The NEMES Gazette

Vol 05, No 053
September-2000

The Newsletter of the New England Model Engineering Society
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Our next meeting is at 7:00 PM on Thursday 7-Sep-2000 (first Thursday of every month) at
The Charles River Museum of Industry
154 Moody Street
Waltham, Massachusetts

Annual dues of $20 covers from Jan to Jan. Please make checks payable to NEMES and send to our treasurer. (Address in letterhead).

This Months Contents

From the Editor's Desk

By Kay R. Fisher

Somehow last month I managed to cut off the last half of the article from Jay W. Stryker. So this month I have included the missing material plus just a little from last month for overlap. See the whole story in the "Questions from way out west" section.

We have a new column this month from Max ben-Aaron. I have been bugging him for a "Connections" column for months. He called this submission "Random Ramblings" but I changed the name. I think he can bridge the gap by making a connection between this months column and his next. Welcome aboard Max. I hope the rest of you will take a chance to thank Max and encourage him to make many future contributions to the Gazette.

Group Purchase

Three members haven't picked up their scraper books and videos yet. Bob Cookson, Ed Borgeson, and Neil A. Brock. If you can't make the next meeting please let me know.

Kay

The President's Corner

By Ron Ginger

September Meeting

A few weeks ago, I took one of my network switches to a company in Westboro for a repair. While I was there I noticed a fellow with a large locomotive drawing on his wall, so thinking I had found a new model engineer, I struck up a conversation. It turns out he is not a locomotive modeler, but a Radio Controlled aircraft modeler. We talked a while, and he showed me some amazing photos of the planes he has built, and some of the detail of their control. I told him about our club, and a bit about our version of modeling.

He suggested we do a speaker exchange and I thought that would be a fine idea.

Therefore, our speaker for the September meeting will be Collin Tower and possibly another member of his R/C club. He will be bringing a couple of his planes to show and explain some of the controls and construction.

I have always been interested in R/C, but never really looked into much detail; this should be an interesting evening. I will be speaking to his R/C club at the end of September and would like one or two of our members to go along to show some of our kind of models. Let me know if you would like to be part of that.

September Show

Ed Rogers has again arranged for us to be at the North Shore old car show on Sunday, September 10. We have been there the past two years and it has been an interesting day. Many nice old cars to see and the car guys seem really interested in our models. The show is on the Topsfield Fairgrounds, just off I-95 and Rt. 1 in Topsfield. Its opens about 9 AM and there is activity until about 4 PM. We will have a nice tent for shade and tables for our models. There is also quite a large car flea market.

October Meeting

The speaker for October will be Denis Edkins talking about jet engines. In the late 1930's, Denis worked on the early development of jets in England and he is a real expert. He has sent me some material about his talk and he will be covering some history and some very interesting technical details.

Cabin Fever Show

I have told Gary Schoenly that NEMES will arrange a demo at the show this year. He is working to get us some machinery to use. We just need to decide what to build. Steve Lovely has a nice whistle design that is possible, and I am trying to work out a simple gyroscope. We can still use some suggestions, so if you have a good idea please let me know. Remember, it should be something that can be built simply, to show both a lathe and a mill in action, and be a neat give-away for the kids attending the show.

Sound System

I was troubled at our last meeting that it was so hard to hear Cal. It occurred to me that since we are a club mostly of old men that like machinery, we probably have all lost more hearing ability than we want to admit. I polled the club officers and we agree that spending some of the clubs money to help solve this problem is appropriate. So, if we are lucky at the next meeting we will have a new sound system. As I am writing this several of us are still trading notes over e-mail to work out the best approach. We appreciate the work done by Bobby and Don with the current speakers, but I think we can do better. I am determined we should be able to hear our speakers!

Ron

Calendar of Events

By Bill Brackett

September 3 Owls Head
Antique Motorcycle Festival

Sept 7, 2000 Thur 7PM NEMES Club Meeting
Waltham, Ma.
Charles River Museum of Industry 781-893-5410

Sept 8-10 Dublin NH Rt. 101
Granite State Steam and Gas
Phil Barker 603-495-3640

Sept 10-17 Lees Mills NH
Lake Winne. Steamboat rally
Jackquie Dearborn 603-726-3257

Sept. 14-17 Fitchburg Show
At The Fitchburg Airport, MA
Grover Ballou Jr. 413-253-9574

Sept 15,16,17 Southwick MA
Pioneer Valley Live Steamers Fall Meet

Sept. 15-17 Powow Cove Show
Powow Cove Campground, Amesbury, MA
Bruce Eaton 603-394-7660

Sept. 16-17 Tobacco Valley Flywheelers
Valley Rxr, Essex, CT:
Allen Koch 860-635-4287

September 17 Owls Head
Tribute To Convertibles

Sept. 22-24 Cranberry Flywheelers Meet
S.Carver,MA Edaville RR
David Moore 508-697-5445

Sept 23-24 Kent CT Rt 7
CAMA Fall Fest
Josh Reynolds 860-868-0283

Sept. 23-24 Lion's Fall Foliage Show
U.S. Rt. 2 St. Johnsbury, VT
James Young 802-748-3994

October 1 Owls Head
Foreign Auto Festival

Oct 5, 2000 Thur 7pm NEMES Club Meeting
Waltham, MA.
Charles River Museum of Industry 781-893-5410

Oct 7 9-4 Yankee Steam-Up
The New England Wireless And Steam Museum
401-885-0545 Robert W. Merriam, Director

Oct. 7-8 Water's Farm Days Show
Exit 4 (Sutton) From 1-395
4 Miles To Douglas Rd.
(Right) After Church Then Left On Waters Rd.
W. Sutton, MA
Butch -508-234-5035

Oct. 7 Lebanon Show
Tomapo Farm, Off Rt. 120, Lebanon, NH
Bruce Townsend 603-448-1125

Oct. 14-15 Cranberry Flywheelers Meet
S.Carver,MA Edaville RR
David Moore 508-697-5445

Oct. 14-15 Martha's Vineyard
West Tisbury, MA
Dale Mcclure 508-693-9456

October 15 Owls Head
Ford Vs. Chevy Meet

Oct. Call Granby Show
Call George Randall 413-467-9541

Oct. 21-22 Bangor, PA Show
Jacktown Community Center, Bangor, PA
610-588-7466

Oct. 21-22 Model Show- Windsor, VT
American Precision Museum
Call: 802-674-5781
www.americanprecision.org

October 29 Owls Head
The Great Fall Auction & Open House

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

Connections

By Max ben-Aaron

I recently acquired a vertical/horizontal milling machine which weighs close to half a ton. I picked it up in Springfield, in the shop of John (never found out what his last name was), who is a specialist in the restoration of Pierce-Arrow cars. We took it apart - three major components, column, base and knee - and some bits and pieces, and loaded it into my rented van using the engine hoist.

I drove very carefully from Springfield to Bedford with half a ton of unsecured cast iron behind my seat. Not a recommended procedure. I took great care to ensure that I should not have to brake suddenly, but, even so, the angel that takes care of fools like me must have been sweating by

the time I got home. I swore that I would never do anything so idiotic again.

Getting the machine out of the van into my driveway presented another problem that I had ignored in my enthusiasm to acquire the machine. Fortunately, my next-door neighbor has a 'toy', a little Kubota tractor that has a backhoe and a front loader. With their help the pieces of the machine were soon sitting under a fir tree in my driveway, otherwise I would have been renting the van for a month instead of a day.

My son was to be my resource for getting the machine into my basement, but my timing was bad - he was preparing for the bar exam and would not be available until the end of July. The precision machine would have to sit outside, exposed, for at least a month. I smeared cheap generic 'Vaseline' on all vulnerable surfaces and covered the parts with tarps and hoped for the best.

The imbecile who had owned my house before me had bricked in the access hatch to the basement, so the only way down is through the kitchen and down the very rickety steps. While I was waiting, I decided to shore up the steps. I figured that I might as well build shelves under the steps while I was doing that. By the time that chore was done and I had poured a decent concrete pad for the machine it was time to move it downstairs.

Three husky young men ("strong like ox, smart like tractor") made short work of moving the iron into the basement, leaving the base on the new concrete pad, with the column sitting on it (more or less in place, but not bolted down) and with the knee loosely attached to the column.

I bolted some plywood plates to the rafters and mounted a piece of 1 1/2 inch black galvanized pipe between the plates. Without the come-along hanging from the pipe I would not have been able to move anything.

The machine is now well along and will soon be making swarf. Its sojourn outside does not seem to have hurt it. I am amazed that I managed to keep all the significant parts together; I lost only two nuts and one washer.

When the machine was disassembled there were about ten thin wooden shims. Six of them fit between the steel cabinet base and the cast-iron table that rests on it. I was not there when they took the table off the cabinet, and I don't know where the other four came from, so I have not installed them. Does anybody know where they should go?

This is the fifth machine I have disassembled, moved, and then reconstructed in working condition. I am not the best millwright you have ever seen, but neither am I the worst. I wonder what the qualifications for the job are; would I be worth my wages as a millwright? I hasten to add that this is a rhetorical question.

Mb-A

Questions from way out west

By Jay W Stryker

Bridgeport Zerk Oilers

Bridgeport milling machines were originally fitted with a lot of oil points using the "Zerk" type spring and ball closing fitting. Unfortunately, these are the same as the commonly used grease fittings and I am always coming across Bridgeport mills being greased. This happened a few days ago at work and the (young) foreman did not know that he was supposed to be using way oil.

(Most of the machines in the shop have one-shot lube with way oil.) He wondered why the older ones took grease!

I spoke with Peter at Brother's Machinery, and he says that they always lube the machines they sell with way oil and that they have their own pressure oil gun. No, he only had one, and said such guns used to be supplied by Bridgeport with each new machine. He had none to sell.

In calling various suppliers, they all said that the old style pressure oil gun is off the market.... but also Alemite has just put one back on the market, at about $120.

I was told once that an ordinary oil gun, or a modified grease gun, would do the job.

Question: who in NEMES uses a pressure oil gun on their Bridgeports?

Is it a Bridgeport original? A modified grease gun? A modified oil pump gun? Custom built? A new one?

And, now I have found that there was a commercial oil gun made by

Schrader Bellows
"Oil Fill Gun"
Model B161-003

The Schrader Bellows oil gun is off the market, but some are “around”. I tried to buy one I saw but no sale. Do any NEMES folk have one? Use one? Did you build your own? Did you change your older B'port to one-shot lube?

By taking off the Zerk fitting and checking the oil hole, you might just find congealed oil -- or grease. My tip for this is to find some long pipe cleaners (now on the market more as crafts items to make "twisty and fuzzy" toys) soaked with grease remover and try and dissolve and pull out that greasy goop from as much of the oil tube as possible.

Steam Locomotive Expert in Cuba

I have been told that one of the world's last steam locomotive designers is alive and well and working on locomotive designs, in Cuba! Dr. Porta worked in Argentina for many years on the locomotives used for copper ore hauling. When they were replaced with diesels, he was invited to Cuba to help boost locomotive efficiency on the sugarcane hauling locomotives.

Would it be possible for some engineering group, perhaps a venture between MIT and NEMES and the various live steam clubs, to contact him and learn about his latest designs?

I understand he is elderly but still in reasonable good health. He would be the last in a line stretching back to Trevithick and Stephenson.

At the least, those of us interested in steam locomotives should recognize such a designer.

Perhaps, at the grandest, he could be brought to Boston for a series of technical lectures (via translator?).

Thanks for the info. [Editor’s note – if you think you have a good answer for Jay he is at (413) 665-3125 in South Deerfield]

Jay

Treasurer’s Report

By Rob McDougall

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As of 7/31/00

Balance 6/30/00	**$3,523.30**
Dues Received	70.00
Interest Income	2.16
Less:	
Gazette expense	-224.75
Advance payment for 12 books + videos on Scraping	-600.00
Balance 7/31/00	**$2,770.71**

Note: Maintenance of the official membership database now resides with the Treasurer. Please notify Rob McDougall of any updates in your contact information.

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Rob

The Meeting

By Stephen C. Lovely

The Meeting, 3 August 2000

As usual, Ron Ginger started the meeting off with a few words.

Ron has heard from Gary and Jared Schonely, the organizers of the Cabin Fever Show. The one coming up will be in a new location. It's about 20 miles further, but is closer to the interstate so the bus ride for us should be about the same. The new place is bigger, has a better kitchen so the food should be better, and is closer to hotels. The Schonelys would like to have a demonstration area with machines set up and actually building a project of some sort and asked Ron if NEMES could organize it. The balloon engine was done at the last NAMES show in Detroit, so they would like something different. I suggested whistles, and Ron is going to run that by the Schonelys to see what they think and also see what other suggestions he gets for a small project that NEMES members could make and hand out at the show. If you have a suggestion, get it to Ron.

Last year we had a busload of folks who went to the Cabin Fever show, and this year it looks like we'll have at least that. Ron would like to see TWO buses go from NEMES to the show. Each bus will carry 47 people.

Howard Gorin suggested a bus to the big machine tool show in Chicago. The general tenor of the response was that it was just like Eastec only a lot bigger, and since Eastec is too big to see everything what's the point of going all the way to Chicago?

Ron suggested a bus to the American Precision Museum's first model engineering show in October. It's going to be held in the High School Gym a block from the Museum. The Museum will be open during the show. Things will be happening both places. This is the first of what will hopefully become a regular annual event, so there's no telling what will happen. It doesn't look like a bus will be organized to go to this one; car pools are more likely since it's relatively close. We should try for a good turnout from NEMES because it's pretty close and should be a good time.

Next month's program is still up in the air as of the meeting, but the program is set for October. Denis Edkins will talk about the gas turbine. He is the last living member of the team who worked to develop the first jet engines in England and was a friend of Whittle. Denis isn't a member of NEMES but has come to our shows and was at the poster session in June with the steam plant out of one of his model boats.

Errol Groff passed out instructions on how to use an edge finder. He says when you buy them from Starrett they expect you to know how to use them as there are no instructions.

Geoff Brown let us know about a shop in Whitman Mass that is looking for a place to donate a bunch of old machinery too. The shop was started in the 1930s and they are looking for a 501(c)3 group that could utilize the entire package as a display. There are a couple of lathes, a couple of horizontal mills, a 10" Hendy shaper, some other machines, and all the line shaft to run it all. There is about a boxcar's worth of stuff altogether.

Ed Rogers brought up the Topsfield Fairgrounds show. This year it's going to be the 10th of September, which is the Sunday of the Dublin Show weekend. From the hands raised he's going to plan on one tent, and as requested he will try to get it located near the center of the action so that people will be able to see that NEMES is there.

Leon Schiff brought in a few pounds of sharpened end mills to give away. They have Brown and Sharp tapers on them in sizes 5, 7, and 9. If you can use them get in touch with him as he's got 500 pounds more at home.

Douglas Ruska announced that he recently bought a machine shop and now has lots of extra stuff that he wants to sell. It includes 3 surface grinders, horizontal mills, and a bunch of lathe parts, and tooling. You can reach him at 617-783-

3020 if you want to see if he's got what you're looking for.

Don Strang reports that most of Paul Budlong's stuff has already been sold.

He had Paul's Stirling Tractor project with him and it sold at the meeting. He also passed around a photocopy from an American Machinist showing the first Ericson hot air engine of 1880.

Jeff DelPappa is back from the Scrap Heap Challenge (known here in the USA as Junkyard Wars) in the UK and came dressed up in his official Maroon Coveralls with "Jeff" on the front and the pocket protector logo of the New England Rubbish Deconstruction Society (the Nerds) on the back. As most of you probably know, Jeff saw the "Junkyard Wars" show on the TV and was filled with a burning desire to become part of it. He then investigated it, found out how to enter a team and proceeded to organize a team that successfully auditioned as a living sewing machine, and proceeded to fly to England with the rest of his team to compete in the show.

For the first round of the competition the Nerds and the other team needed to build a two person wet sub to negotiate an obstacle course. The subs were constructed, then taken to the course, which was located in a British Navy hull test tank 160 by 120 by 5.5 meters deep. The big problem here was to maintain neutral buoyancy. The Nerds used foam, which stayed pretty much the same volume down as deep as was needed. The other team used metal cans. With enough air in the cans to keep them from collapsing as you went down to the bottom, they would not hold up at the surface and would leak. So the Nerds managed a win on their first round challenge. That was in June.

In July the Nerds were back in the UK for the second round. This time it was a steam car race. The Nerds vehicle was based on a "Reliant," which is a three-wheel car that weighs under 10 hundredweight. In the UK it is legally a motorcycle with a sidecar, which means it costs a lot less to operate on the roads. Because English law has pretty strict rules dealing with boilers and steam, they were essentially provided with a boiler and a single cylinder launch engine to put into their vehicle. They built a fairly light machine, cutting the top off the Reliant in the process. The boiler burned coal.

A flatbed truck took the two teams' vehicles to the National Motor Museum in the New Forrest to have a three-lap race around the track to decide the winner.

At the race site the Nerds had steam up in 20 minutes and were able to practice some with their vehicle. The other team took an hour and a half. The other team broke down at 1/3 lap and the Nerds lapped them but were unable to pass because they were broken down at a narrow point in the track.

The Nerds won the three-lap race by a lap and a half.

The third challenge was to build a fireboat, cross the lake in it, put out the burning garden shed, and then return. For this one the Nerds cut a Landrover in half, using the engine to power a centrifugal pump they welded up from a vented disk brake and a few other odds and ends. They turned the front half of the Landrover into a boat by using oil drums for floatation. The pump would absorb all the power they could get out of the engine, and put out enough water from the nozzle they were using to provide 80 pounds of thrust.

The other team was from the British Army and made a piston pump out of an engine by replacing the head with a plate and some check valves. The piston pump worked but the fires were wimpy and both teams had them out in about 10 seconds. The Nerds, navigating the Landrover using the thrust from the pump for propulsion, ended up losing the boat race to the army who had a much lighter craft and four people paddling like mad.

So, after two straight victories the Nerds lost out on the third challenge despite producing a superior fire-fighting machine. Every cloud has a silver lining though, because Jeff was out of vacation and couldn't have gone back again right away anyway.

When will the shows be broadcast in the US? Jeff doesn't know, but suggests you call the learning channel and ask. There are seven shows from the English version that are ready to go but have never been broadcast here in the US. The American version of the show is being taped in the same junkyard as the UK version - it's cheaper to fly the teams over there to tape than to insure it to tape here.

The final show in the series of four that the Nerds were in was to build a dragster. If they had been in that show they planned to cut a car in half vertically the long way, since they'd cut the top off one and the back off another in two of the earlier shows. Jeff got three one-week trips out of being on the show, plus a lot of fun. Ron told Jeff that he was impressed that he had managed to pull it all together and to get a team into the contest.

Kay Fisher brought a laser thermometer in that he'd picked up for a hundred bucks. You put the red dot from the beam on what you want to measure and it tells you how hot it is.

The main speaker for the evening was Cal Guiry. He started working for Fafnir Bearings in 1950.

In 1909 in New Britain Connecticut, Hart and Cooley wanted to build a car. They went to Eliza Cooper and asked him to make a ball bearing machine so that they could have ball bearings in the cars spring shackles. He made them a machine in six months. Then someone else came to him to ask about making a double bearing pillow block for line shafts. This pillow block used two ball bearings, the block was self aligning, but not the bearings inside it.

At that time most of the ball bearings that were available came from Europe and Cooper had problems with the imported competition. He asked his wife to come up with a suitably European sounding name and she picked Fafnir. Fafnir is the magician from Wagner's operas. The logo was a dragon in a bearing. Fafnir made ball bearings from 1/16 inch to 4 1/2 inch diameters.

Most bearings today are made from 52100 steels. These are not stainless steels, but do contain a lot of nickel. The balls are made from 51100 steel. 440C is a stainless that is sometimes used in ball bearings.

Machining the inner and outer rings is a precision job, but making the balls is the most interesting part. Up to 1/2 inch balls are made from wire. The wire hits a stop and is cut off. The piece goes into a hammer with cups in the face and formed into a rough sphere. From there it goes into a machine were it goes between two stones rotating in opposite directions. The stones grind the balls into spheres as they roll between the two moving surfaces.

From rough grinding they balls go into heat treat, where they are heated to 1200 degrees for two hours. Then they are quenched in oil and the temper is drawn for five hours at 400 degrees. The balls are tested for proper heat treat by holding three of them in a Vblock for alignment and giving them a bang so one splits evenly in half. The split is then examined to insure that all is well.

After heat treat they go into size grinding. This time there is a cast iron wheel on one side and a stone wheel on the other. When they are within a tenth they go between two iron wheels within a slurry of lime. They might spend about a week and a half here. After being ground to size the balls go into polish, where they spend two weeks in ground corncob.

After the corncob polish bare human hands do not touch the balls. They are sorted for size by sixteen graduated holes and checked for proper hardness with a bounce test. The balls that go into a bearing will be within 30 millionths of each other in size.

To assemble a bearing the inner and outer races are held offset and all but one bearing is dropped in. Then at the next station a machine squeezes the races together and the last ball is added. Most bearings today are metric but Fafnir still has an inch series from 1/8 to 4 inches in size.

The race for a bearing is two per cent more open than the diameter of the ball, so blue on the ball gives an elliptical mark on the race. This

controls end shake. End shake is between 2 and 5 thousandths. Radial shake is less than 5 thousandths. For every tenth over the recommended interference between the bearing and the shaft or housing, you lose eighty per cent of the clearance in the bearing.

How do you get the desired preload on a bearing pair? Support the bearing by the outer race, and apply the desired load to the inner race. Measure the deflection. Grind the outer race so that when two bearings are pulled together the inner races push out each other the required amount for the desired preload.

A good sealed bearing should run for five years solid providing it is not over speeded and that it is not subjected to such large radial loads that it spalls. More bearings are lost due to over lubing than to under lubing.

Bearings come in ABCE classes 1, 3, 5, 7, and 9. They are all made the same way, but on different machines in different departments. For higher classes the inner and outer races are more carefully made. Heal Machinery in Worcester Mass makes the best machinery for bearing races. Most of the polished bearings are sold to people who put them into vacuum cleaners.

One of the listeners said that he has sent big bearings such as are used in rotating excavators and cranes on their bases to Avon Bearing in Ohio to be rebuilt. These bearings are 7 or 8 feet in diameter, weigh several tons each, and can cost $25,000 new. Cal says that he's familiar with Avon and that they do a good job.

Brinelling is when the balls put dents into the races. This was a problem with car wheel bearings where the cars were vibrated on a train or ship without the wheels turning so that when the new car arrived at the dealer to be sold the wheel bearings were already no good.

For grinder spindle bearings you need the bearings to be preloaded. Test the bearings for runout. You need less than one tenth runout for a grinder spindle. There is repeatable runout and non-repeatable runout. When a ball in the bearing is bigger than the rest you will notice the difference after nine turns of the bearing. You want a high precision bearing when you are making a grinding spindle.

Terminal velocity of a bearing occurs when the centrifugal force on the balls reaches the radial capacity of the bearing. In order to make the large bearings in jet engines and such that turn fast able to turn faster, the balls are hollow. M50 tool steel hemispheres one eighth of an inch thick are welded together to make the balls. Bronze retainers with a silver coating are used. Air mist lube is the best for a bearing, and many of the current jet engines have systems to provide a deluge of air mist to the bearings after landing when conditions are the harshest.

How does lubrication affect the acceptable speed for a bearing? If a given bearing will operate at 500 RPM with grease lubrication, it could do 20000 RPM with air mist lubrication (one drop per minute.)

Roller bearings are now used in the front wheels of cars to avoid the brinelling problem. Cal had a bunch of Heal Boremastic heads on a rack that was vibrating and it ended up ruining the bearings in about 60 heads.

About 98% of the balls are good. That's because they are very careful at every step of the process while making them.

Asian ball bearings are excellent. After all, we taught Japan how to make them. Since WWII India, Russia, and Sweden also make ball bearings. MRC, New Departure, Fafnir, and SKF all make good bearings.

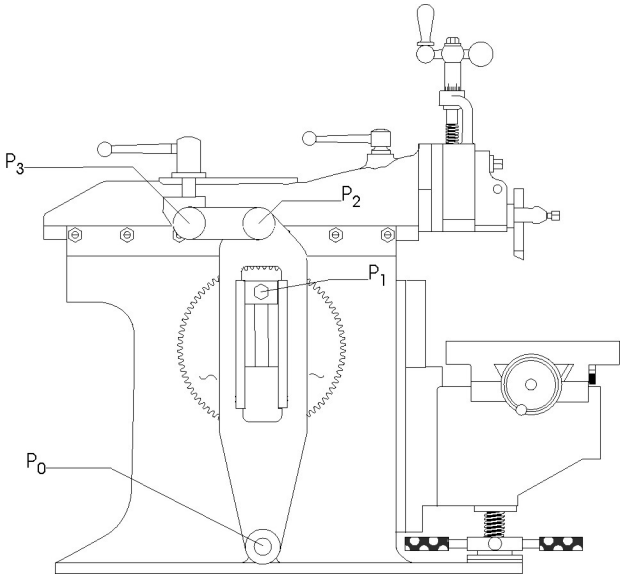
Loctite brand Adhesive for Bearings is good to a 5 thou fit. If you press the inner and outer both you've got a tricky situation because of the potential for losing all the clearance in the bearing - you can brinell them just installing them. Using the adhesive to secure the bearing you don't run this risk.

Finally the subject of ball bearing races came up. This is where you hold the inner race, blow on the outer race with compressed air to get it spinning, and then drop it onto the floor and watch it race across the room. It is not

recommended because it is possible to overstress the outer race, turning it into shrapnel and probably doing a real number on your hand at least. So, don't do it.

See you at the meeting,

Scl



Metal Shapers

By Kay R. Fisher

But wait – there's more. Remember our discussion about the proper motor direction along with the related math. It's back! I know I promised no more math but I received some interesting feedback from the previous article including some related engineering work.

Previously we talked in depth about the cutter speed but not a lot about the power or force. At the next meeting we had a lively discussion about whether changing direction would increase the life of the bull gear and pinion or decrease its life. In a room with 70 home shop machinists a few believed you could increase gear life by running in reverse (using the previously unused side of the gear), a few believed you decrease gear life (stressing the gear in a new way after it has been stress relieved in use for many years), but 90 percent of the members thought you would never see any difference or failure because the run time on a shaper by a home shop machinist is so small compared to the long life expectancy of the machine.

Dave Piper however brought an interesting perspective to the question by doing a little engineering work on the problem of force. The forward stroke is the power stroke and slow. The return stroke is fast with no load. Obviously the force on the gear teeth is at maximum in the middle of the power stroke. In the entire return stroke (and certainly in the middle) it would be minimum. If you reversed the motor then the maximum force would be in the middle of what used to be the return stroke.

What would be the maximum force applied on the teeth if the only change was to reverse the motor - that is if you kept the depth of cut and table feed the same?

If point P_1 was not offset much (a short stroke) or if the length of the rocking arm (from P_0 to P_2) was very long with the bull gear very high (close to P_2) then the difference in force between forward and reverse would be negligible. Dave supplied some formulas so we can check the difference for some real numbers.

F = Cutting force.

F_G = Force exerted on the arm by the gear.

F_{G1} = Force when offset is at top of bull gear (as pictured).

F_{G2} = Force when offset is at bottom of bull gear.

T = Gear torque.

R = Radius of offset adjustment in bull gear.

X = Distance from P_0 to P_1.

X_1 = X when offset is at top of bull gear (as pictured)

X_2 = X when offset is at bottom of bull gear.

L = Length from P_0 to P_2.

The sum of the moments equals zero.

$$\sum \overset{+}{\circlearrowleft} M_0 = 0$$

Our assumption is that the shaper and all its various components are moving relatively slowly. The cutting loads are continuous and constant and the dynamic loads are insignificant compared to the steady state cutting loads.

If this were not the case, then the above equation would not equal zero and we would have to factor in component weights, variation in load, spring when entering or exiting the cut, and etc. The dynamic load is relatively small and the cut relatively steady.

So imagine we are taking a "snap-shot" in time. We are looking at the instantaneous position when the ram is at mid stroke and the block, at P_1, is all the way up and/or all the way down. At this instant, the loads just balance each other and we can look at the problem as a static problem, not dynamic

$F_{G2}X_2 - F\,L = 0$

$$F = \frac{F_{G2} X_2}{L}$$

Transposing I get:

$$F_{G2} = \frac{FL}{X_2}$$

And therefore also:

$$F_{G1} = \frac{FL}{X_1}$$

This says that F is constant and the force (F_{G1} & F_{G2}) is proportional to X/L. This is the force at the sliding block not the force actually on the gear but what we care about now is just how much the force changes if we reverse the motor. For instance if it changes 39 percent (and it does) then the force applied to the gear would also be 39 percent higher if you reversed the motor.

Plug in values for L, X_1, X_2, and F and see the torque on the gear is $T = F_G R$.

Therefore the torque is proportional to the force F_G. Gear stress is proportional to F_G (assuming Hertzian contact stress).

For my 7" Rhodes these values are:

L = 16.5"

X_1 = 11.625"

X_2 = 8.375"

I don't know how to measure or properly estimate force F but all we care about is its relative change reflected back to F_{G1} and F_{g2}. So I will assign a value to F of 50 pounds of force. This in turn would be a cut of something on the order of .025 deep x .005 wide in mild steel.

To calculate for force with a forward motor we would use values for X_1.

$$F_{G1} = \frac{50 \times 16.5}{11.625}$$

$$F_{G1} = 70.97 \text{ pounds.}$$

The force with a backward motor direction would be calculated using X_2.

$$F_{G2} = \frac{50 \times 16.5}{8.375}$$

$$F_{G2} = 98.50 \text{ pounds}$$

So as you can see if you reverse the direction of the motor the force applied back on the gear increases substantially.

Kay

For Sale

Kennedy Model 520 machinist's toolbox. 7 drawers, felt lined. Front cover. Not in perfect condition, but not beat up either. New retail is about $150; I'm asking $25. If interested, please call me @ 508 987-0654. I can bring it to the next meeting.

Howard Evers

Wanted

Not for a particular project, but just to complete a set. 33/64" and 43/64" #2 Morse taper shank drills.

Howard Evers

Web Sites of Interest

Waushakum Live Steamers

www.medugorje.com/waushakum/

Pioneer Valley Live Steamers

www.the-spa.com/jim.cook/trains.htm

You can get a FREE copy of TurboCAD 2D at

http://www.turbocad.com

The NEMES Gazette

Newsletter of The New England Model Engineering Society

c/o Rob McDougall (Treasurer)

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