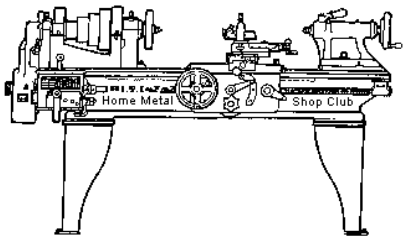
Home Metal Shop Club

November 2010
Newsletter

Volume 15 - Number 11



http://www.homemetalshopclub.org/

Since its founding by John Korman in 1996, The Home Metal Shop Club has brought together metal workers from all over the Southeast Texas area.

Our members' interests include Model Engineering, Casting, Blacksmithing, Gunsmithing, Sheet Metal Fabrication, Robotics, CNC, Welding, Metal Art, and others. Members always like to talk about their craft and shops. Shops range from full machine shops to those limited to a bench vise and hacksaw.

If you like to make things, run metal working machines, or just talk about tools, this is your place. Meetings generally consist of a presentation with Q&A, followed by ***show and tell*** where the members can share their work and experiences.

President	Vice President	Secretary	Treasurer	Librarian
Vance Burns	*John Hoff*	*Martin Kennedy*	*Emmett Carstens*	*Dan Harper*
Webmaster/Editor	**Photographer**	**CNC SIG**	**Casting SIG**	**Novice SIG**
Dick Kostelnicek	*Jan Rowland*	*Dennis Cranston*	*Tom Moore*	*Rich Pichler*

About the Upcoming December 11 Meeting

General meetings are held on the second Saturday of each month at 12:00 noon in the meeting rooms of the Parker Williams County Library, 10851 Scarsdale Boulevard, Houston, TX 77089. Meetings are currently booked through February 2011. Visit our web link for up-to-the-minute details.

The presentation at the December meeting will be on "SolidWorks CAM and MasterCAD", presented by Steve Moore with MLC CAD Systems.

Recap of the November 13 General Meeting

Reported by *Martin Kennedy,* photos by *Jan Rowland*

Thirty-two members and no guests attended the 12:00 noon meeting at the Parker Williams County Library. President *Vance Burns* led the meeting. Dues were collected for the upcoming year, and we currently have 45 paid members. It was mentioned that a discussion on having a tailgate sale was ongoing in our Yahoo Tinkering Group, and member interest was gauged. Since there was some interest in having a sale, a venue is being sought. HMSC member *Tom Moore* donated some books to our library. Thanks, Tom!

Presentation

Slides are here

HMSC member *Mike Hancock* spoke on “Physical Vapor Deposition”. Mike recounted how he became interested in this subject after finding a turbomolecular pump in the mud at a salvage yard.

Overview

Physical vapor deposition is the deposit of a material in the vapor phase onto a solid in a vacuum. A vacuum is used so that the material can exist in vapor form, at its vapor pressure, and not interact with reactive gases. The vapor pressure is the pressure at which a solid or liquid evaporates. Water’s vapor pressure at 212 F. is one atmosphere. Vapor pressure increases with temperature.

There are many applications for vapor deposition:

- Optical coatings, such as filters, mirrors, and anti-reflection films
- Semiconductors, such as integrated circuits and solar cells
- Cutting tool coatings, such as the TiN coatings that increase hardness and lubricity
- Diffusion barriers, such as separation layers in semiconductors and ceramic coatings on turbine blades to reduce corrosion and increase operating temperatures.

Thermal Vacuum Coater

History

The existence of a "vacuum" had been debated up into the 17th century when the mathematician-scientists Evangelista Torricelli and Blaise Pascal provided experimental evidence that the weight of air was responsible for maintaining the mercury column in what became known as the mercury barometer.

Aristotle stated that "nature abhorred a vacuum" and reasoned that "nothing could not be something". Torricelli had a working relationship with Galileo who had been commissioned to investigate the problem of pumping water higher than about 35-ft. using "suction" pumps. Torricelli constructed a 35-ft. water column at his home with one end sitting in a container of water and the other end, which was closed, extending above the roof. He noticed that the height of the column varied from time to time and was associated with weather changes. This did not go unnoticed by the townspeople, and rumors began to circulate that Torricelli may be practicing sorcery. To avoid the real possibility of being arrested for heresy, he replaced the water with mercury, which required a tube about 1m long, and experimented furtively.

Pascal carried one of Torricelli's devices up and down a mountain. He observed that the mercury column would fall and rise, showing that the weight of air was responsible for the height of the mercury

column. Torricelli had invented the mercury barometer. A unit of pressure, the Torr (1mm of mercury), was named in his honor. 1 Atmosphere = 760 Torr.

Vacuums

It's impossible to get to a perfect vacuum. Levels of vacuum are:

Low vacuum	760 to 10^{-3} Torr
High vacuum	10^{-3} to 10^{-8} Torr
Ultra High vacuum	10^{-8} to 10^{-12} Torr
Space (200 miles up)	10^{-8} Torr
Deep space	10^{-16} Torr

Another way of describing vacuums is the Mean Free Path (MFP), or average distance between collisions of particles. Approximate MFP at various pressures:

10^{-2} Torr	0.2"	10^{-4} Torr	20"
10^{-3} Torr	2"	10^{-5} Torr	200"

Oil Diffusion Pump

Vacuum Pumps

The two types of vacuum pumps used are transfer and entrapment.

Transfer Pumps

Rotary vane (common type), down to 10^{-3} Torr
Scroll pump, for 10^{-2} to 10^{-3} Torr
Both can pump large volumes of gas
(Oil) Diffusion pump (right photo)
Common type), to 10^{-7} Torr
Cheap and reliable for this level of vacuum
Disadvantage is that oil molecules can backstream into system
Cold trap can be used to reduce backstreamming
Turbomolecular pump, to 10^{-10} Torr
Built like turbine, with rotors & stators
Runs at 30-60,000 rpm
Turbodrag pump
Similar to above, but less expensive
Has section to "drag" molecules at bottom

Entrapment Pumps

Cryopump 10^{-9} Torr
Low temperature "refrigerator"
Cryofreeze, cryotrap gases
Requires warming cycle to clear condensed gases
Sputter Ion Pump 10^{-11} Torr
Sputters titanium to trap gases against pump walls like getter in old radio vacuum tubes

Measurement

Several types of gauges are used to measure vacuum:

1. Bourdon Tubes
2. Manometer
3. Mcleod Gauge
4. Capacitance Manometer
5. Thermocouple 10^{-4} Torr
5. Pirani Gauge 0.5 to 10^{-3} Torr
7. Hot cathode ionization gauge 10^{-3} to 10^{-10} Torr
8. Cold cathode ionization gauge 10^{-3} to 10^{-12} Torr

Vapor Production

Resistive Heating - Mike uses resistive heating of tungsten or molybdenum baskets or boats to vaporize materials.

Electron Beam Evaporation Source – uses high intensity, focused electron beam to heat materials

Laser Ablation – uses pulsed laser beam to vaporize materials

Sputtering – similar to “sandblasting” material into a vapor by bombarding it with heavy atoms (e.g., argon).

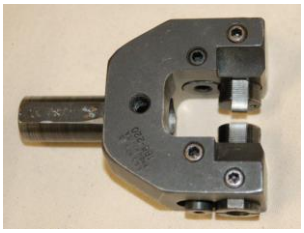
Ion Beam Deposition – uses directed ion beams to dislodge atoms from targets

Deposition rate monitoring – the rate of deposition of an evaporant can be monitored with a quartz microbalance. A quartz crystal is mounted in proximity to the substrate and is exposed to the vapor. The crystal is part of an oscillator and its resonant frequency decreases with increased mass as the vapor condenses on it. The deposition rate is a function of this frequency change.

Thin Film Metrology - One way to measure the thickness of a transparent thin film is by reflectometry. Reflecting light of different wavelengths off of a film and observing amplitude maxima and minima from light interference provides data that is used to calculate film thickness.

(Left Photo) Thermal evaporation device (with bell jar removed) showing substrate holder and quarttz crystal for deposition monitoring).

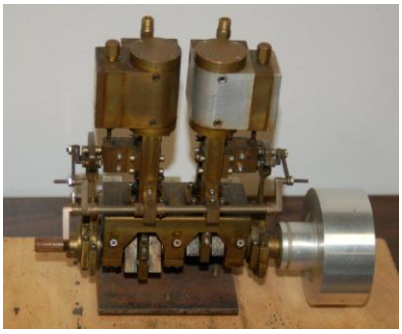
Show & Tell



Joe Williams went through a list showing the relative machinability of various metals . He also showed a knurling tool that he recently acquired and asked if anyone had experience using it (left photo).

Martin Kennedy showed a hollow mill used to make shafts of a given diameter and a gauge holder he made to fit his lathe quick-change tool post that helps center stock on a 4-jaw chuck (right photo). He also made his own dovetail cutter with triangular carbide insert.

Dick Kostelnicek showed some innovative uses for used CD disk spool containers. He mounts them under shelves to hold parts



Dean Henning showed a sample of welding stainless steel using both TIG and stick.

Gene Rowan had a ball turner that he built, and offered plans if anyone was interested.

Leo Reed brought his 2-cylinder Shay locomotive engine from Kozo Hiroka's construction article in LIVE STEAM magazine (left photo).

Problems and Solutions

Rich Pichler asked for suggestions of how to affix diamond paper onto a tool grinder. Suggestions were spray contact adhesive, double stick tape and contact cement.

One attendee answered his own question of how to prepare a new backing plate for a collet chuck he had purchased. He had researched the topic on the internet and found a good guide, such as this one.

A physically fit member (President Burns) wanted help removing a blind plug from the end of a competition barbell, without marring the finish. No good solution was known that did not involve cutting a slot or drilling holes for a pin wrench.

Novice SIG Activities

SIG coordinator *Rich Pichler* gave a very well attended hands-on presentation of how to sharpen a variety of tools.

Articles

More About Filing

By *Dean Williams*

Filing is a great way to get the fine finish that you want on machined parts. In this article, I'll describe the different types of files, how to clean and prepare the files for use, which files to use, and filing techniques.

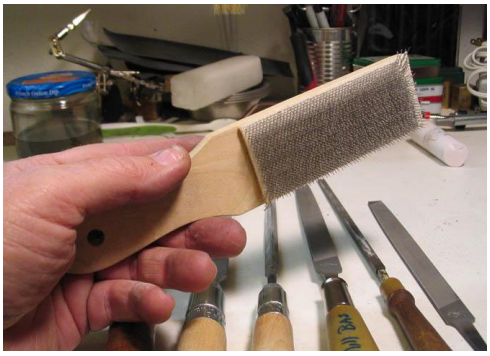
Right after that first old metal worker invented the chisel, he probably came up with the file too. Once he had a file and chisel, along with a hammer, he probably became the first machinist. That's the story, anyway.

First a little bit on files themselves, and other stuff. Here are a few different kinds of files and a couple of other things.

Something that is handy when filing is a piece of chalk. Some people like a certain type. The type that is kind of soft seems

to work best for me. The hard chalkboard kind seems to make a lot more dust and falls out of the file faster.

The chalk is used to "chalk" the file. By filling all the grooves of the file with chalk, it helps prevent pinning. Pinning is the result of the file taking a cut, and is just part of the process with some kinds of metal. The problem starts when the little pins get stuck in the teeth of the file. Then you start having problems with finish, and the file won't cut as well. The chalk helps to keep those pins from sticking in the file.

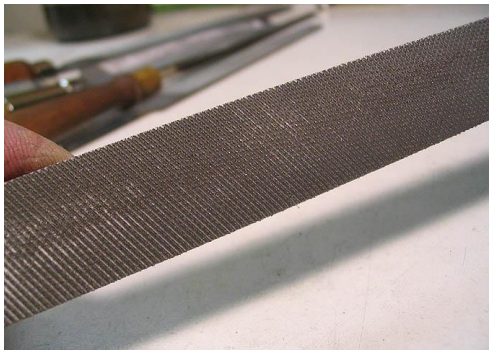


The best way to deal with pinning is to prevent it. To chalk the file, run the chalk over the file teeth and let it fill them. If you don't mind a mess, you can keep oil on the file, and it will also help stop pinning. I've tried this, and it works, but the file has to be fairly dripping with oil. I like chalk better.

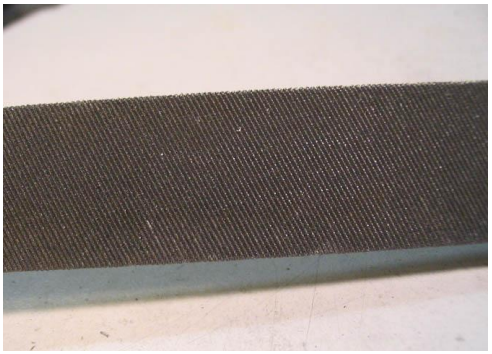
This is a file card, or file brush. It's used to clean stubborn bits from the file teeth. (If you chalk, you won't have to use this so often...) Some materials are simply gummy, and will stick in the file teeth, even with chalk. The file card will help get it out.

Some folks don't like these. A few guys have told me that they dull the file. I don't know how you dull something that is dead hard without something else that is dead hard, and I don't think the bristles on the brush are. I use one of these when I think it is necessary. Some guys are with me on that, some are again' me. You just have to decide for yourself on that. Often, if you chalk the file regularly, the pins will just fall out of the teeth when you tap the file on the work bench. Each time you tap the file, or clean it with the brush, you need to chalk it again.

Part of success with files is using the right one for the job.

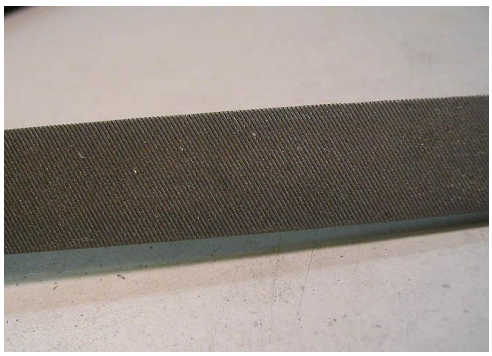


The file at the right is a double cut mill bastard, and it's made for heavy material removal, but it won't make a real smooth finish as easily. If this is the only kind of file you have, you need more files. You can see, if you look closely, that it has a bunch of diamond points on it. That's from the double cuts crossing.



This is a single cut smooth flat, the same length as the file in the previous picture. It makes a much smoother cut, but doesn't remove material as fast.

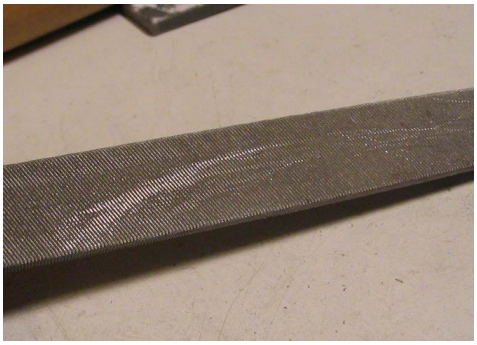
These two files are both 8" long. The cut on a file is dependent on the length of the file. All of the cuts for a given length of file will match from the finest to the coarsest cut, only for the given length of the file. So, if you desire a full range of cuts in a set of files, get them all in the same length.



At the right is a single cut mill bastard, which looks much like the previous picture, except smoother. It's only 6" long, but if it were 8", it would be a faster cutting file than the 8" smooth cut

in the previous picture. That's what I mean about all sizes being relative only to each other. The 6" file of a coarser cut can be smoother than an 8" file of a finer cut.

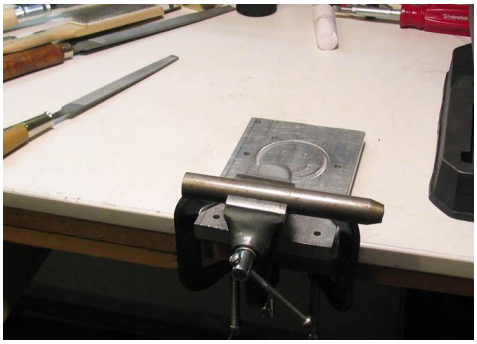
At the left is a taper file, and its triangular shape is good for cleaning up corners with the smaller sizes of files, but it is also easy to screw things up because of the 120 degree angle.



At the right is a ruined file, and I'm putting it here so you will know what to look for. If you're not into filing, then you may not realize that the reason you have a hard time getting a good finish is because your file is ruined.

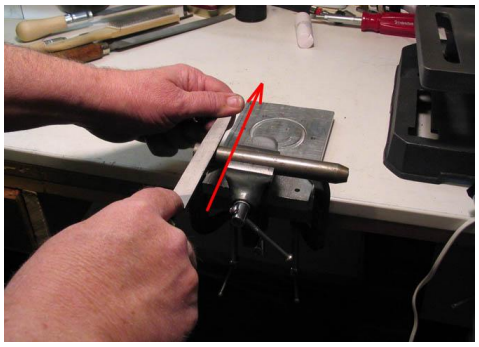
This damage was done, by me, in a "dumb mistake" moment. Cutting a piece of hard steel on the lathe, the bit suddenly dulled because I'd work-hardened a spot on the work piece in the previous pass. Sometimes you can get a file under a hard spot and pull out the work hardened spot, but I didn't go at it with enough conviction and the file skipped over the hard spot. In a second, a good file was relegated to the scrap bin.

Save your ruined files. They can be used for other tooling. There's not much in your shop that is harder than a file, and you can heat them and make cutters from them.



So, everyone is probably thinking, "when is he going to get done blabbering about files and do something".

Okay, when you set up something to file, first get it in a position that will lead to a good result. That means start with your piece held firmly, and start with it "on the level". Starting with the piece level will help to keep the cut level. Put it in a comfortable work position. You want to position yourself in a way that you will not lean to one side. If you are leaning, your cut will likely be leaning too.



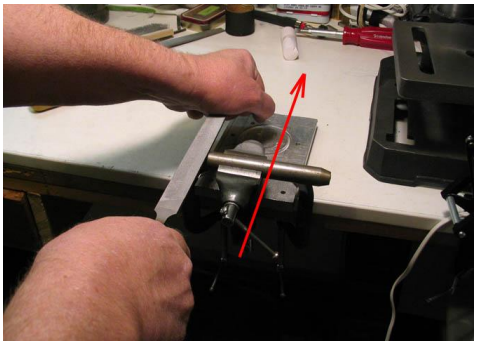
Filing is not sawing. Probably one of the biggest mistakes made, and often seen, is someone sawing away at a piece with a file. The file is made to cut in one direction, (for regular filing). Push the file away from you.

Chalk your file. Get in postion behind the work piece and lay the file flat on it. Rock it side to side to make sure you are not putting more down pressure on one side. Hold the file with both hands. One hand grips the flat end of the file, either by lightly pinching it between your fingers, or, if it is a great big ol' file, put the ball of your palm on the flat end of the file, and wrap your fingers around the end. The other hand goes on the HANDLE. You need handles on all your files. That goes double if you are using the file on the lathe! The handle not only gives you something to hold. It keeps the file tang from piercing your tender body if you should happen to run the file into a spinning lathe chuck. It also greatly increases your control of the file, helping you make better cuts.

Start off with a couple of light cuts, pushing away from you as in the picture above. Push with an even stroke, going the same speed at the end as at the beginning of the stroke. As you reach the end of the stroke, lift the file slightly so it just comes off the work. Then go back to the starting position and make another stroke, making sure to get the file *flat* on the work piece again.

After a couple of strokes, look at the work piece. By examining the cut, you can determine if you are holding the file flat. Is the cut the same width on both sides? If not, now is the time to correct the problem, before you get half way into the work and have a big mess to straighten out. This takes practice. There's no way of getting around that. It's a technique that takes a bit to figure out. If you continually get a cut that is deeper on one side than the other, reposition your body and try again. Just moving yourself an inch or two to the right or left can make the difference.

If you sit while you are filing, like you would when working on a very small piece and need to get your face close to see, keep your elbows off the work bench! If you put one elbow down, you will probably cut a slant, as you tend to slide the file toward the planted elbow. Keep the elbows up.

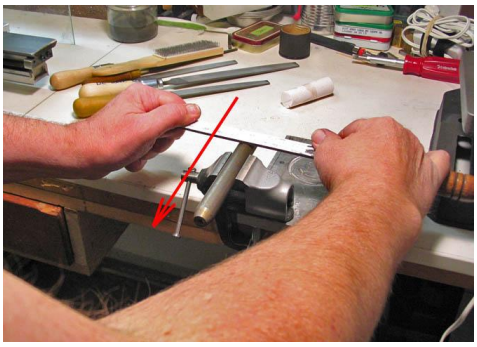


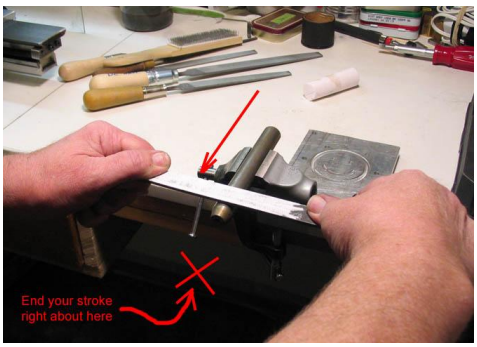
Here's a shot of how you would grip a larger file. Instead of pinching the end between the fingers, make a fist around it. The file in the picture is not big enough for this grip, (for me), but it's the largest one I had handy. Usually you will use a fist grip on the end if you are using a 12-14" or longer file that has a coarse cut, like a big double cut or a rasp.

How much down pressure you use depends on the file, and how smooth you want the finish. If you are roughing a piece down with a double cut file, you can push down pretty hard, but the stroke still needs to be steady throughout.

For finishing cuts with a fine file, less pressure is needed. As you come to your final strokes on a finish cut, you only need enough down pressure to keep the file from skipping over the cut. You want it to cut every time, no matter how lightly you press it. If it doesn't cut a little, you can get chatter, just like with a lathe or mill. A good or new file will cut with very little down pressure.

This picture, and the next, demonstrate draw filing. Draw filing is a method of getting very fine finishes with certain file cuts, and for doing work on thin edge sections, like the spokes on a wheel such as a clock gear. If you want to file the edge of a piece of 1/16" thick metal, this is about the best way to do it. Filing across such an edge will sometimes make so much vibration that it's impossible to get a good finish, but draw filing along the edge makes it easy. To start a draw file stroke, put the file on the work piece sideways, at the point on the piece that is farthest away from you, and "draw" it toward you, as in the right picture.



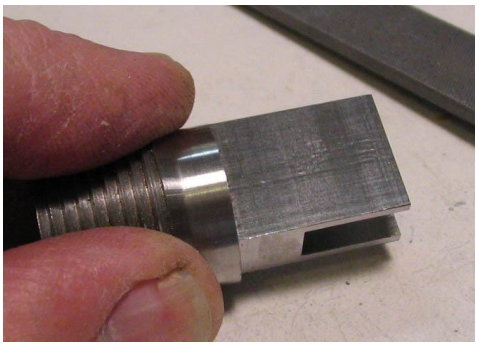


Pull the file toward you, and end your stroke at an imaginary point somewhere past the point where the file comes off the work. All the things about regular filing apply, with regards to a steady stroke, even pressure, and keeping the file flat on the work piece.

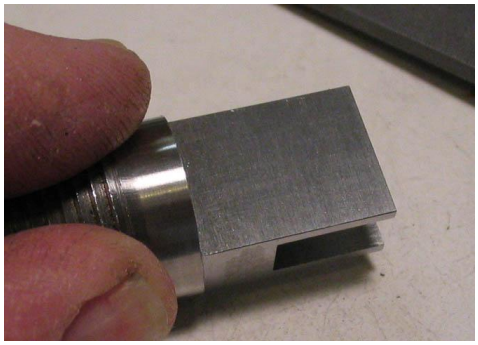
Because of the need to use both hands for the demo shot, and to get my hands in the picture while keeping out of the way of the camera, my grip is not optimum for demonstrating this. Normally, I would grip the file the same with both hands, and usually more like the grip on the left. The main thing is to do it in a position

that will let you keep the file flat, and pull it toward you with an even stroke. Take care not to increase the downward pressure on the file as you bring it toward you. It's what you are normally going to want to do, so concentrate on that aspect.

The following two shots are just examples from my current engine build.



Left is before, right is after a few minutes with a 6" single cut mill bastard. This is about as smooth as I want this piece, because I want it to maintain more of a sheen than a shine. With finer files, you can make things almost bright looking, and from there about all that can be done is light sanding.



Thanks to Dean for permission to reprint his excellent post on filing from Home Model Engine Machinist. Dean's webpage is here.

My Favorite Bedtime Books

By *William Robinson*

Here's some books that I have enjoyed over the past 20 or so years, usually in bed.

People Working Metal

Trustee From the Toolroom (311 pages) by Nevil Shute

A good read with less on the 'hard-core' technical side.

The Revolutionary Blacksmith (237 pages) by Paw Paw Wilson

This is a fictional story about a blacksmith in the American Revolutionary War. It's a blacksmith's story rather than a soldier's, although he is in the army for half of the book. This is the day-to-day working life of the blacksmith / soldier. It has some drawings. There is quite a bit of information about the times and how a village blacksmith lived and worked.

Extracts from Chordal's Letters (412 pages) by Chordal

These are articles from the American Machinist. Some of them address the social conventions and the working conditions of the times, usually in a humorous way.

Echoes From the Oil Country (5 Volumes; 61, 64, 93, 175, and 64 pages) by W. Osbourn

This is a collection articles that appeared in the American Machinist in the 1890s to early 1900s. Mostly one to two pages long, some pictures and drawings. Most are about life in a small job shop in the Pennsylvania oil fields. Some humor and the descriptions about working in the cold are incredible. Some of the equipment used is also incredible. The oil field Eccentric POWER at the end of book 4 is right out of Ruby Goldberg. This was a way to have a central engine work many wells vie reciprocal motion over up to

2000 feet. If he did not have photos I would not have believed it. The stories and photos of storing, moving and using TNT are incredible.

Apprenticeship in Steam (182 pages) by Jack Hampshire

The author is a starting as an apprentice machinist in England just prior to WW1. Sixteen-year-old apprentices can get into and cause a lot of trouble. The working conditions in England are quite interesting and don't meet OSHA standards (an understatement). There's quite a bit of technical detail in the stories. A number of pictures of road machines but not of the workshop are shown. What was expected of 16 and 17 year olds and the responsibility delegated to them was interesting and could not happen today.

The Bull of the Woods (Six volumes: 124,147, 148, 148, 136, and 144 pages) by J. R. Williams

These are one-page comics out of the 30's and 40's. There about machine shop operations and management. This is big shop not the home or job shop type. I recommend getting one book and seeing if you like them. The caricature and stereotyping can get old.

Strike While the Iron is Hot (173 pages) by Guy Lautard

This is a fictional story about a machinist in Canada who goes west to help a friend who is hurt. He provides transportation of a lady. The machinist builds models and there is a lot of how-to and interesting details in the book. There is adventure, romance, solving problems and stopping the bad guys.

The Machinist's Bedside Reader (206 pages)
The Machinist's Second Bedside Reader (201 pages)
The Machinist's Third Bedside Reader (259 pages)
Hey, Tim, I Gotta Tell Ya (52 pages) by Guy Lautard

These are an unstructured collection of metal working stories and articles. There's a lot of good info about metalworking and many drawings and pictures. They are very readable and hard to put down.

Metal Working

Me and the Model T (217 pages) by Roscoe Sheller

The book presents look at how transportation made its first great strides in the transition from horse-and-buggy days to the world of super highways.

Related as a series of amusing incidents and hilarious predicaments, this is certain to please the teen-ager as well as the old-timers.

Sheller writes about selling and teaching almost every prospect how to drive. The three floor pedats were confusing; may got their feet tied up in them and ended up trying to stop by yelling "Whoa, damya, Whoa!"

Not much of an Engineer (255 pages) by Sir Stanley Hooker

This in an autobiographical account of a player in the enhancement of the Rolls-Royce Merlin engine at the start of WWII. He then worked on jet engines during their development and production (starting about 1942). It includes some interesting info about the war, the people and the engines that I have not seen elsewhere. The low level details about the life and times are very interesting. Example: He wanted his boss to attend a demo of one of the first jet engines. The boss was not very impressed with an engine rated at 800 pounds thrust until Hooker pointed out (he had already done the math) that the Spitfire flying at 300 mph developed 840 pounds of thrust.

I worked With Traction Engines (152 pages) by Jack Hampshire

These are short stories about working with steam traction engines. They're bout the family firm in England in the early 1900s, with some drawing and pictures. I found the readable but I liked Apprenticeship in Steam more than the others. Unlike Apprenticeship in Steam, there is no machine shop info or stories. They're about the working of traction engines in England and driving then on the public roads. This is the real life of working traction engines, with long hours, hard work, that's dangerous and dirty.

Wood working

Note: It may seem strange to include woodworking books in a list intended for metal working people but these books are more history than how to about working wood. The amount of wood used in the 1700 and 1800s was staggering. It was used for things that are now made of plastic or pot metal. A few photographs in the woodworking books but there are many very good drawings. Metal working content, the many tools (metal) that the wood worker required are illustrated. It really brings home the fact the specialized tools are nothing new.

A Museum of Early American Tools (108 pages) by Eric Sloane

This book illustrates a huge variety of axes, hammers, chisels, etc.--each one perfectly suited to a specific task and carefully made to individual specifications.

Eric Sloane's America (342 Pages) by Eric Sloane

This was originally published as three separate volumns American Barns and Covered Bridges, Our Vanishing Landscape, and American Yesterday (a companion volume to Eric Sloane's Sketches of America Past).

Eric Sloane's Sketches of America Past (337 pages) by Eric Sloane

Here's compilation depicting the lives of America's forefathers stresses resourcefulness, craftsmanship and tools, and farm life as portrayed in the three books Diary of an Early American Boy, It's a Museum of Early American Tools, and a Reverence for Wood..

Old Ways of Working Wood (255 pages) by Alex Bealer

This revised edition of a classic guide to woodworking methods provides valuable information on the evolution of wood products, the types and characteristics of wood, essential tools, and such techniques such as planing, splitting, boring, chiseling, and shaping. These are the techniques and tools of a time-honored craft.