Just remember one thing, it's called electric power. There are a lot of lathes out there that use 230 volt three phase power; this can be over come with the use of a converter.

If you buy a lathe, mill or any power equipment check the warranty before you make the purchase, some new tool warranties do not allow the use of a three phase converter.

There are new and used lathes out there that use 110-220 volt power, most homes have 220 volt single phase electric service. Now I know some are scratching their heads wondering what I'm talking about, most homes have 220 volt electric single phase service, but there are some older homes that still have the original 60 Amp 110 volt Rural Electric Service, if you live in an old home like that either buy only 110 volt equipment or upgrade your electrical service.

There is one curse to buying machine tools, that's keeping your better half from finding out about the cost of the little extra's like cutters and boring bars, if your single your ok, if not, don't worry you soon will be. (Just kidding) The bottom line is you will want some extra cutters and tooling so don't spend all of your money at one time.

The next big ticket item will be a milling machine. This is the one item where a Mini Mill or Mill/Drill is suitable. If you have the money buy a Knee Mill or larger Bridgeport style mill, but a $500.00 Mini Mill can do the job. If you do go with the Mini Mill, it is an absolute must that you buy one that uses R8 tooling.

The mill used for the receiver built in this book is a Mill/Drill. There are many Mill/Drills on the market, buy one that uses R8 tooling and has at least an 8x28 table. There are some Mill/Drills on the market that have direct powered heads, if you buy one of these mills buy the one that has a minimum of 1970 RPMs.

To build the receiver, we will use the Mill/Drill as a surface grinder to make the broaches needed to cut the raceways, so don't fudge on RPMs.

To grind the broaches we will need a 1 ¼ inch arbor with R8 shank. We will also need a white straight cup type grinding wheel

This is the R8 1 ¼ arbor and 5x 1 ½ x 1 ¼ white grinding wheel that will be needed to grind the broaches to size

You will need two 7/16 inch D style broaches, one 3/8 inch C style broach and one ¼ inch or 6mm C style broach. Broaches are expensive; I personally don't like imports, but if you need to save some money, then go ahead and buy the import broaches.

I have found the cheapest place to buy import brand broaches is from a machinery and supply company in Mentor Ohio.

You are going to need some specialty pillar files; these are long thin files with safe or non- cutting edges. Files are a funny thing I have bought El-cheapo files and high priced USA and Swiss made files and based on the application and use there is very little difference.

When I first started grinding broaches I ground a broach to cut the arc of the raceway, I soon found that I could get by with just a special cut file. The file that I use is a 12 inch long half round file that is ground down on both edges to the .4375 inch with of the raceway for a Mauser.

I used a 4 1/4 inch hand held grinder using regular grinding wheels, for metal. If you don't have a 4 ¼ inch grinder get one, El-cheapo works fine.

This is a picture of the files that I used to complete the receiver.

The bottom file is the 12 inch half round that I ground down to .4375 inches to fit the Mauser raceways. The next file above it is the long thin pillar file, with safe edges. It's needed for cleanup of the race ways. Hint: If you buy a good second cut file for the 12 inch half round file, the flat edge can do the work of the pillar file.

If you are buying drill bits for the first time, you can buy an assortment of drill bits and yes try to buy the best you can afford. To build your mauser receiver you will need a ½ inch 6 inch long bit to drill the pilot hole for the receiver, I then switched to an 11/16^{ths} bit at least 6in long to open up the hole.

I mentioned earlier to buy the best bits you can afford, you will need some 3mm and 7/32nd bits, don't go cheap, these are used to cut the holes for the receiver hold down screws, sear and bolt stop holes.

After I drill and bore for the barrel end I rotate the receiver stock and drill the opposite end, after drilling I ream the full length of the receiver with a 45/64 HSS reamer that is 9 inches long, straight spiral.

After reaming I hone with an 18mm flex type silicon carbide hone using transmission fluid as the cutting fluid.

I use both boring bars and a special ground 1 inch counter bore to bore the barrel end of the receiver and form the locking lug area in the receiver. I also use a 13/16 and 1 ¼ counter bore, I use the 13/16th counter bore to bore the bolt shroud relief area, the 1 ¼ counter bore is to form the rear hold down bolt tang.

Counter bores are end cutting only, and are slightly oversize. I ground the sides of a 1 inch counter bore slightly so it would cut a little less than one inch. I use this counter bore to cut the barrel opening and form the locking lug area at the same time. However if your lathe has a sloppy tail stock or your set up is not ridged, I suggest you use a cobalt or carbide tipped boring bar or you will have an oval shaped hole.

The miscellaneous tools will be a 4x6 power metal saw to cut the receiver stock or hack saw with a blade for metal, layout dye, scribe, punches, and ¼ x28 inch taps.

You're going to need end mills ½ and 3/8 inch, carbide or cobalt is a must. Standard end mills could be HSS, but I am finding that carbide or cobalt work best. Standard length 3/8 and ½ inch can do most of the milling.

To cut the magazine feed rails I use a 3/16 inch cobalt end mill with 3/8th shaft. To cut the cartridge feed ramp you must have a long 7/16th end mill.

Contours are cut with 3/8 and ½ inch ball end mill's don't skimp here and buy El-cheapo's.

Chapter Two

The Strength is in the Steel

I hope your still excited about homebuilding your own personal use firearm.

This chapter will be very short and simple, if your going to build a firearm you must absolutely use the right steel for the application. There are many designs out there, some good, some bad, and some down right horrible, but every receiver must be made with steel capable of handling the pressure for the cartridge it was designed for or you will have a disaster.

I use one design in my home built bolt action firearms, Mauser, why Mauser? it's a design that is time tested for over a century. The large ring Mauser may be the safest design ever built for a bolt action rifle and it's not because of the 3rd locking lug.

The original Mausers were built at a time when many firearms still used black powder as the cartridge propellant. To make new advances in firearm and cartridge designs, new developments in heat treating and steel production had to be made first.

There is a lot a debate on the type of steel used to make the Mauser receiver, the best guess is a medium carbon steel similar to 1030 with a little extra magnesium thrown in to ease machining. The Mausers were then machined from a forging and case hardened. By modern standards a simple case hardening for a bolt action receiver firing a cartridge that develops a chamber pressure of 49,000 cup would never get past the corporate lawyers.

For my home built Mauser I used 4140 pre-hardened steel. 4140 is readily available everywhere in the country, now that doesn't mean every supplier has it setting on the shelf, but 4140 can be purchased from suppliers though the mail, over the internet, and at local machine shops.

If your going to buy it from a local machine shop make certain its 4140 Pre-hard and not annealed or something else like 1018 cold rolled steel. I say this because I went to a local supplier a big machine shop that claimed to have 4140 pre-hard in stock. The guy went over to a big rack picked up a piece and said here you go, I asked do you have any Stress Proof, he went to the same spot on the rack picked up a piece of steel and said, here you go.

There is no way in hell I would use that steel to make a receiver, you must absolutely know the type of steel you are using when making gun parts. That's why big suppliers that sell over the internet or out of catalogs may be the safest place to buy steel in small quantities.

Now I know there are other types of steel that could be used to make a receiver, fatigue proof and flextor. In a survivalist situation, Stress Proof could be used provided you build your receiver for a lower pressure cartridge, like 7mm Mauser or 7.62x39. Car, truck, or tractor axles could also be used, but I would only consider this in a desperate survivalist situation.

Any steel that you use you want to be certain about its hardness. The best way to determine the hardness of steel is by using Hardness testing equipment. If you had heat treating equipment and the know how to use it, 1040, 4130, 4340 and 4350 could all be used.

I have read on the internet where some homebuilders send their receivers out to be heat treated. Let me give you a word of warning, not everyone knows the law on home building firearms, not even the police.

When you complete a firearm even before its heat treated, by law it is a firearm. Unless you are an FFL dealer, sending a firearm through the mail is a felony, plus some states have laws about firearms needing serial numbers or identification marks. Under current federal law a homebuilt firearm does not require a serial number, but it is suggested that they are marked with the makers name and town.

This is why I make my home built receivers out of 4140 pre-hard steel. In my opinion it's strong enough to handle any standard cartridge in the .473 head size. This is the case head size of the 30-06, 308, 243, 22-250, 7 and 8mm Mauser.

Every one has their own ideas about how strong a receiver should be they go on to the internet and read about some bench rest rifle with a receiver hardness of 35-45 on the Rockwell C scale and think their rifle should be just as hard. Those types of rifles are designed to be ridged for long shots, using very high pressure rounds, up to 65,000cup.

When Uncle Sam was upgrading from the Krag to the Springfield, those rifles were proofed at 70,000 cup and from what I have read; Paul Mauser proofed his receivers at 66,000 cup.

Different manufactures have slightly different ratings for their steel, 4140 pre-hard on average has a tensile strength of 150,000 psi and yield strength of 128,000 psi.

Some manufacturers list their steel by a hardness scale from 28-34 RC. This means the steel is suitable for most applications that require hardness in that given range.

There are actually formulas to determine what strength of steel should be used for a given design, but since I am using a proven design instead of making my own, I look at the steels yield strength only.

Now I must admit looking at the yield strength of a steel is an over simplification for determining the type of steel used in a firearm, but 4140 has a long history of use in firearm manufacturing.

Chapter Three

Receiver Design

I started my quest on homebuilding in 1998, having waited almost eight years before I even acted on the knowledge of broaching a receiver. I was certain that I could broach the raceways of a bolt action receiver, but the question was what design to copy.

Being an admirer of the bolt action Mauser the decision was easy. In my opinion Paul Mauser was a genius; his bolt action design has lasted for over a century and is still being manufactured to this day.

When I started to duplicate the Mauser I realized there was one Mauser feature that I could not duplicate, the inner locking ring. I think Paul Mauser added the ring to his design just to aggravate other designers and to confound state run arsenals that might try to copy his design without a licensing agreement.

My version of the Mauser also has a slightly different variation on the extraction cam area of the receiver, but other than that it's very similar. I do take a little liberty with the Mauser design, I use a round piece of 4140 pre-hard steel 1 ¾ inches in diameter 8 ¾ inches long, because of this the recoil lug is round bottomed instead of flat. I believe the round bottom still provides sufficient area to act as a recoil lug. If you want your version to have a flat recoil lug, then use a larger piece of steel.

Some homebuilders want to build from scratch, I say go for it, but for me, I prefer the mauser design, because of the availability of parts and over the counter accessories The fact that I can buy stocks, bolts, triggers and sears is enough for me to stay with the mauser, I like it easy.

Now you don't have to use strictly a Mauser bolt with this design. For now I'm using a Mauser bolt, but if the price of Mauser bolts keep rising, I'm going to switch to a 1903 Springfield bolt. One plus of the Springfield bolt is that you don't have to mill the third locking lug slot.

Now I do not consider an internal eccentric cut to be a problem, but the Springfield bolt may be an option to those looking for an alternative to the eccentric cut. There is one draw back to the Springfield bolt, the bridge end must be tall enough to accommodate the safety lug grove, but that's not a problem either.

If you are looking for a Mauser alternative with out the third locking lug, try a bolt from a small ring Mauser. I would for safety reasons add the safety notch in the receiver similar to the 95 Chilean. Another option could be a bolt from a 700 Remington. So don't think you're married to a Large Ring Mauser bolt.

If you are going to build a bolt action receiver using a bolt other than a large ring Mauser, first measure the width of the bolts locking lugs, before you buy any broaches. One reason I like the Mauser is that the standard 7/16 inch D style broaches can be used to cut the raceways.

Now don't get upset if you want to use a Springfield bolt and find out that the locking lugs measure .400 inches wide. A 10mm D style broach measures .394-.395 inches and can replace the 7/16 inch D style used for the Mauser, a little tight, but this allows for some final fit and a little polishing.

Now if you need a broach for a raceway that a corresponding standard or metric broach size is not available, find someone with a surface grinder and have a ½ inch D style broach ground down to the size you need.

I like a lot of people would prefer to buy made in the USA, but unfortunately that may not always be an option. Broaches can be bought any where, the USA made broaches may be the best ever made, but they are expensive, if cash is short don't be afraid of the imports.

There are many wholesale and industrial supply businesses on the internet, so do a web search and see what you can find. The cheapest place I have found for new import broaches is from an industrial supplier in Mentor Ohio.

Some of these internet wholesale and industrial suppliers only offer the more common sizes of import broaches, but I promise you there is a 7/16 inch import broach available, because I own one.

I am including hand drawings of the Mauser receiver that I built. I believe all of the dimensions are accurate, but check your measurements before you start.

I like to make my receivers just a little oversize for final finishing. I also cut my barrel and receiver threads using a 1 1/8th, 12 thread/inch USA made tap and die.

The real Mauser uses 12 threads/inch, but with a barrel shank diameter of 1.100 inches.

This means a standard Mauser barrel will not work in my home built receivers, but you can build your receiver to accommodate a standard Mauser barrel or any size you want. So keep this in mind before you commit to a barrel.