/~jones/step/>

<http://www.ams2000.com/stepping101.html>

http://www.euclidres.com/apps/stepper_motor/stepper.html

<http://www2.ebtech.net/~pais/Stepper.html>

<http://www.doc.ic.ac.uk/~ih/doc/stepper/>

<http://www.controleng.com/archives/2000/ct10601.00/000600w1.htm>

<http://www.techno-isel.com/Tic/H830/HTML/H830P023.htm>