The NEMES Gazette

Vol 06, No 066
October-2001
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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
4-October-2001 (first Thursday of every month) at
The Charles River Museum of Industry
154 Moody Street
Waltham, Massachusetts

Annual dues of $25 covers from Jan to Jan.
Please make checks payable to NEMES and send to our treasurer. (Address in masthead).

Missing a Gazette? Send mail or email to our publisher. (Address in masthead).

This Months Contents

The Editor's Desk

By Kay R. Fisher

The sale of the NEMES CD went better than I anticipated. I made seven and sold them quickly. Orders were placed for 20 more for the next meeting. If you want a CD and can't make a meeting send your check for $5.00 to my address in the masthead.

If you missed the scraping class you missed a great class. It was fun and the three instructors (Rob McDougall, Larry Twaits, and Fred Widmer did a great job).

Stephen Lovely no longer has time to write up the minutes of the meeting for the Gazette. We are looking for someone to step up to the plate. Please send me email or make yourself known at the next meeting if you could make this valuable contribution to the club and the Gazette.

October Meeting

In October, Bob Cline (who just recovered from having a pacemaker installed) will tell us how to get the 30,000 horsepower steam plant up and ready to go on a WWII destroyer. The destroyer had two of them.

Kay

The President's Corner

By Ron Ginger

Annual Roland Gaucher Open House

This has become one of the club's major annual events - a combination of shop visit, flea market, buffet feast and just general gabfest. Everyone is invited. Bring "good stuff" to sell, swap, or give away. Bring goodies for the feast table. Or just bring yourself, but be sure to get there! The official time is 12 Noon to about 5 PM, on Sunday 21-Oct-2001.

To get to Rollies take the Mass Pike west to the Sturbridge Exit (Exit 9). Just out of the tollbooth take the second exit for route 20 east. After 1.5 miles along route 20, turn left onto route 49 north. Follow route 49 about 3 miles to Flagg road. Turn right onto Flagg, but the road will almost immediately curve left. Follow Flagg road about 2 miles to Rollie's. When you cross into Spencer MA the road becomes South Spencer Rd and Rollie is at number 90. If you reach a community center with an old army cannon in front, you just missed it. See you there!

Cabin Fever Trip

It's about time to begin planning this annual trip. In the past I have worried about getting enough people signed up to make the trip possible, this time I'm worried about selling out of space! So we will have a signup sheet at the meeting, or for the fellows that don't get to meetings, call me at (508) 877-8217 or email ronginger@rcn.com.

This year we must be very sure that everyone gets the right hotel reserved. I have held 30 rooms again at the Quality Inn (717) 273-6771. The show is January 26th and 27th. Everyone must call and make their own reservations. I have talked with the manager and she promises the dinners will be much better handled than last year. They will likely do a buffet each night. We have the option of taking the bus somewhere else for Saturday night, and I will work with Gary Schoenly to find us a nice place.

We will have more details at the next meeting and in the next newsletter. This has also become a "Don't miss" event.

Ron

Random Ramblings

By Max ben-Aaron

Big engines.

A little while ago, Ron Ginger posted the URL of a website that, only for a few days, posted pictures of a very big diesel engine built by the Swiss company Sulzer. This engine has 12 cylinders, each with a bore of 960 mm and a stroke of 2,500 mm - that is roughly 38" x 100". It puts out 89,000 HP at 100 rpm and is obviously for a ship, probably a tanker. If the ship has, say, a 40-foot screw, at 100 rpm the tips will be doing about 150 mph as I calculate it.

That engine is big, but, as I found out, not humongous. What makes it really big is the fact that it has twelve such cylinders. I was amazed by the bore/stroke ratio. Hardly oversquare. I suppose that a bore/stroke ratio of approximately one works for high speeds, but for low speeds you want lots of torque, so a long stroke is required.

In "Live Steam" magazine (May/June 1999) there was an article in the series "The Engine House", about the Harlan & Wolff shipyard in Belfast, "The Builders of the Titanic".

The Harlan & Wolff shipyard had the capacity to cast cylinders up to 110" in bore and weighing 50 tons. The columns for such large engines tipped the scales at 22 tons (2240 lb tons). For casting iron, they had cupolas with a total capacity of 75 tons and

their largest casting pit was 30 x 20 feet x 12 feet deep. Core ovens up to 20 x 25 feet, 14 feet high, were also installed. Casting of large propellers required up to 25 tons of brass to be poured at a time.

The tools necessary to machine these enormous parts had to be comparable in scale. They had a horizontal boring mill with a table 67½ feet long by 16 feet wide that could bore cylinders up to 17 feet in diameter. The boring bars for this monster were 11" and 22" in diameter. One vertical boring mill could handle cylinders 120" in diameter by 120" high.

To complement these, they had a planer that could accommodate pieces 25 feet horizontally and 20 feet vertically, able to machine both horizontal and vertical faces, at the same time, most likely. The steering quadrant lathe had a swing diameter of 35 feet, with 23 feet between centers. Not exactly a jeweler's lathe!

They had a double-ended lathe, with a 34-inch headstock at each end and an 80-foot bed. Trepanning operations could be performed on this lathe, with water-cooled boring bars for 9", 10" or 12" holes.

Gargantuan steam turbines were built as well as steam engines. One of the turbine rotor lathes could take work 100 inches in diameter by 50 feet in length. The turbine and engine erecting shop was 725 feet long, (more than two football-fields long) 80 feet wide and 67 feet high, allowing all engines to be assembled at floor level. Several cranes with 80 ton capacity provided lifting power.

In the boiler shop, immense Scotch marine boilers were fabricated by rolling, bending, flanging, drilling and rivetting 2" plate. Some of the planers could handle plates 27 feet long by 8 feet wide. The largest boiler turned out by Harland & Wolff up to that time measured 17foot 3inches in diameter x 21 foot 4½inches long. Dry, it weighed over 126 tons.

At that time, arc lights provided the lighting, requiring 2,500 HP to drive the lighting generators alone. Despite that, the roof of the erecting bay was entirely glass because the work proceeded more quickly and accurately under daylight.

To operate any of these monster tools one truly had to be a machinist. I have often wondered what it might be like to be responsible for one of those leviathans. One would have to be especially careful that nothing came adrift, I suppose, both in moving pieces up to 80 tons with a crane, and in setting them up. Except for the awesome responsibility, it seems to me that the skill level required was not much different from working at "normal" scale, although extraordinary skill might be required to achieve great precision, somewhat like being able to produce high quality work on a clapped-out machine. Because of the drastic economic effects of a machining blunder on a gigantic piece, the rule "measure three times, cut once" was probably standard, with several people checking before every operation.

Because of the rigid social structure in that milieu, I suspect that a "fitter and turner" had to serve an apprenticeship and then, as a journeyman, move slowly up the ladder, for twenty or more years, having to prove himself a master craftsman at every level, before he was allowed to lay a finger on one of these giant machines.

I wonder how many shops in the world today are capable of undertaking work of such magnitude.

Mb-A

Antique Car Show Gathering

By Dick Boucher and Mike Boucher.

Once again Ed Rogers' antique car club, the North Shore Old Car Club invited us to share a space at the Topsfield Fair grounds. It was a nice, almost too warm fall day. Our hosts had provided tables for us to set our display on and a nice tent to shelter us from the elements. We had a space right at the front entrance to the Fairground and the model car club that we have recently been in contact with joined us. We enjoyed a good response from the public and they enjoyed our projects.

Our club liaison, Ed Rogers brought and ran his two single-cylinder overhead-valve air-cooled engines, the vertical hit-and-miss air-cooled engine,

a four cylinder water cooled engine, and "of course" the quarter-scale Ford V-8.

Herb Cotterly displayed his four-cylinder in line overhead-valve water-cooled engine and his steam powered boat in progress "Weymouth." It is of plank-on-frame construction about thirty-six inches long in which he had removed the frames after construction and fiberglassed the interior, which gave him a strong hull and a lot of extra space for the steam power plant installation.

Norm Jones brought and operated his Ryder Erickson Sterling-cycle hot-air pumping engine and the newly completed Merry six-cycle gas engine. He also had a small Sterling-cycle hot-air engine that is operated by using ice cubes for the temperature differential. In the time I spent answering questions on that side of the tent, that engine brought the most questions from the viewing public.

Mike Boucher had his collection of small steam engines including his wooden grasshopper engine, all of which he was operating on air. He also had his ¾ scale Boston and Maine Pacific steam locomotive on display.

Next on the tables I had my steam table engine, a flame-licker engine, a Sterling engine, the one-inch scale PM Research drill press and the steam locomotive "Tom Thumb."

Ron Ginger showed his Stuart Turner No. 9, his four-cylinder inline water-cooled engine and a five-cylinder radial air-cooled work in progress along with his "Minnie" steam tractor.

Henry Szostek arrived on his much modified and much modernized 1970 Motto Guzzi motorcycle. The modernization included replacing the front cable operated drum brake with a hydraulic disc brake. Henry also had one of his cannons on display. Unfortunately discretion required that this particular item remained a static display.

The last exhibitor on our tables was Roland Gaucher. His exhibit included the rotary Bentley, more of the ice cube hot (cold) air engines, and his latest work in progress - a "Kozo" 0-4-0 steam locomotive. For those interested in steam boiler construction, Roland's boiler is in the early stages of construction, so all of the interior bits and pieces are open for study. I was particularly interested in the method of staying the front tube sheet and the backhead.

The conversation under the tent was (as always when ever club members gather), interesting and varied from model engineering topics to such items as rowing across the Atlantic. In between running our engines and above-mentioned conversation we also had the opportunity to stroll the fairgrounds and enjoy the fine collection of old cars gathered there.

Once again thanks to Ed for acting as liaison to the event and to our hosts, the North Shore Old Car Club, for supplying such a great venue in which to display our craft.

Dick and Mike

Treasurer's Report

By Rob McDougall

As of 8/31/2001

Balance as of 7/31/2001:	**$3,468.62**
Dues Received	40.00
Interest Income	0.82
Less	
Gazette expense	-279.12
Front door security (June)	-35.00
Front door security (July)	-50.00
Balance as of: 8/31/2001	**$3,145.32**

Rob

The Meeting

By Stephen C. Lovely

The Meeting, September 6, 2001

Things got off to a good start when Ron told us that the sound system was missing again, but it hadn't been stolen and would be back after it's warranty repair was completed.

Rob McDougall gave a pitch for the scraping seminar to be held the Saturday following the September meeting, and then brought up the issue of the amount of the club annual dues. The dues are currently $20 a year, running from January to the end of December. This is about the break-even point for the club at current expense levels, but expenses are going up. The recent color issue of the Gazette was the most expensive issue ever, costing $270 to print and mail. Without an increase in the dues the club won't be able to do anything extra that might come up.

Currently the treasury has $2000, and no more dues will be coming in for three months. Rob proposed that the dues be raised to $25 per year. That would give the club extra money and the ability to put out two or three color issues a year if needed. It also gives us more flexibility with honorariums for speakers. We don't pay our own members who talk to us, and don't pay commercial speakers who come and present us with sales pitches, but people who are asked to talk to us from outside the club are given an honorarium of $50. Rudy K got more, to cover his expenses in coming up to Massachusetts to talk to us. Another recent addition to the clubs expenses is the addition of the man to watch the museum's door during the meetings, which costs us $50 per meeting.

Kay Fisher pointed out that at one point we had shifted our year back six months to go on a calendar year basis and everyone had gotten a six month period without any dues.

A vote was taken and the dues for 2002 were set at $25 with no opposition expressed.

Kay Fisher had CDs with all of the back issues of the NEMES Gazette on them available for $5. He will have them available in the future as well, with new issues included as they are published. The newsletter is also available now in an electronic form via email. If you want to get the Gazette via email let Bob Neidorff know (address in the masthead). He'll take you off the paper list and put you on the email list. That way you'll get the pictures in color and save the club the cost of postage on your issue.

The sculpture just outside the Charles River Museum is rather controversial, and I have yet to hear anything very positive about it. Mike Boucher brought in a picture of a sculpture he saw outside an old mill building in Burlington Vermont. It was an old freestanding multi-spindle drill press with a cast or sheet metal figure standing in front of it as if drilling something. The general consensus seemed to be that it was definitely **art**.

The American Precision Museum will be having their second annual show on the 27th and 28th of October. Sunday afternoon there will be a cash raffle drawing that you have to be present to win. I think they want to encourage people to stay to the end of the show.

Dave Stickler bought a loco on eBay. It's a 2.5" gauge Little Engines Pacific that was started in the 70-72 time frame. It was never finished because the builder developed medical problems. 2.5" gauge has a long history of activity in the area, going back to Charlie Purinton. Dave won't be working on it for a few months as he wants to finish up the projects he has underway now first. All the copper boiler parts are completed, but it was never soldered together so he will be taking it apart to clean and then will silver-solder it together.

Dave got a collection of construction photos and a bio of the original builder. As purchased it

has a steam atomizing oil burner in it and it ticks over nicely on 5-10 psi of air pressure.

Frank Dorian mentioned that some of the propane fired weed burners mentioned recently as ideal for use in silver soldering model boilers have been recalled by Harbor Freight. The ones made in China have brittle hoses that can break and leak propane, causing serious fire problems. The ones from Italy are fine, but if you have one made in China don't use it.

Max ben Aaron has been in charge of scheduling our speakers for a while now, and discovered tonight's speaker at Eastec. Kevin Dyer represents Interpro from Deep River Conn. (860) 526-5869, fax (860) 526-8056.

In 1988 Kevin was a computer programmer and went to work for 3D Systems, where he spent eight years working with rapid prototyping systems. He left 3D Systems to form his own company, Interpro, which has been in business for four years now specializing in rapid prototyping.

In 1988, there was one technology for rapid prototyping, stereo lithography. In the early stages it was hard to sell, but now there are many different rapid prototype processes and it is much better known. With rapid prototyping you can take a CAD file from your computer and get a quick and inexpensive prototype part.

Interpro can provide a variety of services to meet customer's rapid prototyping needs.

They have the Z Corporation solid object COLOR printer available. It is made in Burlington Massachusetts and was developed at MIT. This is a popular unit and is used by Lucent, Yale, RPI, Pratt & Whitney, and over 400 other customers. The model is grown one layer at a time, and the starting point can be any computer file that describes a solid. The file is first processed into an STL file and then the part is built up from the two dimensional slices of the object.

The maximum envelope for the part is 32 by 22 by 20 inches, with larger parts being made up from assemblies. Tolerances are not as tight as when a part is machined, and the layers are a couple of thousandths of an inch thick. So, sandpapering the final piece is common. Like most things, you need good skilled people to get good results.

The Z Corporation machine works by putting down a layer of starch powder and then using an inkjet printer head to spray the starch with sugar water to bind the starch grains together. Its advantages are cost, ease of use, and speed. The disadvantages are the tolerances and the material properties. The materials needed cost about a dollar a cubic inch. A cubic inch can be built up in an hour.

This sort of model building has been widely adopted today and Rapid Prototyping has become a billion dollar a year industry.

Rapid prototyping doesn't replace the machine shop; it unloads the machine shop from all the intermediate models that are needed to get to the point where the design is finalized so the machine shop can build the final product. Printing out solid parts lets the designer see mistakes so that when the prototype goes to the machine shop they only need to make it once to have it right.

The cheapest rapid prototyping machine today costs about $40,000. The upper limit is over $800,000.

For engineering evaluation of parts laser cured plastic is used. In this type of machine a laser draws each layer of the part on the surface of a tank of photo-curable epoxy resin. The layer is drawn, then the part is lowered slightly and the part is drawn again. This process has good accuracy, and the resulting part can be plated to give the appearance of a metal part. The material is also strong enough that some functional testing can even be done.

Intropro has a tank for their unit that is 20 by 24 by 20 inches. The machine needs a good operator to make sure that things work correctly. The epoxy used is not cheap, and at any one time the resin in the machine is worth about $45,000.

The epoxy part can also be used as the model for an investment casting to get a rapid prototyped part of whatever metal alloy is desired. If one part is needed the epoxy prototype can be used. If desired a rubber mold can be made from the part

and then waxes can be produced from the mold to investment cast as many metal parts as desired.

Rapid tooling has been oversold, but it is useful for some things. The epoxy is tough and heat resistant enough that it can be used to make cavity-forming inserts for steel injection molding dies. Engineering plastics can then be injection molded in the rapid tooling die cavities to produce prototype ABS or polycarbonate parts.

Another machine uses an ink-jet printer to put down wax 1.6 thou thick at 300 dots per inch resolution. This makes a terrific investment-casting model.

Any kind of computer model of a solid object can be used to provide the data necessary to produce a model. An example is in the field of medicine. Medical images are used to provide the data necessary to produce orthopedic items, such as parts to be used to reconstruct skulls. In another case CAT scan data was used to build plastic models of the bones of a set of Siamese twins so that the doctors could plan out and practice exactly how they would be separating the twins.

Another process is selective laser sintering. Here you start out with a powder, such as nylon or filled nylon. The laser provides heat to fuse the particles together. This process can produce a part with considerable strength. You can start with a resin coated steel powder, then take the resulting part and put it into a kiln where the gaps in it are filled with bronze, yielding a solid part that is 80% steel and 20% bronze.

Fused deposition modeling has an advantage over many of the other rapid prototyping processes in that you can build a part that is approved by the FDA for use with food. It works like a glue gun, depositing material under computer control.

Laminated Object Manufacture (LOM) builds objects up from layers of Kraft paper. It goes fast. The paper is rolled out, a laser burns it to shape, and a hot roller activates the glue on the bottom of the paper, gluing it to the previously deposited paper. The result is like a block of wood.

Unfortunately, the company that made this machine went out of business. One problem with LOM is that if anything goes wrong, like a paper jam, the combination of a hot roller, a cutting laser, and lots of Kraft paper can cause a fire.

Z Corporation's machine can make parts from plaster and sugar water, as well as from starch and sugar water, with an envelope that is 10 by 8 by 8 inches in size. The plaster models are cheaper than the starch models, with machine operating costs of about 40 cents and a dollar per cubic inch. The powder is the support for the next layer using this machine. In the machines that build their models in a liquid bath the software can be used to generate any needed support structure within the tank to provide support for the model while it is being produced. They have added color capability to the machine, and Kevin had a slide of a figurine that looked as if it had been painted. To make the parts more durable they can be impregnated with cyanoacrylate (super glue) or urethane resin.

Another company does something similar to Z Corp., using ceramic powder to produce shell molds for casting metal parts.

Does getting a rapid prototyping machine make sense? One of Kevin's customers typically took 18 weeks to develop a product. They had been using Kevin's services and in the 18-week period they would typically get 11 models made, at a cost of $7,500 to $10,000. After they got in-house capability to produce rapid prototypes, they cut their development time to 7 weeks, and made about 75 rapid prototype models at a cost of about $5,000.

What is the typical routine in getting a rapid prototype part produced by Interpro? Call in the morning, and then send the STL file. Interpro can build the parts on their Z Corp printer in one day. A fist-sized part would probably cost between $300 and $500.

Visit the Interpro web site for more information: http://www.interpro-rtc.com.

After his talk, Kevin displayed a number of interesting objects produced by rapid prototyping. He also passed around a neat item. It's hard to describe, but I thought it looked like what you might get if you crossed a mobius strip with a donut. It also looks like a weird and wonderful new

pasta shape. Whatever it is, it definitely is an attention getter because when you look at it, you don't see how it could possibly be made. This is a perfect example of the advantages of 3D printing technology. I hung one up on the wall outside my cube at work and it has attracted a lot of attention.

Scl

Calendar of Events

By Bill Brackett

Oct 4, 2001 Thursday 7PM
NEMES Monthly club meeting
Waltham, MA
Charles River Museum of Industry (781) 893-5410

Oct 13 Yankee Steam Up
New England Wireless & Steam Museum
East Greenwich, RI (401) 885-0545

October 14 Foreign Auto Festival
Owls Head Transportation Museum
Route 73 Owls Head, ME (207) 594-4418

Oct 21 Roland Gaucher Open House
90 S. Spencer Rd. Spencer MA (508) 885-2277

Oct 21 Sunday 9AM
MIT flea market Albany and Main St.

Oct 27-28 Model Show
American Precision Museum
Windsor, VT (802) 674-5781

October 28 The Great Fall Auction & Open House
Owls Head Transportation Museum
Route 73 Owls Head, ME (207) 594-4418

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

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

ME Workshop Manual Book Review

By Bob Neidorff

The Model Engineers Workshop Manual

By George H. Thomas
Edited by William A. Bennett
Companion Volume to *Building the Universal Pillartool* and *Dividing and Graduating*
Tee Publishing; Leicestershire England
ISBN 1-85761-000-8

George Thomas is revered by readers of Model Engineer magazine at least as much as Rudy Kouhoupt is to readers of Home Shop Machinist. A few of his projects have achieved near-cult followings, including the Universal Pillartool and the Retracting Toolholder. This mystique attracted me to this book, his most recent, and last.

I'm not sure what I expected, based on the title. With a title like *Model Engineers Workshop Manual*, it could have been a collection of charts and tool profiles. But there is almost none of that here.

At first skim, I was a bit disappointed. This book looks like a project book. It has chapters on making various shop accessories, like a Centre-Height Gauge, a Scribing Block, and The Retracting Toolholder. However, first impressions are often misleading.

This book is really the collected wisdom of a master. It is a collection of articles on how to perform many common machining operations, how to make difficult parts, and how to put these operations and parts together into the project of your choice.

Many books say that you can cut screw threads with the lathe and show you the profile of the tool and a picture of the cut in progress. Beginners often start with *How To Run A Lathe* by Southbend Lathe Works or an industrial arts textbook like *Machine Tool Practices* by Kibbe, Neely, Meyer and White. These are good books and tell you basically what to do. But they are sorely lacking in details and advanced techniques. That's really where *The Model Engineers Workshop Manual* takes over.

For example, *Machine Tool Practices* has three pages on knurling. It shows the common pressure knurl and the angled cutting knurl. By comparison, *The Model Engineers Workshop Manual* has two pages on knurling, but doesn't bother with pictures and academics. Instead, it shows some examples of beautiful knurling, explains the best ways to form these knurls, and discusses the appropriate pitch of knurl for various size shafts. *The Model Engineers Workshop Manual* also explains, in detail, many other lathe and mill operations, including chasing screw threads, parting, cutting precision tapers, graduating dials, making ball handles, locating holes, finishing castings, stamping numbers, and precision boring. It also includes information on setting up and truing a lathe, tool sharpening, machine maintenance, and choice of screw threads.

Many will recognize (recognise In the Queen's English) the English perspective to model engineering in this book. Many chapters revolve around making tools for your tools, using and modifying the Myford lathe, and BA screw threads. However, dimensions are mostly in imperial units and the stereotypical English love of beauty and elegance in handwork is refreshing in the American world of weed whackers and chain saws.

This book is not inexpensive, but it lives up to its name of being a really useful manual for both the amateur and expert model engineer's workshop. To me, this was money well spent. I'm still holding onto my copies of *How To Run A Lathe*, *Machinery's Handbook*, and *Machine Tool Practices*, but I find myself referring to *The Model Engineers Workshop Manual* more and more. Order your copy direct from the UK from Tee Publishing by phone 011-44-1926-614101 for £21.95 plus approximately £5 shipping (approximately $38).
http://www.fotec.co.uk/mehs/tee/wkshop.htm

You can also buy a copy through the US distributor, Wise Owl Worldwide Publishing, Redondo Beach, CA phone 310-944-5033 for $49.95. http://www.wiseowlmagazines.com/

Bob

Medina Ohio Boiler Explosion Report

The following report is reproduced with the permission of the author - John D. Payton

Examination Report On The Antique Boiler That Exploded In Medina, Ohio On July 29, 2001

I am the Director of the Certified Boiler Engineers for The Commonwealth of Pennsylvania and have conducted an inspection of a boiler explosion of an Antique Boiler at Medina, Ohio. This inspection and evaluation was conducted at the request of the Medina County Sheriff Mr. Neil F. Hassinger and Lieutenant John Detchon. I was briefed on August 6 about 1300 by Lieutenant Detchon and he informed me that the safety relief valve had been removed by Chief Dean Jagger, the chief boiler inspector of the State of Ohio, and sent to the National Board for inspection and testing. He stated that the seals were intact on the valve and that the National Board test lab's initial report stated that the valve did not lift with pressures up to 200 psi. This exceeded the set pressure of the valve of 125 psi. The pressure indicator was also tested in the same lab and found to indicate 25 psi. lighter, meaning the pressure could be 25 psi. higher than the indicator reads. Chief Jagger also removed part of the damaged "crown" sheet and the fusible plug. The crown sheet and fusible plug were sent to Case Western Reserve University for a metallurgical examination. Lieutenant Detchon also stated that the fusible plug shows slight signs of overheating, however it did not melt and blow out. Lieutenant Detchon's investigation revealed that the late owner had purchased some type of boiler sealer. It could be safe to assume that the late owner knew that the boiler was leaking and attempted to seal the leaks with this compound. I have accepted Lieutenant Detchon's statements as fact and started my examination of the boiler parts that were available for inspection and I found the following conditions:

The staybolt holes in the crown sheet showed a maximum engagement of threads of 2.5 threads and often the least amount of engagement was 1.5 threads. The original design of thread engagement was 4.5 threads in a 3/8" crown sheet thickness. There were at least 5 stays that had been welded

around the threaded area because of excessive loss of metal in the crown sheet.

The crown sheet shows excessive amounts of corrosion throughout the total surface area. The area around the threaded stays showed more reduction of thickness because this is a high stress area. The problem is compounded because the less the thickness the higher the stress. Measurements conducted show a thickness of .210", .170", .125", .105" and .085". The original design thickness was .375". The original staybolts were 1" in diameter and appear to be 11 threads per inch by measurement with a thread gauge. The condition of the stays in the crown sheet area is one of uniform deterioration and confirms the thread engagement in the crown sheet of not more than 2.5 threads and as low as 1.5 threads of engagement. The diameter of the stays in the corroded area is between .600" and .700". This is a reduction of 64% of the cross sectional area of the staybolt. The staybolts position in the wrapper sheet, with exception of approximately 5 staybolts, were in the original position indicating the ease that the crown sheet separated from the stays. The pitch of the stays as was measured in the crown sheet was 4.5" and this was confirmed by measuring the staybolts in the fire box.

The computations using various formulas ASME 1924 and ASME 1998 computed using a thickness of .085" came out to be between 40 psi. & 47 psi.

I also used a carbide type scriber to test surface hardness. I noticed that there was no difference between the steam dome, the barrel and the ruptured crown sheet. This test is not conclusive but an indicator of the metal condition.

The ASME code requires that when the fusible plug is installed, the fusible plug must remain at least 1" above the crown sheet. The plug design was proper and met the requirement as confirmed by Lieutenant Detchon.

Inspection of the hand hole plug above the crown sheet revealed that the plug has not been removed recently as the threads were rusted. The area shows improper inspection of the crown stays. The front tube sheet hand hole plug threads were corroded revealing that the plug had not been removed recently. This plug allows the removal of scale and inspection of the condition of the barrel.

CONCLUSION

It is my evaluation of this boiler that the crown sheet failure started at the .087" thickness area, the weakest point in the crown sheet, and this is where the most bending damage is done to the sheet. The rest of the sheet shows signs of being peeled away much as peeling wall paper off of a wall. This was caused by the massive expansion of released steam. It is my evaluation that because of the very poor condition of the crown sheet with the reduction of the original thickness from .375" to .087" leaving only 23% of the original thickness; this was insufficient metal to hold the pressure of the steam resulting in a mechanical failure of the boiler. To further explain, the thinning of the crown sheet allowed the crown sheet to slightly bag in between the staybolts. This bagging allows scale to build up in these pockets or bags that insulate the metal from the cooling of the boiler water. This further compounds the bagging by localized overheating until there is failure of the crown sheet. This explains how the sheet could be slightly overheated without melting the fusible plug and does not support the theory of a Boiling Liquid Expanding Vapor Explosion (BLEVE).

Professor Wallace's Report supports the bagging theory as some parts of the crown sheet shows signs of overheating while others do not.

I estimate the amount of energy released during the explosion at 90 psi. to be around 28,000,000' lbs of force of which approximately 1,280,000' lbs was used to lift the engine and the remaining was dissipated in the blast area around the engine.

The inoperative safety valve had no direct bearing on the explosion as the valve was set for 125 psi. and with the condition of the crown sheet. It is doubtful that pressure was attainable.

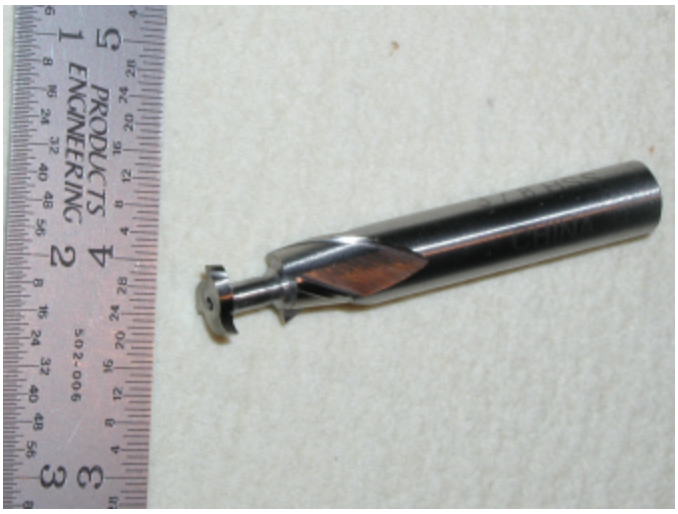
I further conclude that, had the boiler been presented for inspection in Pennsylvania, the boiler would have been placed out of service and not allowed to operate.

John D. Payton, Director
Boiler Section

Cutting Small Tee Slots

By Larry Twaits

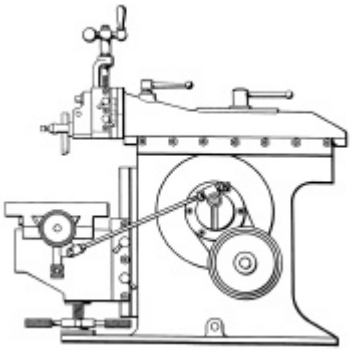
Small Tee slots are sometimes an interesting feature for small fixtures or instruments, but since milling cutters are not generally available in sizes smaller than one half inch they are seldom used.



Shop Made Tee Slot Cutter **Photo by Larry Twaits**

Recently I made a three eights inch cutter that worked surprisingly well by simply mounting an end mill in a spin index and carefully grinding a neck into the cutter without touching the end. The photo should make this clear. Angle the wheel slightly to make the flutes wider at the tip than the root so that they don't drag. I used this cutter to cut nearly two feet of Tee slots and found that it worked at least as well as a standard Tee slot cutter, possibly because the smaller than normal number of flutes reduces pressure on the tool.

Larry



Metal Shapers

By Kay R. Fisher

The Shaper of the Month

David, a collector in Australia (who prefers to remain anonymous) recently acquired his first shaper.

It was a bit rusty and seized up when he bought. He cleaned it up and got everything moving.

At first he couldn't identify it. The only identification (embossed on the cast head) was "Made in England DEPT N".

After some detective work on the World Wide Web, David managed to find out it was an Adept. His model is based on an Adapt shaper that he saw at http://www.lathes.co.uk/adeptshaper/index.html.

They labeled their shapers such as their model 2 as "Adept No2". His casting only had the remaining letters DEPT N left from the original label due to the machining operations carried out in converting it from a hand operated shaper to a powered shaper.

It is a very small "bench-top" model. The max stroke is about 6 inches with about 4 inches of practical useable stroke.

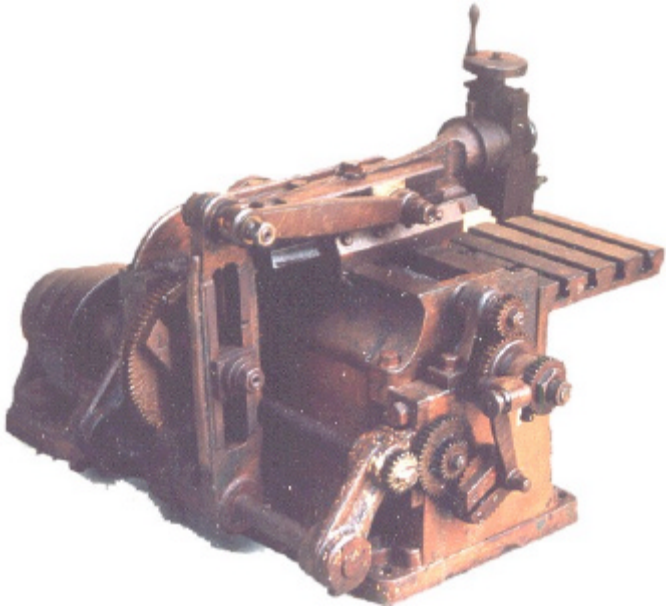
Cross feed, which is power operated via gears and the usual ratchet device, has about 4 inches of travel.

The head moves sideways, driven by a square threaded leadscrew. The head design is conventional, with vertical slide carrying the clapper box mounted on a swivel.

David has seen plenty of shapers, mostly gathering dust and derogatory comments in dark corners, but has never actually used one. He bought

this one because it looked cute and obviously needed someone to rescue it before it rusted to death.

One thing which seems odd to David was that the crank that operates the cross feed is not geared one to one with the main drive crank, so that the cross feed will occur at a varying point in each cutting stroke. He counted the teeth to figure out the gear ratios exactly. The cross feed is geared down by a factor of 4 via 2 pairs of 20 and 40 tooth gears. The main ram is geared down by 24 to 86 teeth so that the ratio is not quite 4. He wonders if someone made a clerical error and produced a batch of 86 tooth gears in place of 96! It would be possible to correct the error and preserve the same tooth size and gear centers by changing the gears to 22 and 88, respectively.

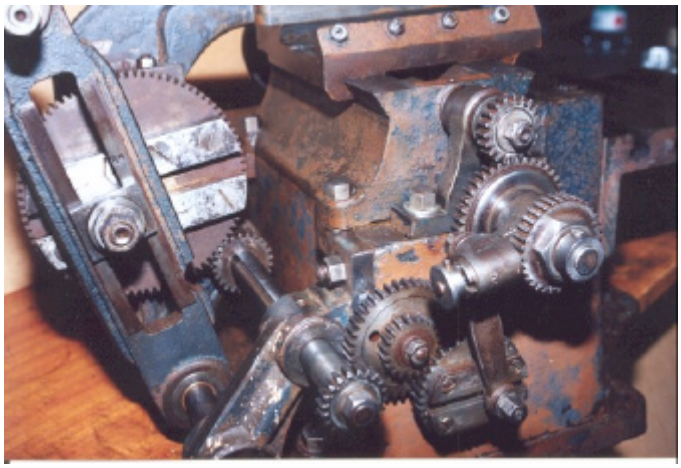


Shaper as received feed side **Photo by David**

Shaper as received front view **Photo by David**

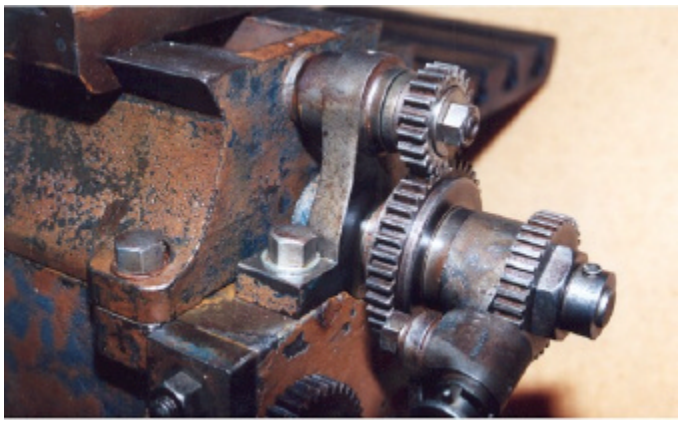
David speculates that the hole in the gusset under the table is a part of the table support system, which is missing.

To me the most unusual thing about this shaper is that the knee stays stationary while the ram moves sideways in a carriage mechanism.



Drive and Fed Mchanisms **Photo by David**

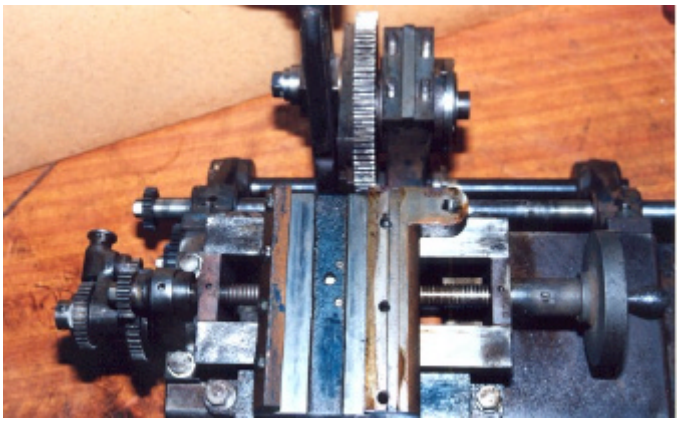
The photo above shows the drive and feed mechanisms with the ram and connecting link removed.



Feed Clutch **Photo by David**

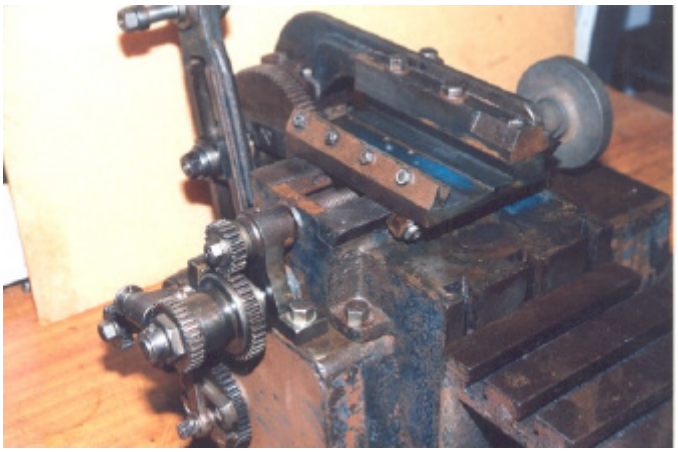
In the close up of the feed mechanism above the large gear in the center contains a torque limiting friction clutch. This device is to prevent the machine from destroying itself if the operator fails to stop the feed before it reaches the end of the travel. On some shapers the threads on the cross slide screw are removed near the ends to prevent such a crash. Many shapers have no protection at all. I would think that, with the possibility of the clutch slipping, attempting to correct the gear ratios would be non-productive. David thinks that there

should be little chance of slippage because the normal amount of friction in the cross travel is very low.



Top with Ram Removed **Photo by David**

Most Adept shapers were manual. Models were released that had been converted to power. This is the most complex powered shaper that Adept ever produced. It looks like the carriage is the same as on a manual machine but rotated 180 degrees. A lug, which holds the fixed pivot bolt for the hand lever system, is now used to secure the bridgepiece.



Bridgepiece Linking Drives **Photo by David**

In the photo above, note the "bridgepiece" linking the carriage with the drive mechanism. The main "chassis" casting is probably identical to that used on the manual machine. The left hand end of the carriage leadscrew is supported close to the drive gear by a special casting bolted to the base box.

Rear Quarter View **Photon by David**

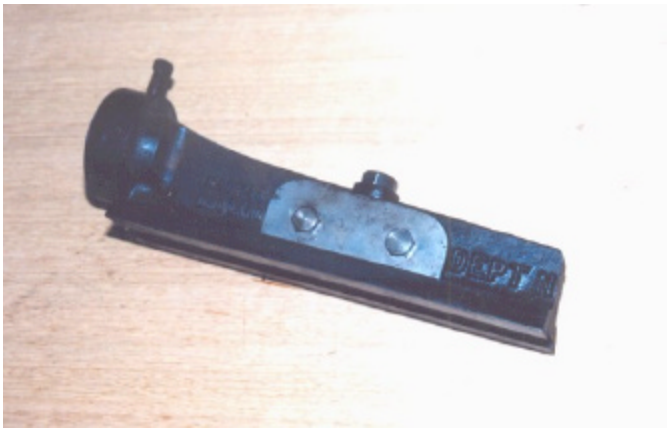
In the photo above the flat belt pulley has been removed. The keyway in the upper shaft transmits power to the drive system. The lower shaft is stationary and acts as a guide for the lower end of the slotted drive arm.

Rear with Drive Removed **Photo by David**

As David started rebuilding the shaper and removed the drive mechanism, it was necessary to do some shimming of the two mounting brackets for the drive mechanism as the two horizontal shafts must be parallel to the carriage dovetail.

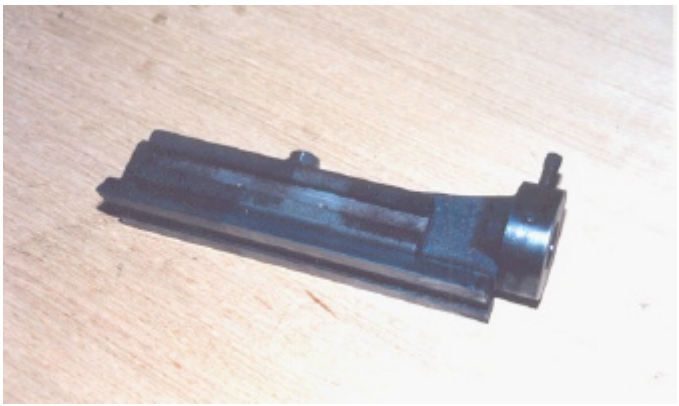
Base Box **Photo by David**

When you strip machines down to their fundamental parts they start to look pretty simple as in the base box above. But this is necessary for a thorough cleaning and that new paint job.



Ram Right Side **Photo by David**

In the photo of the ram above note the lettering “DEPT N” left on the casting from original “ADAPT NO 2”. The long slot through which the hand-operated lever would pass is behind the clamp plate.



Ram Left Side **Photo by David**

Bolted to the ram left side is a tee slot piece with serrations to provide a positive location for the pivot bolt.

Bridgepiece **Photo by David**

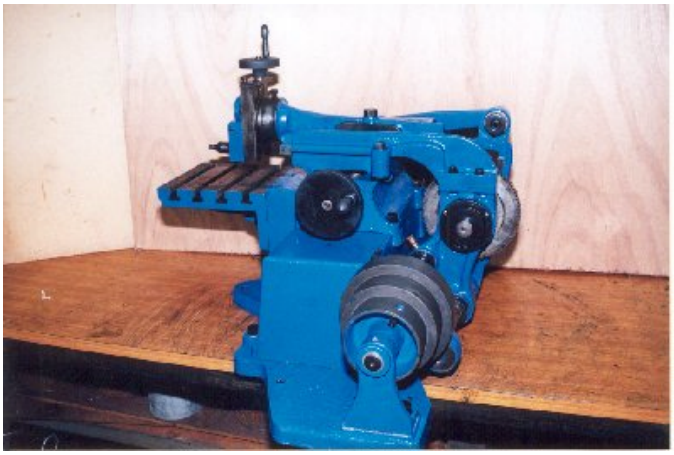
The bridgepiece, which links the carriage to the drive mechanism is connected quite solidly being keyed, bolted, and pinned.

Drive Mechanism Dismantled **Photo by David**

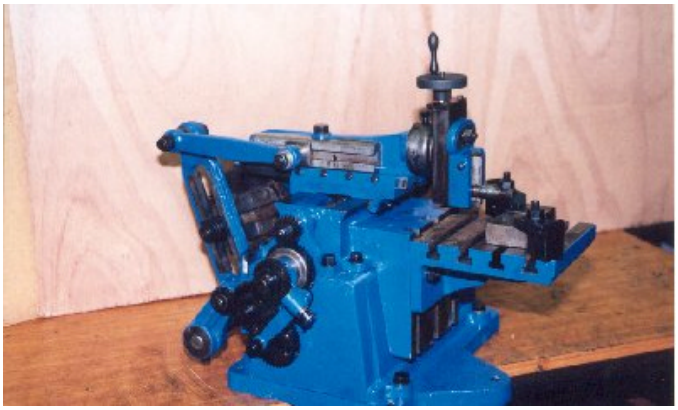
Stripping Paint **Photo by David**

Parts After Painting **Photo by David**

After weeks of work cleaning, stripping, and painting; a selection of parts (pictured above) is completely restored and ready for assembly. The blue color he chose is turning out a bit brighter than the original color as judged from the remnants of paint.



Completed - Right Side **Photo by David**



Completed – Left Side **Photo by David**

The pictures above show the shaper painted and reassembled. Gears and other unpainted components have been chemically blackened. Traditionalists might be offended as the manual Adept shapers were usually black. David prefers bright cheerful colors for machines as it is easier to keep them clean, and in photography it is easier to distinguish the workpiece from the machine.

Thank you David for another great shaper story.

Kay

For Sale and Wanted

Lathe Wanted

I'm looking for a fairly precise, bench-top lathe about 6" to 8"x20" with accessories. I want to machine small iron castings such as are in Stuart kits, and would like to do threading also. I'm impressed with the Myford ML7R but don't want to spend the money for a new one. Hopefully someone will have a machine for sale that meets my needs.

Tim Straw (401) 792-8724

Brass jewelers lathe for sale

Errol Groff has a friend who would like to sell a small hand-operated bench lathe (perhaps a jewelers or watch-makers lathe) made of solid brass. It is a great looking and very interesting small tool. He is asking $500 obo. For members of NEMES, Errol could deliver it to a meeting.

http://pages.cthome.net/errol.groff/Elbert%20Lathe.htm

Elbert Botham (860) 691-1937, (860) 608-0797 (cell)

Starrett micrometers for sale

Set of Six Starrett micrometers, 0-6", with Fowler standards, recently checked. Five are Model 436, one is #226. Two have ratchet spindles. Best reasonable offer.

Howard Evers (508) 987-0654 hwevers@charter.net

Web Sites of Interest

NEMES home page

http://www.naisp.net/users/fisher/nemes.html

Machine Tool Archive. The world's largest collection of machine-tool illustrations, descriptions and specifications for hundreds of different lathes, millers, and shapers. Also available as a publication on CD-ROM.

http://www.lathes.co.uk

The "Frog". A low cost single-axis computer numerical control (CNC) device for micro lathes and custom applications.

http://www.emachineshop.com

Gerstner Tool Chests. It is time to start that Christmas list.

http://www.GerstnerUSA.com

Coffee Cup Stain Prints has plans for $50 of a .22 Cal. Semi Auto 1917 Browning machinegun.

http://www.Rnetinc.net/~ccsprints

Websites related to the Confederate Submarine H.L. Hunley which was the first submarine to sink a ship in battle.

http://www.hunley.org

http://home.att.net/~JVNautilus/Hunley.html

http://www.geocities.com/yello_armadillo/hunley.htm

Tee Publishing

http://www.fotec.co.uk/mehs/tee/wkshop.htm

Wise Owl Worldwide Publishing

http://www.wiseowlmagazines.com/

A web page of nicely made telescopes and eyepieces.
http://home.fuse.net/astronomy/

Interpro rapid prototyping.

http://www.interpro-rtc.com