

## **NEWSLETTER April 2025**

**Hello and Welcome** to the April edition, time certainly is marching on this year. Since the last meeting at the Hungate Centre, Paul Gammon has procured a *Clarkson* cutter grinder. It needs a bit of fettling and paint, so this is where you can help. As I have said previously, Paul volunteered to share his experience using cutter grinders, but it is a joint effort to get it running and learning to use it.

Please will some of the six or seven people who put their hands up to acquire the machine, contact Paul and offer to help him. We might be on the scrounge for some <sup>3</sup>/<sub>4</sub>" plywood, less than half a sheet. Have you any? Probably also looking for an inverter drive to run it. Before a new one is sourced, do you have a serviceable one you wish to sell? I expect it will be about <sup>1</sup>/<sub>2</sub> to <sup>3</sup>/<sub>4</sub> hp, but please contact Paul for more information.

Once again, I enjoyed the lunch at Kirkbymoorside Golf Club, although the numbers were down a few on last year. Could this have been because there wasn't Steak Pie on the menu?! Seriously though, a good pint, good service, good food, and being in good company is a nice way to spend an afternoon, isn't it?

I found last month's meeting very interesting because workshop grinding is something I knew very little about. Being a bit of a luddite, I don't bother much with tipped lathe tools, so my experience of grinding is with a bench grinder. Thanks to Richard and Paul I am a bit wiser now.

It is a '*Bring and Brag*' next week, and you might not have anything to bring, but if you have anything to ask, or if you want people'e opinions about some aspect of engineering, please shout up. It would be nice (and interesting) to get a bit of dialogue going.

Thank you. Jonathan.

**•** Forthcoming Events.

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- Wednesday May 7<sup>th</sup> Spring "Bring and Brag".
- Tuesday May 15<sup>th</sup> Workshop Morning.
- Wednesday June 4<sup>th</sup> World War 2 Radar in North Yorkshire ~ A talk by Brian Mulvana.
  - Saturday June 7<sup>th</sup> Bradford Challenge. (Car share for a visit only).
- Tuesday June 19<sup>th</sup> Workshop Morning.

# Club Evening On Wednesday 2<sup>nd</sup> April 2025. A Talk About Cutter Grinders By Paul Gammon, And A Talk About Cylindrical, Surface and Tool and Cutter Grinding by Richard Radcliffe.

Jonathan welcomed everyone to the meeting, and gave some announcements before the talks began.

- **Donated Magazines:** Mike Sayers' sister has donated her late husband's magazines to PEEMS. There is a major collection of each magazine title and they are bound in volumes. The titles are:
  - Engineering In Miniature,
  - Old Glory,
  - Model Engineer,
  - Model Engineer Workshop,
  - Home Shop Machinist,
  - Digital Machinist, and
  - Machinist's Workshop.

The last three are American publications. All have been bought via subscription so should be continuous runs, and some are in bound volumes. All have to go. If any member would like any of these volumes, they should contact Mike.

- Some Further Magazines and Tools Available: Chris Bramley has got a collection of "Old Glories" and other transport magazines. He also has a drill grinder, press and a scroll saw. If anyone is interested in any of these items contact Chris.
- The Former PEEMS Railway: Someone from Selby has e-mailed Jonathan to say he has bought the former PEEMS railway at a "well known" auction. Although the correspondent has the instructions for the railway, he would like to "touch base" with the Club, and would like to join. Once he has the railway installed and "up and running", he would like to invite the Club down for a barbeque.
- Model Shows: There is a *Pickering Vintage Rally* on Saturday 24<sup>th</sup> Monday 26<sup>th</sup> May, and PEEMS has considered having a display stand there. It would have to be an "outside stand" for three days which means that the security would be a problem. There is a large steel framed building on site, and Jonathan asked about that, but it will not be available for the rally. The consensus among members was that it would only be worth exhibiting over the full rally period, and due to lack of security that would be unfeasible. But the Rally should be good, and maybe next year.

Bradford Model Engineering Society (BMES) have their model show at the same time in the Bradford Industrial Museum. BMES have been asking if PEEMS are interested in attending. Jonathan has announced this event many times, but only one person has shown any interest in going. It seems to be too far away for a number of people. It's a two day show on Saturday 24<sup>th</sup> and Sunday 25<sup>th</sup> May, but PEEMS would only attend for one day, which is no problem for BMES.

### • PEEMS Annual Lunch at Kirkbymoorside Golf Club.

There was a good attendance at the PEEMS Annual Lunch on Thursday 10<sup>th</sup> April, with a favourable review by all twenty attendees.





### • The Cutter Grinding Tool ~ A Talk By Paul Gammon.

### • Introduction.

Paul started off by saying that he was involved in cutter grinding when he was an apprentice. He has kept up his skills and has built himself a cutter grinder, which he had on display at the meeting.

There has to be dedicated machines for grinding the cutter ends and diameters, and for grinding the cutter flutes. The most important rule is that whatever grinding operation is being carried out, the cutter has to be set up in the correct position to start with.



### • CBN Grinding Wheels

CBN is Cubic Boron Nitride. This is the type of grinding in Paul's machine. These type of grinding wheels either have a steel or aluminium base, and the CBN coating is on them. You can get straight plated wheels, the problem being that as soon as the plating pulls off, the grit falls off and the grinding wheel is lost.

Basically, you only get what you pay for. Woodworkers normally use the plated versions. Paul doesn't think the plated wheels are very good.

Paul found out about the CBN wheels around thirty years ago in one of the trade magazines. He spoke to Mike Crisp who was the editor of the *Model Engineer Magazine* at the time, and he put Paul in touch with Neil Reed, who was working either at a university or *Timkin Bearings*, when both organisations were doing a joint project. Neil told Paul that when they were grinding small holes, a needle was used and they put a single grain of CBN on it to do the grinding. That just shows how effective CBN is.

Paul got hold of some wheels, and then he found out there was a manufacturer in Bristol, so he bought some more wheels from them. He found out that the wheels were brilliant but not cheap! The fine grinding wheels tend to block up a little bit, so Paul uses either the carborundum 'black fretting sticks' or the white aluminium oxide sticks to clear the wheels out.





The grinding wheels have to be 'trued up' when fitted, so Paul scrapes the backs to get the face of the wheel running true. Alternatively, he puts them on an eccentric spindle to make sure they're running true.

### • A Description Of Paul's Cutter Grinder.

The cutter grinder that Paul brought to the meeting has been converted by him to run in forward and reverse. Some wheel carriers had to be made up so the wheels don't become unscrewed during operations.

Paul said that if anyone wanted to convert a cutter grinder so it ran backwards, don't do what he did in the beginning, which was just to cross the windings. The machine did run backwards, but it was the starter windings which were doing all the work, and you could smell it. Paul phoned an electronics friend, who suggested a 6-pole toggle switch on it which did the job of crossing the whole of the windings the other way.



Front Face Of Coarse Grinding Wheel



Looking at the three cutters above: Cutter A's end is normal with relief in the centre. Cutter B has been over-ground and the centre relief has been lost. Cutter C has been previously over-ground but has been re-worked to return the centre relief. Note the cruciform notching also introduced during rework. Without the relief in the centre of the cutter, the cutter would rub on the workpiece when milling.



If you look at a lot of modern end mills, and stop drills, there are no primary or secondary cutting angles.

Typical parameters:

Clearance: Primary (first angle  $5^{\circ}$  to  $9^{\circ}$ ) – relief adjacent to the cutting edge. Clearance: Secondary (second angle  $14^{\circ}$  to  $17^{\circ}$ ) – relief adjacent to the cutting edge.

Clearance: Tertiary (third angle) – additional relief clearance provided adjacent to the secondary angle.

There is about 25 thou back relief on the teeth of the modern 3/8" cutter installed on Paul's machine, whereas with the primary and secondary cutter angles on the same size cutter, it's only about 20 thou clearance.

Paul uses  $7\frac{1}{2}^{\circ}$  on all his cutter angles, even on his lathe tools. A single setting is good, and in fact he finds  $7\frac{1}{2}^{\circ}$  is good for cutting mild and even tool steel.

### Cutting Speeds In The Milling Machines.

Some people may use a book to get their cutting speeds for the different cutter diameters. Paul uses the "Clarkson Table" which he still has from his apprenticeship days. However, it pays not to run the cutters too fast in order to not take the edge off.

You can go quite quick with carbide cutters. Paul doesn't use many carbide cutters but he does use some. CBN will grind carbide cutters reasonably well.

As can be seen in the photos of the cutter grinder, Paul uses ER collets for holding the cutters. If the correct size collet is used for the cutter shank, the cutter doesn't have to be constantly screwed up, which Paul doesn't have patience for.

#### The Cutter Flutes And The 'Air Bearing'. •

For grinding the cutter flutes, Paul uses an 'Air Bearing' which he has built to hold the cutter.



View Of The Air Bearing Showing Air Lines

The photo shows the cutter flutes ready to be ground in a *Stent* grinding machine. The cutter is held in the ER collet of the

The spindle is manually rotated, and moved across the grinding wheel in the

To grind the flutes successfully, the cutter must remain in contact with the finger at all times.

Paul uses an ER Collet parallel shank. He got the 'Air Bearing' out of the Home Workshop Machinist magazine or one of the American magazines. It's just two bushes on the end of a block with the spindle through the middle. Then you have to put in 80 to 90psi of air to get the bearing to spin.

#### **Cutter Set Up** •

Seen below is the 'finger tool' that Paul uses to set up the cutter flutes prior to grinding. It's got threaded adjustment on it. As mentioned above, the finger must stay in contact with the flutes during grinding.

It's very easy to set up with this tool, you can really get the adjustment with it. That's half the battle with cutter grinding, getting the position and adjustment of the cutter quickly. You can raise and lower the finger and move it backwards and forwards. With small cutters, it can be a nightmare setting them up and adjusting them.



Setting Up Finger Height On Flute Setting Tool



Setting Up The Flutes With Flute Setting Tool Finger, Prior To Grinding

Paul's Cutter Grinder Demonstration.



As mentioned previously, the cutter grinder Paul brought to the meeting was just dedicated to arinding the cutter ends, and he just grinds a  $7\frac{1}{2}^{\circ}$  cutter angle rather than primary and secondary angles. His cutters cut alright afterwards.

Paul is holding the tool he uses to set up the  $7\frac{1}{2}^{\circ}$  cutter angle. It's a simple plate with the top edge inclined at  $7\frac{1}{2}^{\circ}$ 





The cutter setting tool, seen in the photos on the previous page, is used to set up the cutter before the ends are ground. It is used to adjust the cutter centre prior to grinding.

The tool has a pocket on the bottom and Paul has a block and uses that for the air bearing as seen in the photos at the bottom of the previous page

There is an index line marked on the index wheel so the operator knows when he has completely rotated the cutter. The index line shows the start point. There are four rivets equidistantly spaced around the index wheel, so that when the cutter is turned, a click is heard at each of the four positions. At each position, the cutter table traverse lever is pulled so the cutter traverses across the grinding wheel.

The grinding wheel shown opposite is very coarse, but Paul finds that it is quite satisfactory for this job. You don't need a good finish on the cutter face because it's just the corner it's cutting on, and if that's sharp that's all that matters.

As said previously, it's the setting of the point on the cutter in the correct place that's important.

If you grind a lot off you really have to reset because you will have lost the position of the point. If the point setting is not done correctly, the angles will be wrong. That applies to drill grinding too.

### **Questions and Answers.**

Q: Do you need to dress the grinding wheel?

**Paul:** No, I've never dressed it in the last 20 years, although I may have cleaned it out with the black sticks.

- Q: Is the small wheel on the other end of the machine the same material?
- Paul: Yes it is, but it's finer. Everyone says these CBN wheels are quite expensive. If you look at the finer grinding wheel, there's about 1/8" thickness of CBN on it.

I've never heard of CBN before. Comment:

- Paul: The Chinese make them now. Before that, it was just the Americans who made them because they had access to the boron through De Beers.
- Could you explain the 'Air Bearing' a bit more. Q:
- **Paul:** The 'Air Bearing' is the fixture you need to have when you're grinding the cutter flutes. You use the finger device for setting up. Without the 'Air Bearing', if there is any grinding dust on the spindle, it will 'jump' and you have to start again. With the 'Air Bearing' and CBN grinding wheels you haven't got the dust. Plus, the 'Air Bearing' is blowing the dust off the spindle.
- **Q**: Is the cutter grinding machine modified?

**Paul:** Yes, I explained at the beginning it is now modified to rotate in reverse as well as forwards.

**Comment:** We have sourced a cutter grinding machine for use by PEEMS members.

Paul: Yes, it's a *Clarkson*. If we put an 'air bearing' on it we can grind cutter flutes. We just have to 'cobble something together' similar to my Stent grinding machine, which is guite simple. We need another machine to grind the cutter ends.

If you go to a cutter grinding shop, you will find there are 10 to 15 machines in there, all set up to do different jobs.

**Comment:** 99% of the jobs PEEMS members might want to do are just the cutter ends.

- **Paul:** Yes, if it's just the ends that need doing, that makes it easier, once the cutter has been set up using the setting up tool. The Clarkson shows a finger on the end under the cutter, whereas my machine has the indexing wheel.
- **Q:** Can you explain again how you set up the cutter.
- **Paul:** Yes, you use the setting up tool to position the cutter point in the right position at the start. The ER collet includes a revolving ring which makes this initial set up easier, as it prevents the cutter from rotating away from its setup position. ARCEURO supply reasonably priced ones, and the ER collets with the revolving rings make the initial setting up so much easier.



- **Q:** If someone had 4" to 5" horizontal milling cutters, could they be ground?
- Paul: Not really, you would need a tapered mandrel in between centres. Not many people use horizontal milling cutters.
- **Q:** If anyone had a decent sized twist drill <sup>1</sup>/<sub>2</sub>" up to 1", could that be ground?
- Paul: Not really.
- **Q:** Your machine looks quite 'delicate' compared with the *Clarkson,* how small a cutter can you deal with? **Paul:** Normally I go down to  $\frac{1}{4}$ " to  $\frac{3}{16}$ "
- **Q:** Do you grind the flutes to size too?
- **Paul:** Yes you can, but for a cutter under ¼" used with the 'air bearing', I would get an FC3 or a carbide cutter. The small cutters are not easy to grind.

PEEMS will need two machines, one for the cutter ends, and one for the flutes. The *Clarkson* could be used for the flutes. An 'air bearing' will need to be put on it. The problem with cutter grinding is the setting up. It takes time.

- Q: What do you use the smaller finer wheel for?
- Paul: All my lathe tools.
- Q: On your machine, couldn't you use one of the wheels for the flutes, and the other for the ends?
- **Paul:** No, you need adjustments for the flutes because you have to get the right diameter grinding wheel for the diameter of the cutter, and the height it's going to be.

Although you need another machine to grind the ends or the flutes, you usually find that **you will be grinding the ends five to six times more than you will be grinding the flutes.** 

Jonathan asked the members present if they thought it would be a good idea to acquire a cutter grinder machine and a show of hands indicated there was a lot of interest. Paul would give members instruction in how to use the cutter grinder, and then after instruction, it would be up to each member to do their own work.

PEEMS thanks Paul for giving a very interesting talk on cutter grinders and for his help in compiling this article.

### o Richard Radcliffe ~ A Talk About Cylindrical, Surface and Tool Cutter Grinding.

Richard said that his presentation included three types of grinding:

- Surface Grinding.
- Tool and Cutter Grinding.
- Cylindrical Grinding which he would spend most of the time on.

### • Surface Grinding.

This is the *Jones and Shipman* 540 surface grinder. The first photo shows the grinder when Richard acquired it. It possibly came from *Lodge Ignition Ltd*. the spark plug people, but Richard isn't sure.



LODGE IGNITION LTD SIMAC LTD. SAFETY CERTIFICATE No ... 1994 CERTIFICATE ISSUED ..... PLANT NO.C.S. SIGNATURE ....

Richard set about restoring it and this is the result:



### • Tool and Cutter Grinding.

Richard said that he wasn't going to spent time talking about tool cutter grinders because Paul had already covered that.

This is the *Cincinnati* tool and cutter grinder which has large capacity. It has a central column which rotates 360°. The head itself will tilt 20° either side.

On the left-hand side can be seen the motorised head which rotates 360° in two axes. On the far side of this head is the work head which can accommodate a 5 Morse taper, so it will grind practically any cutter you would want. The nearside of the head accommodates a 50 International taper.

On the left-hand side there is a dust extractor and on the righthand side there's a coolant tank. The dust extractor allows dry grinding and the coolant allows wet grinding.

The dust extractor on the lefthand side is split so that dust can also be extracted from the *Cincinnati* tool cutter grinder which is installed next to this machine.





Here you can see a large slabbing cutter held between centres. There's a finger behind, which can't be seen, but traverses across the wheel and allows you to grind spirals. Like on Paul's *Stent* machine, the finger remains stationary. As the slabbing cutter (in this case) moves across the wheel, it must stay in contact with the finger in order for the spirals to be ground correctly and the angles maintained.

The way the angles are set up on this is quite simple. There is a 'hockey stick' tool which rests on top of the wheel head. There's a similar tool which rests on the table, and where the two coincide, the centres of the conical grinding wheel and the centre of the shaft will coincide. With these tools, you will know that the important centres will align.

There's an adjustment on the wheel, so it can be raised by a predetermined amount to give the required angle. It's a very versatile machine.

### • Cylindrical Grinding.

This is the *Myford MG12* cylindrical grinder. It's a "plain" machine which means it doesn't have a swivelling head (like the *Cincinnati*). The work head on the left-hand side is fixed.



Front face of the bed

Down stand of the tail stock

There is a version of the machine where the work head swivels, so you can grind a much steeper taper if you need to.

This machine will grind up to about a  $5^{\circ}$  taper in the direction of the swivel table.

When Richard started using the MG12, he couldn't get repeated accuracy until he realised that the front face of the bed, and the down stand on the tailstock were getting debris from the grinding wheel. There was also a slight curve on the front face of the bed which was enough to throw out the alignment of the tailstock. This meant that repeated grinding accuracy on the work pieces couldn't be achieved.

Richard ended up scraping the bed, top and bottom. He scraped the underside of the tailstock, and the down stand and its front edge.

The underside of the work head was also milled. The final adjustments weren't much though, just a thou or two, but after the work, the machine was finally in alignment.



The MG12 didn't have a 'drop down head', so Richard made one. The lower section is a rectangular hollow section with a solid block on top, through which there is a commercial spindle which is rated for 28,000 rpm (which would have cost £3000 from a supplier).

The aluminium block under the hollow section allows the assembly above to tilt down. There is an adjusting device at the bottom which allows the spindle height to be raised or lowered. This consists of a pair of fine pitch screws slightly raised above the block.



This is another view of the cylindrical grinder with the two belt pulley wheels shown (with one on the bed). This arrangement gives four speeds. There is a tapered bush in the middle of each pulley wheel which allows it to 'grip' the shaft.

There's flat belt, and the speed is about 16,000rpm. It works very well.

The photo on the right shows the bed after it's had its 'treatment' with the scraper. Richard is now confident that the bed is parallel within a couple of tenths of a thou, which is lot better than it was.

The bed pivots in the middle. There is a micrometer adjustment at the bottom right of the photo which allows the bed to be angled up to  $5^{\circ}$ 



Micrometer adjustment

Scrapers and Scraper Honing.



This is a *Biax* electric scraper. The *Biax* runs at 1200 cycles/min.

This cuts down on a lot of work. It gives a decent enough finish that can be finally finished by hand with the tools below.

Richard uses three types of scraper, a 20mm, 25mm and a 30mm.

The fourth tool on the bottom has, a carbide, very highly polished scraper on the end. Richard uses this for the final scrape. It doesn't

take much off but is an excellent cutter.



This is a far eastern diamond lapping plate used to hone the edges of the scrapers. They are about  $\pounds 12$ , but are well worth the cost.



This is an aluminium plate with a removable *Cincinnati* wheel mount in the centre. There's a taper on the back of the centre. The problem with these is the expense. They aren't easily obtainable here now, but there is a company in America which will sell a hub for \$100. The captive screw in the middle costs around \$25 for a flanged socket, and the circlip is about \$50





In other words, you end up with a very obtuse "ridge" of  $175^{\circ}$  in the middle of the blade. Some people prefer a rake of 5°, but Richard finds 2.5° cuts well without "digin" and the blades last for perhaps five minutes on the *Biax* machine scraper before you need to rehone them.



This is the edge of the carbide scraper. You can see the central ridge.

The brass template is a checking tool to check the 24" radius on the scrapers is maintained after honing, if you are honing by hand. The other template with the 1" square hole in it is a rubber sheet which is used to count the high spots after the scraper being worked on has been 'blued'.



The green casting holds the internal grinding cassette which is part of the *Cincinnati* tool and cutter grinder. It basically bolts onto the same head which holds the separate main grinding spindle. Richard had to replace the bearings on that because they were a bit noisy.

They needed to be precision bearings, so Richard fitted a pair of the bearings shown above. They're not cheap but they make all the difference to the quietness and accuracy.

### **Q:** Where did you buy these?

**Richard:** I bought them from *George Lodge & Sons Ltd.* an engineering supplier in Hull. They are angular contact bearings (with 15° angular contact). They're the cheapest I could get of all the expensive precision bearings available.



Various Items: The lubricant at the bottom. It's very special for this kind of work. It's *KLUBER* lubricant.



Here is a collection of centre hubs. These are the same as the *Cincinnati* wheel mount that was shown in the middle of the aluminium plate on the previous page. Richard has refurbished these in terms of the taper, the outer diameter, the back face and the face below the thread.

As explained before, these hubs are expensive so Richard acquires them when he can, and refurbishes them. He has a collection of about 30 now.

The post seen in front of the tin is an arbor Richard made to sit in the *Cincinnati* 4-jaw to mount the hubs, so they can be reground.

Next to that are the replacement flange socket screws. They have a disk *Loctited* on. That replaces the very expensive flanged socket screws and circlips from America.

Modified Tool and Cutter Grinder Similar To Paul's.



This is the device that Richard uses for all sorts. This is a *Jones and Shipman* radius grinder. It had a pillar about 3 inches high on it, which was originally mounted on the device (like a rotary table). This in turn held the diamond dressing tip. Richard removed this and fitted the spindle in an aluminium block which holds the 5C collet spindle as you can see.

The whole device can now be used to position and index cutters for grinding, as opposed to its original purpose to grind both internal and external radii on ceramic or vitrified grinding wheels.

It is adapted with the block attached on the left-hand side which pivots either way horizontally. It can be dropped down onto the little cylindrical pads and this gives the required angle (Paul grinds  $7\frac{1}{2}^{\circ}$  cutter angles and Richard 8°) and height needed for the tooling cutters. It's quite a useful, 'quick to use' device. It's similar to Paul's tool cutter grinder. The drawing bar is seen at the top right and it takes 5C collets.

• Grinder For Refurbishing Chuck Jaws.



This is part of a tool post grinder Richard built when he was refurbishing some chucks. Someone asked Richard to refurbish the D14 taper on his *Smart & Brown* lathe. The motor was a bit underpowered for the precision work that

needed to be done, so he used the motor in the second photo instead. Using this motor meant that that the grinding wheel didn't slow down when it contacted the workpiece.

When refurbishing 3 jaw chucks, Richard uses the plastic sheets shown in the third photo. They are placed between the sloping faces of the chuck jaw. With these plastic pieces in place and with the jaws pressing inwards, this leaves space for the grinding wheel to get in and refurbish the jaws.

PEEMS thanks Richard for his talk which explored some unique aspects of grinding and for all his help in compiling this article. The photos in this article are reproduced with Richard's kind permission, and should not be reproduced without his consent.

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