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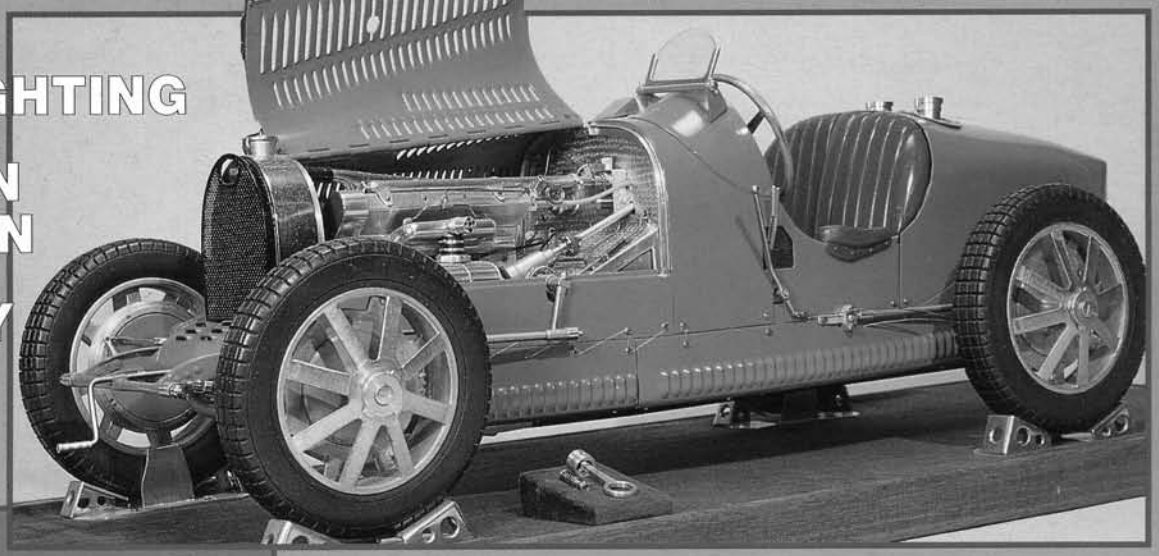

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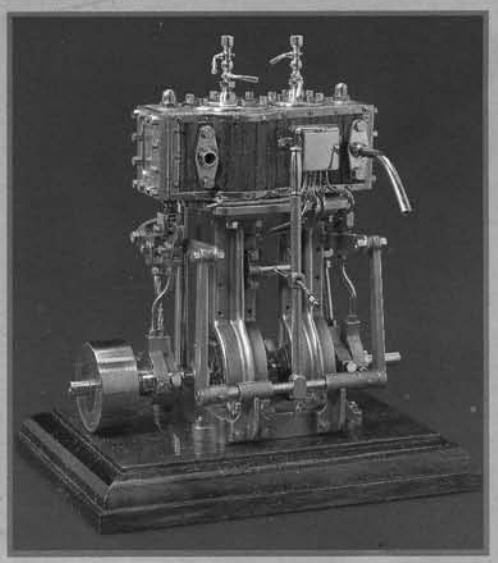

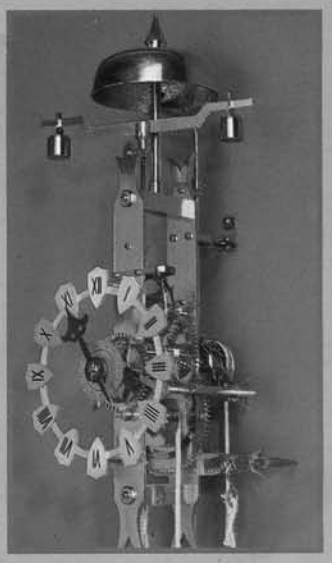

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CONTENTS

I would like to welcome you to another edition of World of Model Engineering and I hope that you will find plenty of items to whet your appetite in this issue.As Nexus Special Interests Ltd. is starting a new Model Railway and Engineering Show to be held at Sandown Park in April, it was decided to publish this edition of World of Model Enginering in time to coincide with the opening of the new show and to increase the scope of the magazine to cater for model engineers and railway modellers alike.

In order to keep to the theme of model engineering, this issue contains articles about the model railway scales on which the running of live steam locomotives may be a practical propostion. These scales run from '0' Gauge through the more popular Gauge '1' up to Gauge '3' which is actually on 2.1/2" gauge tracks.

Although, as stated above, World of Model Engineering is aimed at newcomers to the hobby, it should also be remembered that most people already involved in this hobby tend to stick to one particular area of prototype to model. Sometimes these people may like to try another area for a bit of "light relief" and I hope that this issue will give them some ideas in that quest. I have, therefore, tried to cover a variety of different subjects and hope that they will appeal to all age groups and levels of skill.

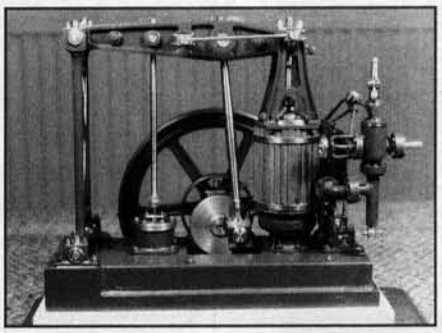
As well as looking at workshop arrangements and tools, there is some advice on lathes suitable for making the smaller models and how to cope if you are restricted in the space you have to work in. Silver soldering is a technique which seems to give problems to many modellers and Bruce Davey tells you how to do it successfully and what you will need. There are also details of a boiler testing rig for you to make so that you may hydraulically test your latest creation before submitting it for a proper boiler test.

Many of the older craft skills are becoming rarer these days and the article on Modelling Horse-drawn vehicles shows you how to keep this craft alive by making your own models using the specialised techniques of bygone days. Clockmaking is another craft skill which has been practiced for centuries and John Wilding, a well known Author on this subject, provides you with an insight into the variety of clock types and their construction methods.

Building a model from a kit of parts could well be an ideal way for the beginner to start in the model engineering hobby. It would give a good insight into how things go together and also provide the chance to complete a first model quite quickly. The article on Building a LSWR B4 tank locomotive in Gauge '1' contains an insight into the design considerations of the kit and why it would be ideal for the beginner. Looking into the stationary engine scene, the "Pipit" Electricity Generating Plant not only provides a quick and easy way of making a steam engine but also has educational value in showing energy conversion from steam to electricity.

I hope the content of this issue will prove interesting and that it will encourage both new and existing model engineers to enjoy the fascinating World of Model Engineering.

Mike Wade - Editor



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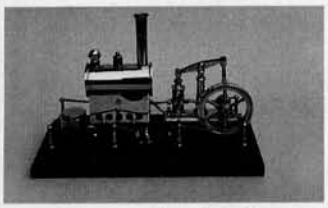

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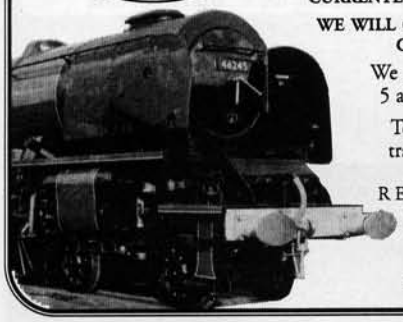

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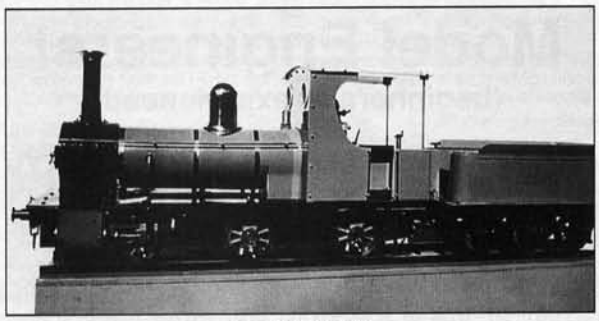

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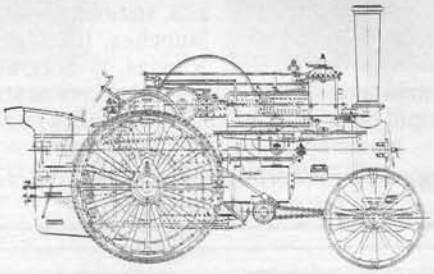

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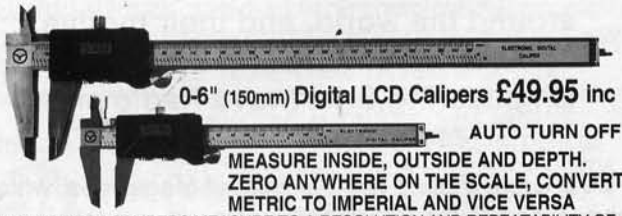

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The world of MODEL ENGINEERING

by Mike Wade

Model traction engines, like this 3" scale Burrell 6 n.h.p. tractor by Ivan Frear of Staines S.M.E., are always popular with young children because they know they might get a chance for a ride on the trailer behind them.

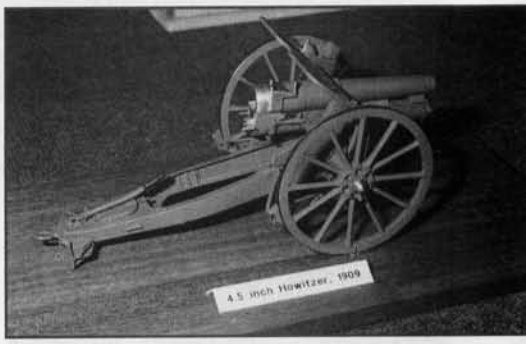
The model engineering hobby covers a wealth of different subjects. This article gives an insight into some of its many aspects ...

Welcome to the fascinating world of the model enginering hobby. You might well be asking what this hobby is all about. Well, this article is intended to give you an insight into the hobby and to give you some ideas about which type of model you might like to have a go at building.

There is a wealth of subject matter for the model engineer to work on, ranging from simple subjects through to highly complex ones. Many forms of transport, types of engines and machinery, clockmaking, fairground rides, structures and so on are covered by the general term "model engineering". Some purists might argue that there should always be an "engineering" context in whatever subject is chosen - and this is probably true - but if you look at what is meant by "engineering" you will soon discover that it is an extremely vast subject in itself.

Engineering is the profession of applying scientific principles to the design, construction and maintenance of engines, cars, machines,

Gerald Webb won a Gold Medal at the recent Model Engineer Exhibition at Olympia for his 1/12th scale model of a 1947 Leyland Octopus 22 ton 8 wheel lorry. This is a fully engineered model built on the same principles as its full size prototype.



Other subjects that may be built by the model engineer include military cannons such as this 4.5" Howitzer from 1909.

bridges, roads, communications, chemical plants, aircraft etc. The important part to remember is that it is "applying scientific principles", such as the laws of physics and mechanics etc. In other words it not only covers the use of metals but also brick, concrete, timber, plastics, glass, water, etc. Understanding what is meant by the term "engineering" in its fullest sense gives one a better understanding of the range of subjects which it covers.

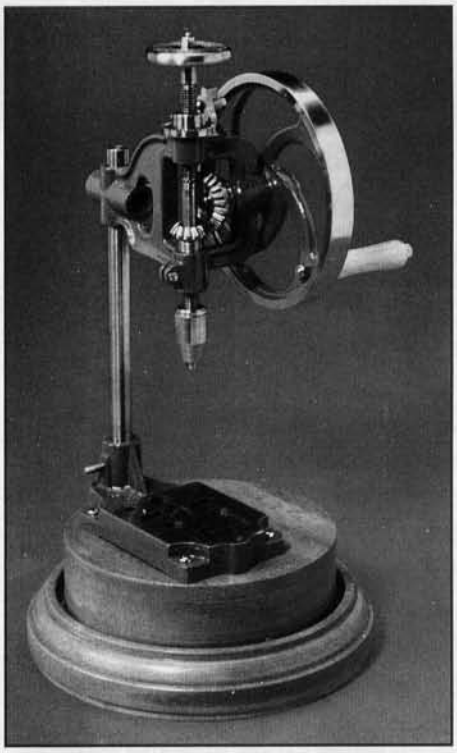
The Model Engineering Hobby

The following is intended to give some idea about the more popular branches of the hobby in order that the newcomer will be better informed as to what sort of model he might like to become involved in and what help may be available to him (or her - there are a great many ladies involved in model engineering!). Further in-depth articles on some of these subjects will be found elsewhere in this issue and will provide more information.

Railway Locomotives

Probably one of the most popular branches of the hobby is that of modelling railway locomotives. Indeed, many of the model engineering societies are heavily based around the live steam railway track which is often used for passenger hauling as a means of boosting the financial income of ▶

Railway locomotives are one of the most popular subjects in model engineering. This scene was captured on the 7.1/4" gauge ground level railway at the Olympia M.E. Exhibition and shows a battery-powered 0-4-0 "diesel" loco about to depart from the station.



Modelling workshop equipment is yet another aspect of the hobby and this exquisite 1:4 scale model of a Hand Driven Bench Drilling Machine by Raymond McMahon was copied from the original machine itself. It evoked fond memories for your Editor because his father has one of the originals in his own workshop!

the society.

The railway locomotive has a lot to offer the modeller and its construction can involve many different aspects of engineering including benchwork, turning, milling, grinding, heat treatment, boilermaking and platework. Do not let this list put you off if you feel that certain areas are outside your scope, because there are many traders who would be able to undertake those areas you can't cope with. Having said that, there is a great

Trams and tramway modelling can be a fascinating area for the model engineer and one of the most popular scales used is 1/16th, running on 3.1/2" gauge tramways. This Liverpool Cabin Tram Car No. 809, made by well known modeller David Orchard, is an excellent example of tram modelling.

deal of satisfaction to be had from learning how to do everything yourself and then being able to drive your own locomotive with the knowledge that "I made it all myself".

Railway locomotives employ several forms of motive power, including steam, diesel, electricity and gas. So you already have a choice of what type of engine to model. There is a great deal of scope for experimentation and development of ideas in this field. Even the full size railways are still experimenting with new and different ideas.

The popular range of scales for modelling railway locomotives goes from 7.1/4" gauge (1.1/2" to the foot) down to "0" Gauge (7mm to the foot). Obviously the larger scales need bigger workshops with larger machinery - and a larger budget! The smaller scales have the advantage of needing much a smaller space to work in and only require small lathes etc. to build them - and, of course, a smaller outlay! Much will depend on the modeller's workshop facilites and funds available.

Traction Engines

Following railway locomotives in the popularity stakes are traction engines. The term "traction engine" is commonly used to describe engines which do not need to run on railway tracks. In fact ,"traction engines" are only one form of this type of vehicle. These engines were designed mainly to provide power for various jobs as needed, but their main purpose was for agricultural use. The steam tractor was designed to haul loads around the country on public roads, while the road locomotive was built for heavy road haulage. Steam wagons were effectively a steam tractor with a built-in means of carrying the load. Other types of engine include ploughing engines (for hauling ploughs etc. across fields), road rollers (believe it or not, for rolling tarmac on roads!) and the ubiquitous showman's engine for driving fairground rides and moving them from site to site.

Again, there are many scales in which to model "traction engines", ranging from miniature engines of 3/4" to the foot up to half size replicas at 6" to the foot. Obviously the dictates of available space and finance will decide the choice of scale but consideration should also be given to the uses and tranportation of the model . Smaller models are ideal for display and general interest, whilst the larger models can be used to give rides and even to do 'real' jobs of work.

Stationary Engines

As the name implies, these engines are static forms of power generation. They include power plants for driving machinery or generators etc., or engines mounted in vehicles or aircraft to provide motive power. Stationary engines may be driven by steam or by internal combustion (such as petrol or diesel engines).

Typical examples of stationary engines are those which were designed to power the mills in the textile industry and those which drove electricity generating plants. It is interesting to note that steam is still used to drive generating plant today, the only difference being that the steam is raised using gas, water or nuclear power sources!

The range of scales for modelling stationary engines covers table top display models up to quarter or half size engines. As well as the engines themselves, some modellers even go to the extent of housing the model in scale-sized buildings - and very impressive these can be too!

Workshop Tools

Most model engineers seem to make tools and accessories for their workshops at

some time, whether it be in order to make a particular part for the current model or simply to save the expense of buying the tool itself. It cannot be denied that considerable savings can be made in this way and the money saved can be put to "better" use in buying castings and materials for the model in hand. However, some model engineers just like to build workshop items etc. for their own pleasure. Many fine examples of this craftsmanship can be seen at exhibitions around the country.

The most usual items built are small machines for use in the modeller's own workshop. There are plans and castings available from the Trade for small drilling machines, milling machines etc. as well as various accessories such as fly-cutters, vee blocks, vices, rotary tables and so on. One of the model engineering Trade suppliers has based his business mainly around the supply of castings and materials for producing workshop items.

The question of scale normally comes down to full size if the tools are to be used in the workshop but I have seen some exquisite small scale models of full size lathes and milling machines which were built purely for the pleasure of making them. It all depends on the modeller's individual requirements.

Clockmaking

The making of clocks and timepieces is yet another branch of the model engineering hobby. Clockmaking is a very ancient craft which has been practiced for centuries. The skills and methods involved today are, to a great extent, the same as those used by the craftsmen of the old days. Modern technology has not had such a great impact on the clockmaking scene as it has elsewhere. Traditional clockmaking methods are still used today by the best clockmakers, electronics have only really come into force in areas of mass- production for the general public.

Model engineers tend to favour the more open style of clock in which the motion work or gear trains can be seen easily (i.e not hidden inside a case or cabinet). Typical examples are the skeleton clocks and the 'specials' like the rolling ball clock. These are usually housed in glass domes or glass cases so that the 'works' are on view all the time. (Why hide all your work in a wooden case!). Having said that, many clockmakers still like the cased clocks such as the Grandfather or Grandmother longcase clocks or the wall clocks such as the regulator and so on. Not to be forgotten, there are also the bracket clocks in their polished brass cases with decorative pillars and spandrels.

As well as being a fascinating hobby, clockmaking can also lead to interesting work if one becomes involved in the restoration of old clocks. All in all a very rewarding branch of model engineering.

Horsedrawn Vehicles

There is a great deal of scope for the woodworker in modelling horsedrawn vehicles. Most of the the old vehicles were built primarily of wood as this was a readily available material at the time. Iron was used for parts which needed greater strength and for axle bearings and wheel tyres etc.

Many different types of vehicle were designed for various uses, including farm wagons, brewer's drays, living vans, coaches, coal merchant's drays etc. Some of these were totally without springing, whilst others employed various forms of suspension depending on the load which was to be carried. Some of the farm wagons were of very simple construction with straight sides and straightforward wheels. These would probably be a better bet for the beginner to attempt as a first project. Passenger carriages were usually more ornate and had compound curves in the side panels with quite complex wheels and suspension.

Many plans and kits of parts are available from the Trade for the construction of horsedrawn vehicles and there are a few specialist suppliers who can offer almost anything the modeller can require, including help and advice!

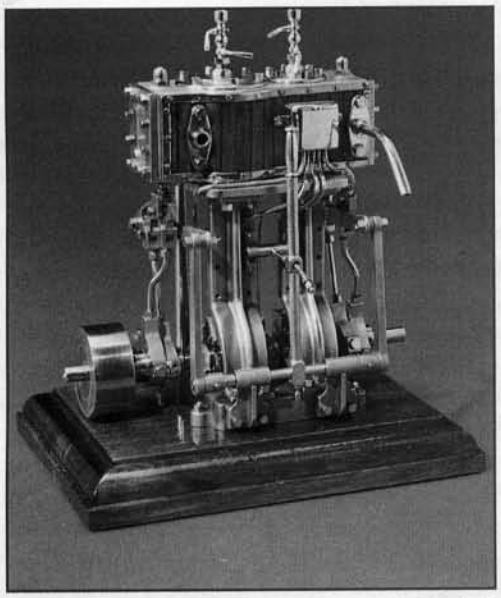
In summary

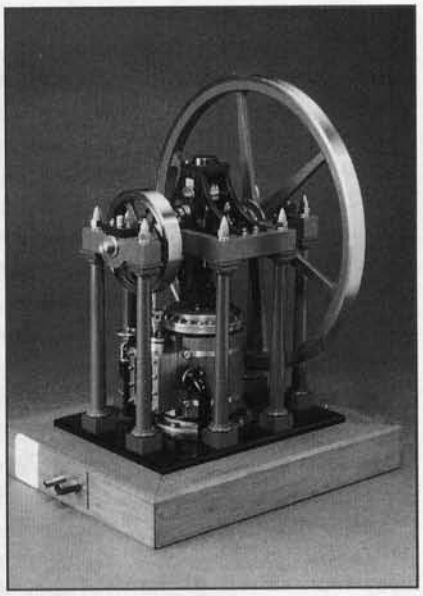
I hope the foregoing has given you an insight into the fascinating world of model engineering and has whetted your appetite enough to seek more information about one of the many branches of the hobby. I would recommend that you visit some of the many model engineering exhibitions which are held locally all over the country and look at the models on display there. Don't be put off by the excellent quality of what you may see, everyone had to make a start at some time in their modelling career and I can assure you that every model engineer has got a box of 'mistakes' and 'bits that went wrong' under his bench at home.

Talk to other modellers at exhibitions and, perhaps, visit a local model engineering society. You will find that nearly all model engineers will be only too pleased to help and advise newcomers to the hobby. I think it must be one of the friendliest hobbies that I know of and the social side can also be great fun.

A lot of enjoyment can be had by researching a particular prototype and finding out all sorts of information which will help in building your model. Whatever type of model you decide to have a go at, remember that the hobby is all about enjoyment and helping one another. There is a good deal of support available from the Trade suppliers, magazines and books, so there is no reason to think that you will be working on your own.

The best advice for a newcomer to the hobby is to not be afraid to have a go - you may well surprise yourself and discover that things are much easier then you thought they might be. So go on, give it a try - and join the World of Model Engineering! ■





(Above) Twin cylinder Compound Launch Engine) (Above) Rectilinear Engine of 1834)

These two photos show beautiful examples of the stationary steam engine scene. Above is a Rectilinear Engine of 1834 built by J.A. Cogdon - this model was made without the use of any castings! Also shown above is a Twin Cylinder Compound Launch Engine built to a scale of 1:6 by Heinz Bigler.

GAS FIRING for MODEL BOILERS

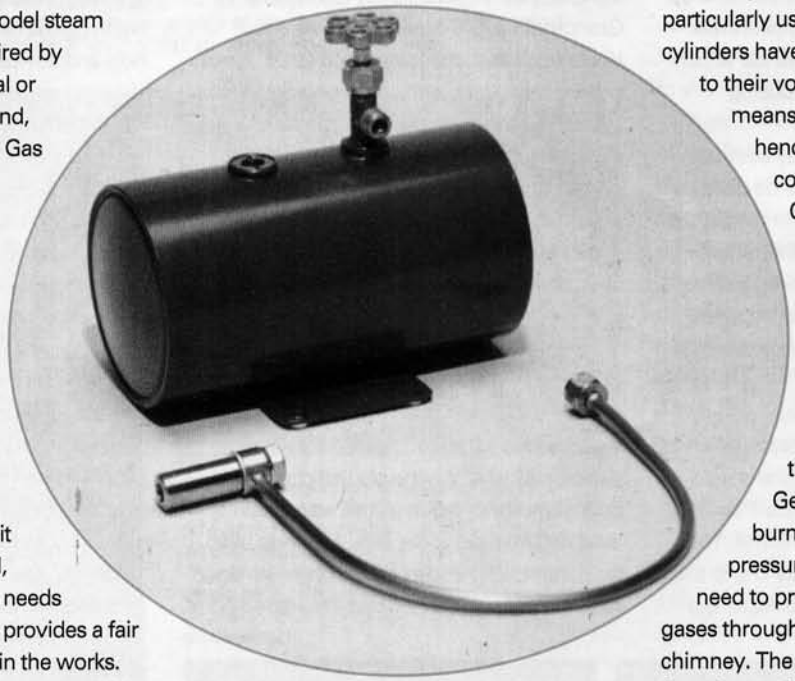
by Bruce Davey

Until recent years model steam plants have been fired by paraffin, petrol, coal or methylated spirit and, occasionally, Liquid Petroleum Gas or LPG for short. Prior to the sixties, and going way back to before the war, paraffin was used in hydroplanes with great success but it is difficult to light and the jets block with carbon and bits off the vapouriser, in all often a frustrating time. Meths was not much better, quite difficult to control and occassionally giving spectacular flare-ups as it boiled over from the wick. Coal, although a simple reliable fuel, needs constant attention to firing and provides a fair quantity of dust and grit to get in the works. So where do we go from here! we use LPG in the form of Butane or Propane which is available almost anywhere in the world in simple throw away canisters providing us with a very dean easy to use fuel.

Primarily there are several ways of gas firing model steam boilers:-

- One :- the blue flame blowlamp type burner .
- Two :- the blue flame round or toast rack style burner .
- Three :- the ceramic bed radiant heat burner.

All of the burners have common factors, they will usually burn propane or butane L.P.G. equally well providing the weather is warm enough, and as flow rate is controlled by the gas jet they can be connected directly to the high pressure gas container withoutreducing valve. All need external mixing of the gas with combustion air by means of a simple venturi.



A rechargeable high pressure gas tank with gas value and a pipe connection with burner adapter.

Blowlamp Burners

The blowlamp style of burner has the advantage of being easy to produce and use in confined spaces. It can provide a fierce hot flame in a small space and as long as the boiler can accept this kind of heat it can be a satisfactory source of heat. Typically the boiler will have a horizontally arranged main flame tube with multiple cross tubes formed in a spiral. As gas velocities are quite high this type of burner is not very efficient unless considerable turbulence and extra heating surface is arranged by having the cross tubes. Improvements can be made by fitting a water feed pre-heater in the smokebox (if the steam plant is fitted with a feed pump) and also a superheater in the end of the main flame tube to take advantage of the hot exhaust gases. Superheating can be particularly useful as the smaller size engine cylinders have greater surface area relative to their volume than large ones, this means they lose heat faster and hence more steam is required to compensate for the losses. Compare a 1" x 1" cylinder with a volume to surface area ratio of 1:5 to a 2" x 2" cylinder with a ratio of 1:2. Clearly the smaller will lose proportionally much more heat than the larger one, (neglecting the piston area as this should not be significant). Generally the blowlamp style of burner provides a strong flame pressure and therefore there is no need to provide a blower to draw the hot gases through the boiler and out of the chimney. The blast from the engine exhaust is adjusted (see draughting) so that it does not suck out the flame nor pull too much cold air in past the burner and hence reduce the efficiency.

Blowlamp style burners are often fitted to locomotives in gauges "O" and "1" and in France to locomotives as large as 5" gauge passenger haulers. They are also used in model steamboats that are fitted with horizontal boilers. The main disadvantage is the rather high noise level associated with this method of combustion and the difficulty of absorbing enough of the available heat within the confines of the boiler design.

Round or Toast-rack Burners

The round blue flame burner is similar to a gas cooker burner and is often made by adapting camping cookers. A toast-rack burner consists of a piece of metal tubing with a plug in one end and a mixed gas and air supply coming in at the other. Slots are

arranged along the top of the tube at regular intervals above which the gas is ignited. The burner is fitted either below a drum type boiler with field tubes or inside a horizontal flame tube. When fitted below the boiler there is usually no problem with draughting as the exhaust gases normally exit around the boiler casing.

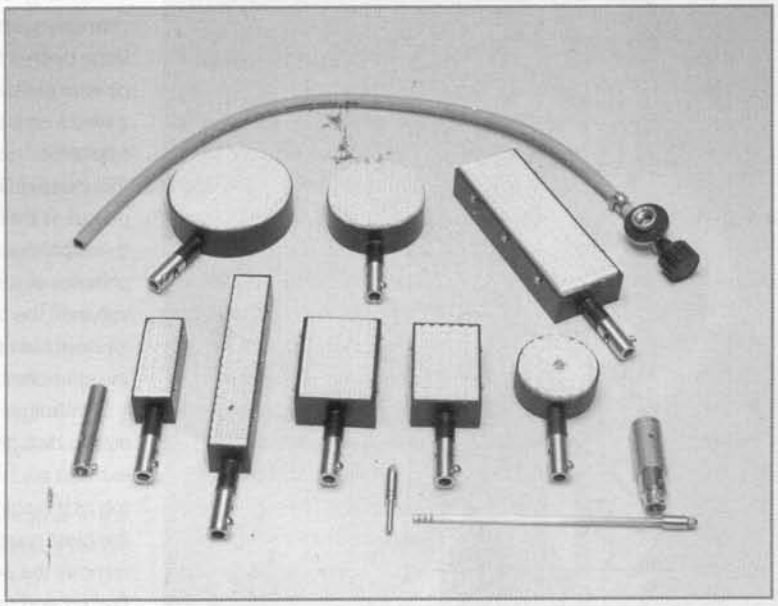
However, when the burner is fitted in the flame tube it is often closed in and exhausts in the same way as the blowlamp type burner. It is sensitive to draught from the engine exhaust which should be just sufficient to clear the burnt gases. In most cases the burner is powerful enough to clear itself through the boiler. As the flame consists of a number of small relatively fierce flames impinging directly on the inside of the flame tube it is quite an effective type of burner and not too noisy. These toast-rack burners are usually found fitted to relatively small locos, "O" gauge 16 mm scale and older gauge "1" main line locos and, until recently, were available from Stuart Models for their 501 and 504 stationary boilers.

Ceramic Burners

Ceramic bed radiant burners are relatively new to the model world and already have been fitted to various small traction engines, hot air engines and hundreds of boats as well as locomotives from a 16mm scale double Fairlie to a 3.5" gauge Rob Roy. In the right conditions these burners can offer better efficiencies than blue flame burners and in some ways can simulate coal fires. The reason for this increased efficiency is that when combustion is taking place in a boiler a stagnant layer of burnt gases tends to form on the surface of the firebox and tubes causing a thermal barrier to the hotter gases as its resistance to heat flow is much greater than the metal from which the boiler is made. This also explains why there is little difference in steaming capacities between similar design steel and copper boilers. The barrier layer can be broken down by turbulence and high gas velocities etc. and by using small passages through which the gases must pass, or by radiant heat as in a coal fired boiler.

The ceramic bed burner works by using the heat from the flame to raise the temperature of the ceramic to about 1100 C at which point it provides radiant heat directly to the boiler without being affected by the barrier layer. In addition, all the remaining products of combustion are still available to have their heat absorbed in the usual way. The ceramic material is approximately 11mm thick, an excellent insulator of low thermal capacity and hence very little heat is lost from the burner to the external air via its casing, with the added advantage that they are very quiet!.

Ceramic burners can be used to replace toast-rack burners and are particularly useful for fitting into small locomotive style fireboxes, vertical marine boilers and stationary boilers like the Stuarts. Another advantage is the turn-down ratio, this is the ratio between the highest and lowest stable flame settings which, because of the nature of this type of burner, is much greater than other types. If a new boiler is being considered it would be worth discussing a ceramic design of burner.



This range of Ceramic gas burners from Cheddar Models is suitable for firing a variety of different types of boilers.

Replacement of toast -rack burners is straightforward assuming that mechanics allow it to fit in position and that a suitable gas supply can be arranged (see gas later). Fitting into an existing locomotive style firebox requires a little more thought, in theory all air for combustion is drawn through the mixing tube but, in practice, sometimes a small amount of secondary air is needed. This can be provided by either leaving a small gap between the burner and the firebox walls of about 1/16" to 1/32" or by leaving open the firebox door a small amount.

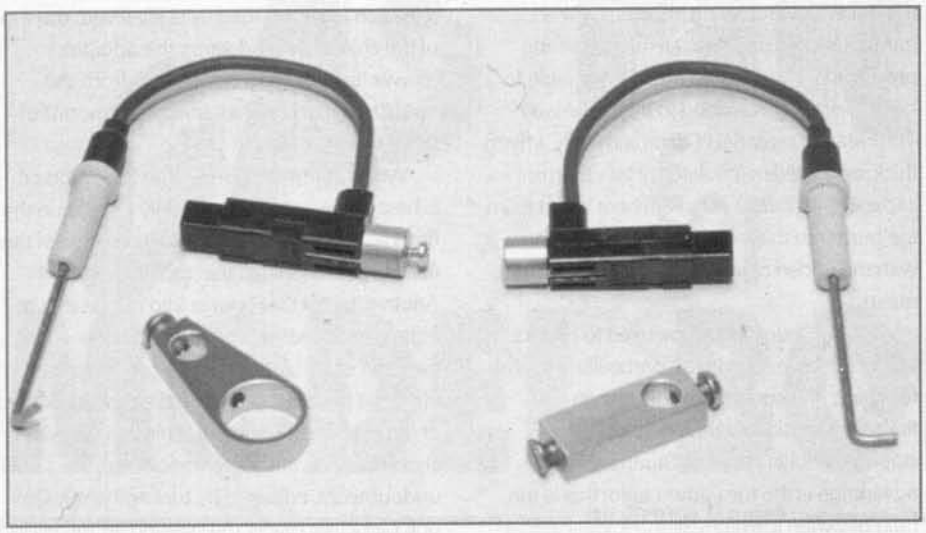
These burners require no engine exhaust induced draught, so the simplest solution is to remove the blast cap on the exhaust pipe and replace it with a plain pipe threaded internally to match and extended until level with the top of the chimney. In addition, the original blower is retained to clear gases from the boiler although only a very small amount of draught is required.

When fitting the burner into the firebox it is best to have the ceramic only just inside the firebox, in this way as much as possible of the firebox is available to the radiant heat. Another factor that comes into play is that at high loco speeds it is possible that the passage of air under the loco can have an effect on the mixing tube and either weaken or strengthen the mixture. This has to be checked by careful observation and, undoubtedly, adjusted by trial and error. On one particular railcar the passing air forced its way up past the burner and blew out half the flame, the firebox has now been sealed and the burner is fine and taking all its air through the mixing tube.

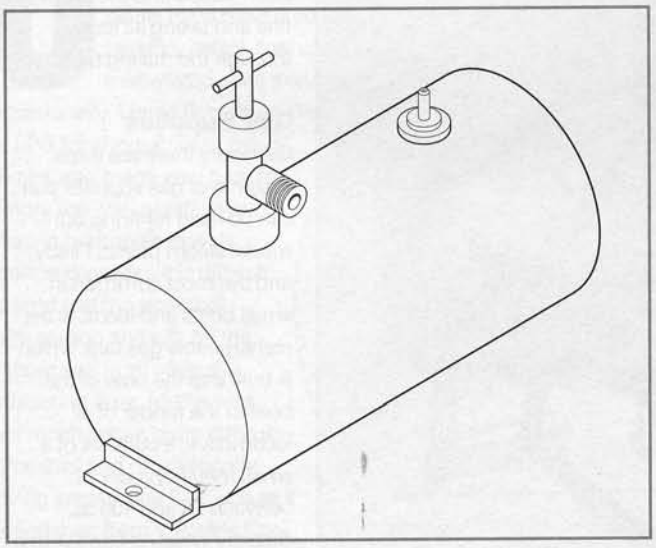
Gas Supplies

Generally there are three systems of gas supplies that can be used for firing our model steam plants. Firstly, and the most common in small boats and locos, is the rechargeable gas tank which is built into the bow of the boat or the tender of a locomotive; it consists of a small metal cylinder of between 25 and 100 cc. capacity which is fitted with a filling valve and a controllable outlet valve to set the size of the flame. The tank is filled via an adaptor nozzle screwed on to a disposable gas canister, which is also our next form of gas supply. Connection between the gas valve and burner is normally made with small bore copper tube with silver soldered connections. The rechargeable tanks are made with the same safety factors as boilers and are generally of the same materials to avoid corrosion etc. I advise a test pressure of 360 p.s.i. for propane mixes and 280 p.s.i. for butane. Safety valves should not be fitted but the tank should be designed so that it can not be more than 80% filled with liquid gas. (see sketch).

Next we have the disposable canister which is available in 100, 250 and 500gm sizes and are available from camping and diy shops. Connection is made via a screw-on control valve that also actuates the self sealing valve fitted into the outlet of each canister. A flexible pressure hose to the relevant standard ▶



Two of the Piezo electric igniters for lighting the ceramic burners. These are more convenient for burners used in locomotive fireboxes and stationary boilers.



is used between the valve and burner. The gas supplied is either 100% butane or a mixture of propane and butane of up to 30%: 70% depending on canister size.

It is important to note that only canisters with the screw-on self sealing connection should be used and not the type where the canister is pierced. Butane is used as the primary fuel as its total heat content is about 25% higher than propane per unit volume and with a much lower vapour pressure.

Heat content should not be confused with flame temperature, although it is true that propane burns at a higher temperature than butane, the total quantity of heat supplied through the same jet at the same pressure is much higher with butane. Propane, with its higher vapour pressure, is used as a propellant for the butane where there is insufficient heat available from the surrounding atmosphere to vaporise it. If a rechargeable tank is fitted to the locomotive then only 100% butane should be used as the local ambient temperatures could produce unacceptably high gas pressures with a butane/propane mix. The rate at which gas can be supplied to a burner is determined by the amount of heat available to vaporise the gas in its container. This is usually determined by the ambient temperature and the surface area of the container, so for a large burner a large container is required unless some carefully regulated heat is supplied to the canister to assist in vaporising the gas. (For example, in model boats an exhaust steam oil separator/condensor is often fitted in the same compartment as the gas canister to provide the necessary heat without an eccessive temperature rise).

This brings us on to the last of the gas sources seen in use, the 'Calor' gas or the large size 'Gaz' bottle. Although the most economical way to buy gas it has rarely been used in modelling until recently where it has made appearances on the rally field firing traction engines and on the track firing 3.5" and 5" gauge locos. Rather ugly and massive in size it has the advantage of being able to supply the required amount of gas for these locos. Personally, I would prefer to hide a row of 500gm canisters in my driving trolley or a suitable goods wagon .

Lighting

As gas is potentially explosive it is essential that it is lit as soon as the supply is turned on. One of the commonest forms of lighter is the pen type gas lighter which, with it's long nozzle, can be used in confined spaces. Recently, Cheddar Models have been offering Piezo electric igniter for use with their steamboat plants and many have been sold for locos and stationary boilers.

This brings us on to safety, gas is safe if used correctly but it is highly explosive and being heavier than air tends to collect in hollows if allowed to escape . Always ventilate well if gas escapes occur. With large containers capable of supplying gas at high volumes a burst hose valve and anti flash back (non return) valve should be fitted .

Draughting

Draught is used on coal fired steam locos and traction engines to draw the fire up through the grate along the flue tubes and out of the chimney . This is done by the exhaust from the cylinders being directed up the chimney via the blast pipe nozzle and to a large degree the harder the engine works the greater the blast and the fiercer the fire . So in a way a coal fired loco is semi automatic in operation . However when stationary, without this exhaust induced draught the fire would go out as there is very little natural draught in these boilers, for this we fit a blower. This consists of a steam supply controlled by a valve on the backhead of the boiler piped to a jet alongside the blast pipe and pointing up the chimney .

When gas firing there is no need for the strong draught produced by the engine exhaust and the exhaust is best taken to the top of the chimney by a pipe instead of using the blast nozzle . The blower is still required to remove the products of combustion from the firebox and generally a plain pipe with no jet is suffcient.

Future developments should expand the application of the ceramic burner to the 3.5 and 5" gauges locomotives and possibly to some traction engines where cleanliness of operation is essential. A local club member is now allowed inside the tent when running a sawbench from his 1.5" Allchin after having a ceramic type burner fitted . Automatic steam pressure operated gas control valves with safety shut-off for low water are an area of current development that I hope they will be commercially available in the near future.

I hope the foregoing will be of assistance to those wishing to try out gas firing in model plants, to me it is far better than meths or paraffin firing and cleaner than coal (but not as atmospheric). Gas is a clean readily available fuel and if used in conjunction with Ceramic burners very quiet, efficient, odourless, more controllable and without those obnoxious fumes of meths . As to safety it is no less safe than any other form of energy provided it is used correctly . ■

The craft of Clockmaking

By John Wilding

The craft of the clockmaker involves many engineering techniques, some of which are unique to clockmaking. This article illustrates the many different types of clock which can be made ...

Many model engineers, although fascinated by clocks, are often reluctant to enter this field because they feel that clocks are high precision mechanisms requiring sophisticated equipment in order to make them. This is quite wrong!

Most of my clocks have been made on a Myford ML 7 lathe which is now some 45 years old. This is an excellent size of lathe for making clocks as the gap in the lathe bed will permit dials and chapter rings up to 9" diameter to be turned. However apart from this facility, the majority of the parts in a clock can be made on much smaller lathes. The Unimat 3 is a well designed lathe and I have made three clocks on this tool including the "Scissors" clock illustrated here Fig. 1 All the wheelcutting and the machining of the fusee were carried out on this tool.

(The figures in brackets which appear in the following text refer to a list of references which appears at the end of this article - Ed.)

Wheelcutting

Clocks are really gear boxes and the cutting of clock wheels often puts some constructors off. However the process is quite simple and modern lathes usually offer a milling attachment as an accessory. A general set-up for wheelcutting is given in Fig. 2 where the main wheel of an English Regulator is shown being cut on a Cowell lathe. The vertical slide and milling attachment are both standard accessories. The dividing plate at the rear of the lathe is supplied by Chronos (1). Again, in the same lathe, we see a dead beat escape wheel being cut, Fig. 3. The cutters being used in both these examples are commercial ones and can be obtained from the manufacturer, Philip Thornton (2).

Another option for cutting clock wheels is the simple cutter frame shown in Fig. 4. Here the cutter frame (3) is clamped in the lathe tool post. A simple home-made fly cutter is being used to cut the ratchet teeth on a clock barrel. The simple method of driving the cutter is illustrated in Fig. 5 where a Black and Decker drill carries a plastic pulley in the chuck. This system works perfectly well but should only be regarded as a temporary method of drive. These drills are noisy.

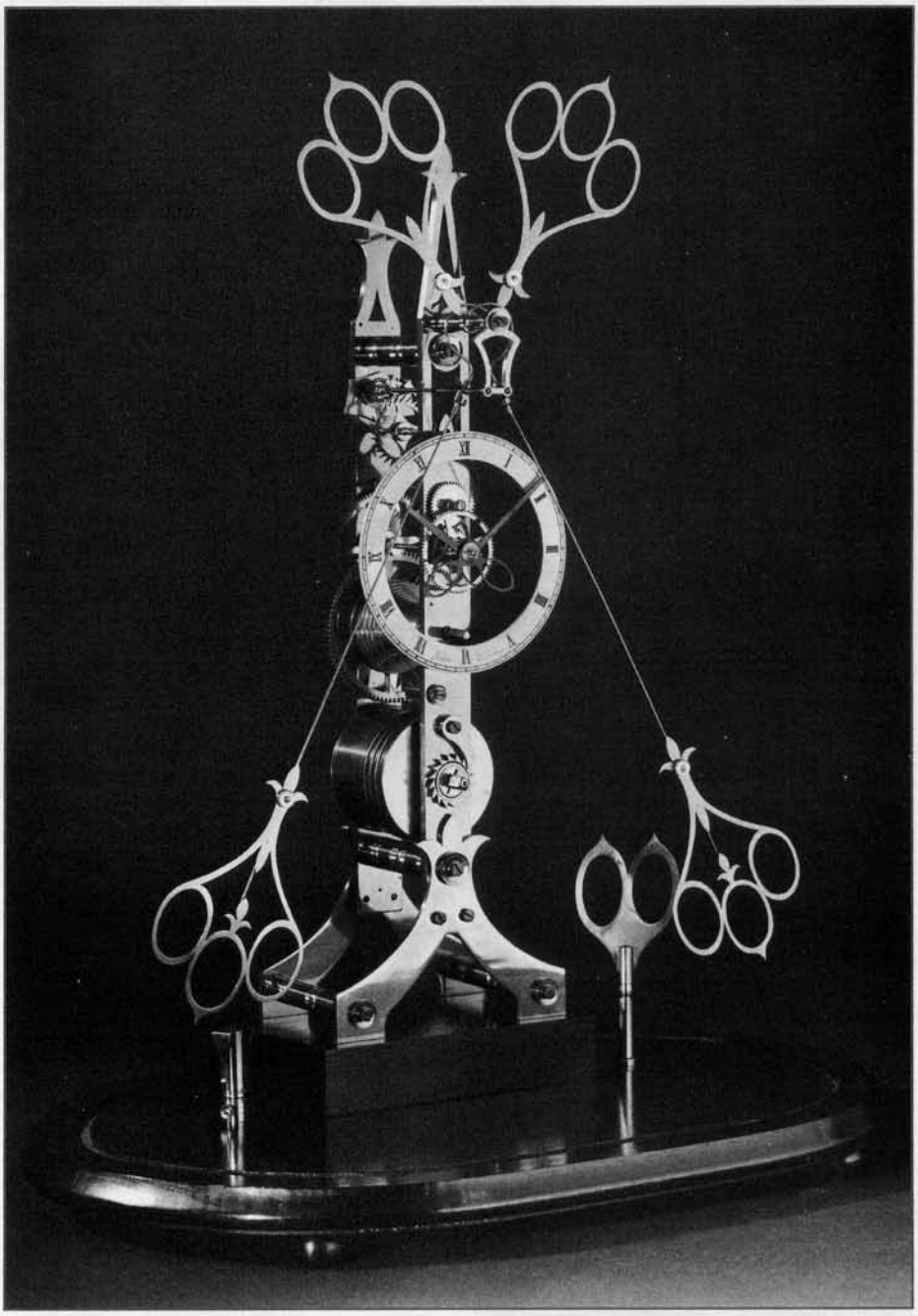


Fig. 1 A "Scissors" clock. The action of the two pendulums resembles a pair of scissors opening and shutting.

Yet another wheelcutting set-up is shown in Fig. 6 which shows a main wheel being cut in the Toyo 210 lathe. This is similar in size to the Unimat 3. The size of the teeth being cut here is No. 1 module, the largest likely to be required in domestic clockmaking.

Even simple basic lathes can be used for cutting clock wheels. One of the most capable amateur clockmakers, the late John Stevens, made beautiful clocks on a lathe he bought ▶

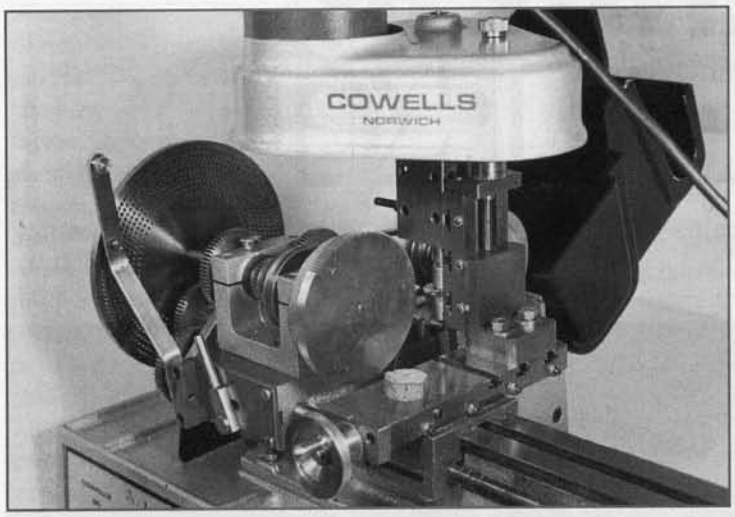


Fig. 2 Wheelcutting operation being performed on the Cowell lathe using a cutter held in a horizontal position on the vertical slide.

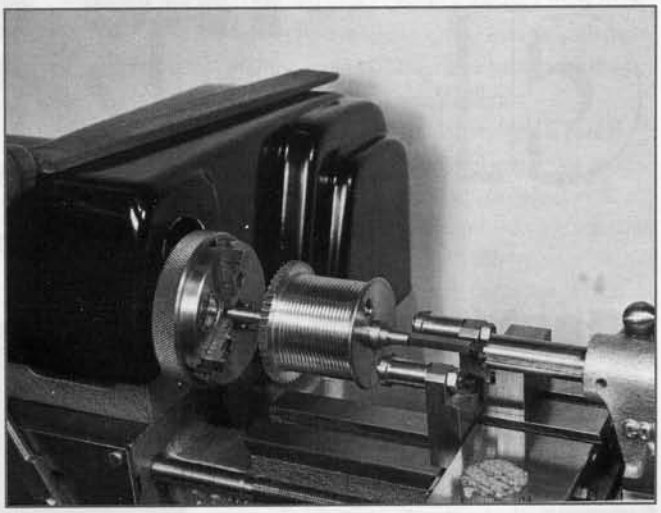


Fig. 3 Wheelcutting operation being performed on the Cowell lathe using a cutter mounted vertically on a vertical slide.

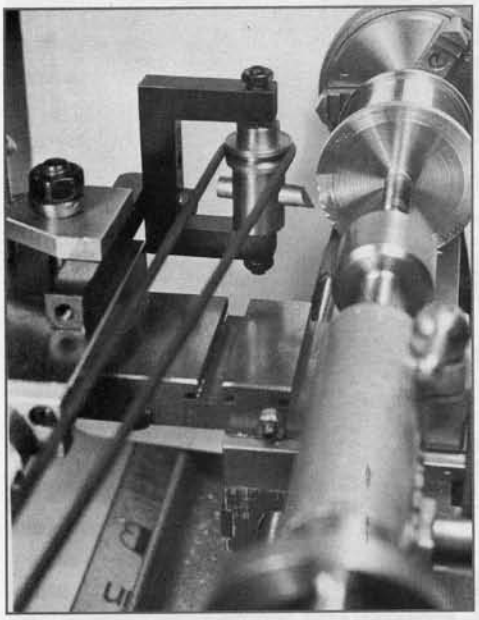


Fig. 4Using a simple cutter frame and a home-made cutter to cut ratchet teeth.

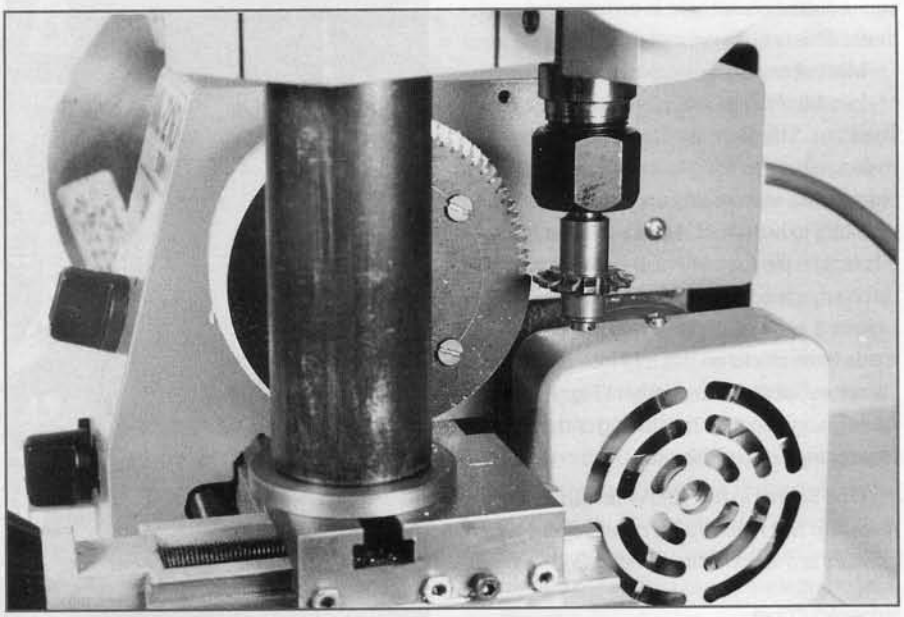


Fig. 6 A wheelcutting set-up in the Toyo 210 lathe.

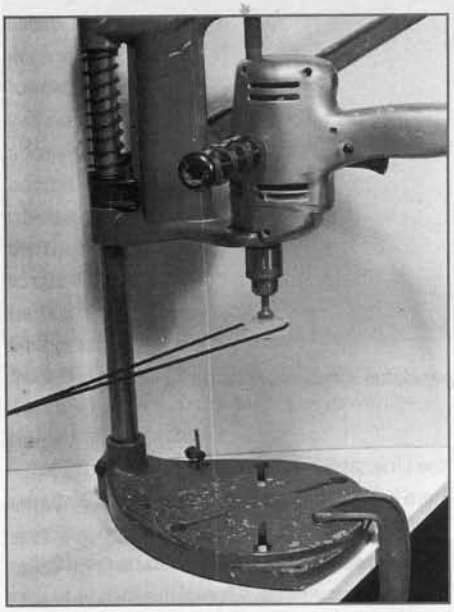


Fig. 5 A simple method of driving the spindle in the cutter frame shown in the photo above

from Gamages for 52/6d (£2.63), specially reduced in price because the headstock casting was cracked! He adapted it for wheelcutting by making all the accessories on the lathe itself, including the division plate. This very valuable exercise was written up for the *Model Engineer* magazine and was published in 1953, issue numbers 2697, 2698 and 2699.

Types of clocks

Part of the attraction of clockmaking is the enormous variety from which the constructor can choose. The Drum Water Clock illustrated in Fig. 7 has no moving parts. However, it is necessary to be able to machine the drum, which is made from Perspex, and a lathe capable of swinging this diameter of 6" over the bed must be available. Again, the Crystal Wheel skeleton clock in Fig. 8 has a main wheel of some 6" diameter and this will require a lathe capable of swinging this diameter.

The early 16th century clock in Fig. 9 was designed as a beginners clock for construction on the Unimat 3 lathe. The battery powered electric balance wheel clock shown in Fig. 10 has a large diameter balance wheel and has a spectacular action as the balance wheel oscillates form side to side. Advanced constructors will like to tackle more complicated clocks such as the year going clock made by Claude Reeve in Fig. 11. Year going clocks only require winding once a year.

Special techniques used in clockmaking

The lathe is a very versatile tool and in Fig. 12 you can see the slots in the pillar screws of a Regulator clock being cut with a slitting saw,

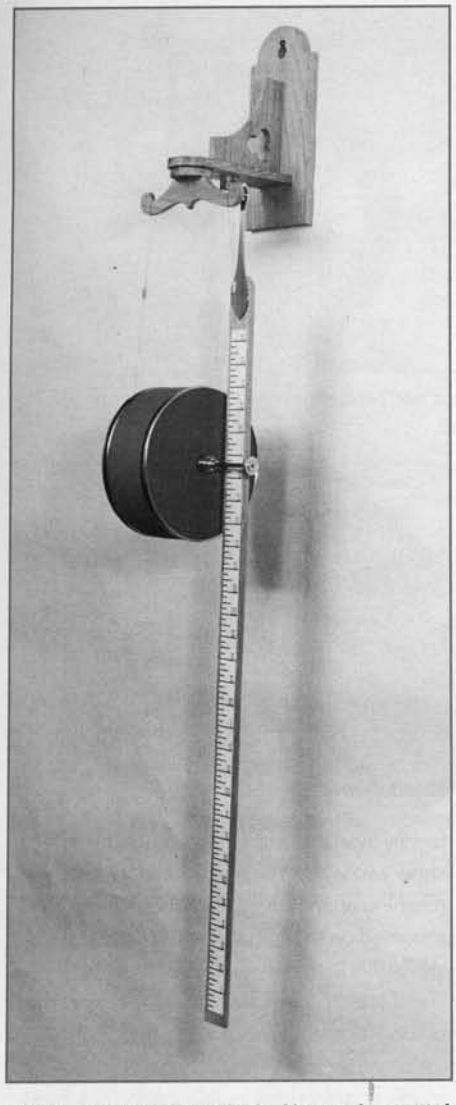


Fig. 7 A Drum water clock. No moving parts!

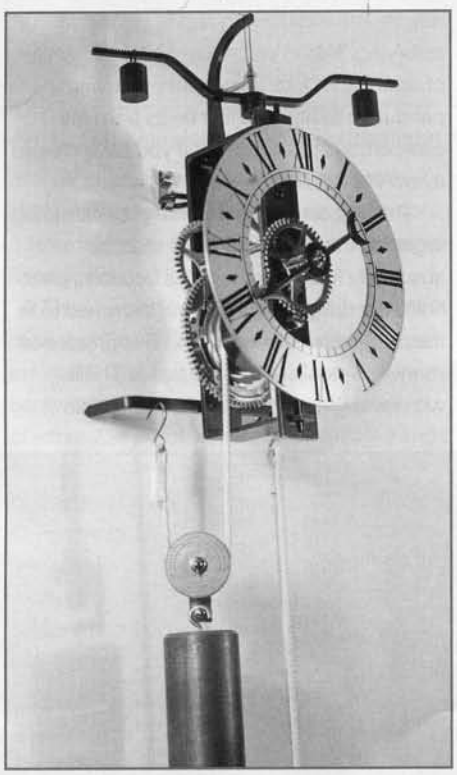


Fig. 9 A 16th Century style clock made on the Unimat 3 lathe.

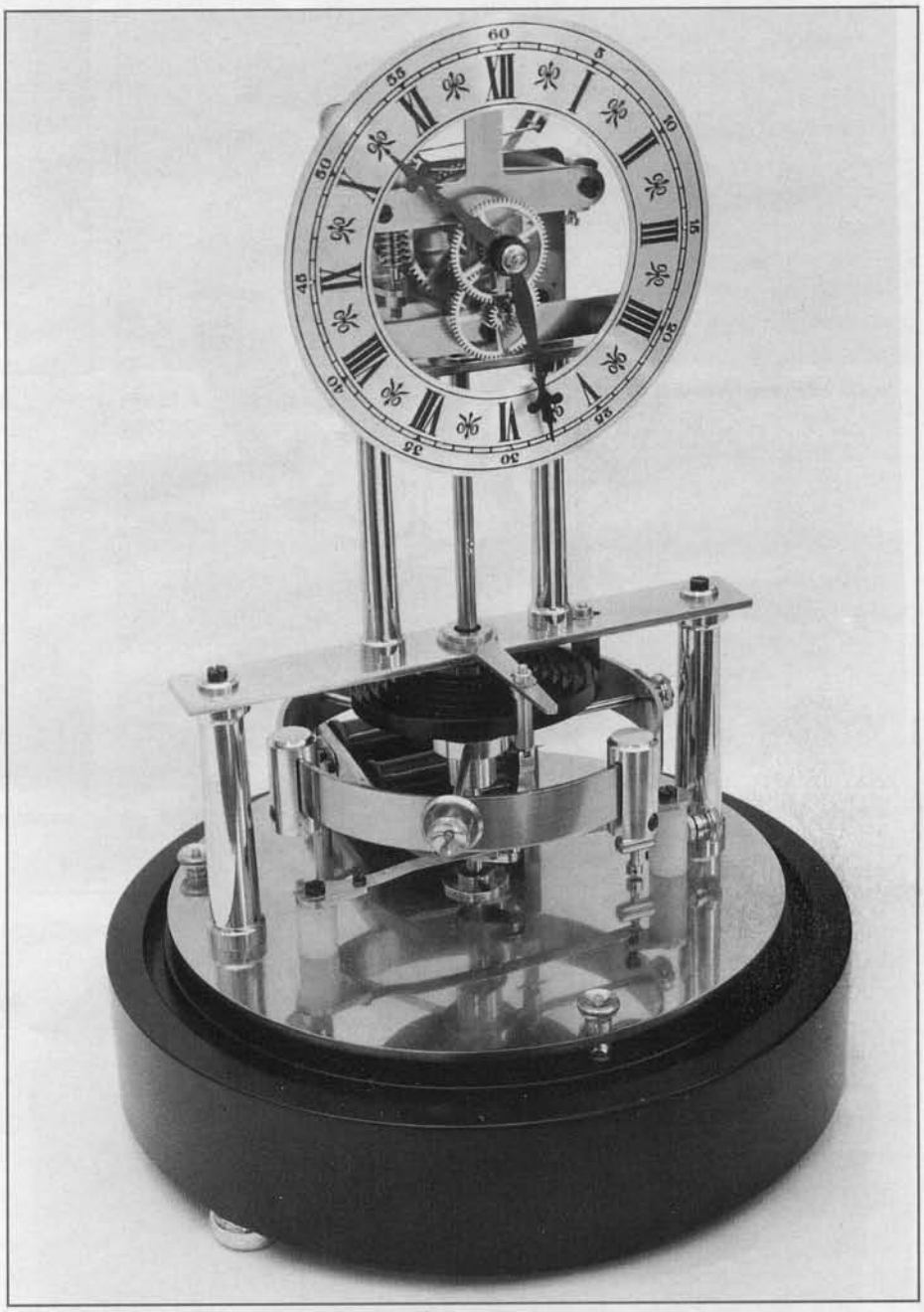


Fig. 8 An impressive example of the skeleton type clock. This one has engraved crystal centres to the wheels.

and in Fig. 13 the lathe roller filing rest is shown being used to form the winding square on the barrel arbor. The pallets of an English Regulator clock are illustrated being lapped in Fig. 14 using an abrasive disc on a home-made arbor held in the lathe chuck. A group of 12 leafed pinions for this clock are shown in Fig. 15. These pinions were all cut on the Cowell lathe and, in fact, this entire clock was constructed using the Cowell lathe.

After clock wheels have been cut they must be crossed out, mainly to lighten them (this is particularly important in the upper wheels), but also for the sake of appearance. This work can easily be carried out by hand with a piercing saw but in Fig. 16 I have shown the work being carried out on the Hegner fretsaw machine.

Sometimes we use the lathe in the role of a press tool, see Fig. 17. The pins in this escape wheel from Galileo's escapement are being pressed in by using a holding adaptor in the lathe tailstock chuck. This ensures that the pins enter truly, thus remaining square to the face of the wheel.

Newcomers to the world of clockmaking should not be worried that the work may be beyond them. There are detailed instruction books available and the special tools required can either be made or purchased from horological tool suppliers (5).

It is customary to obtain the correct meshing distance of clock gears by depthing them in a special tool as illustrated in Figs. 18 and 19. This one is home-made but they are

▶

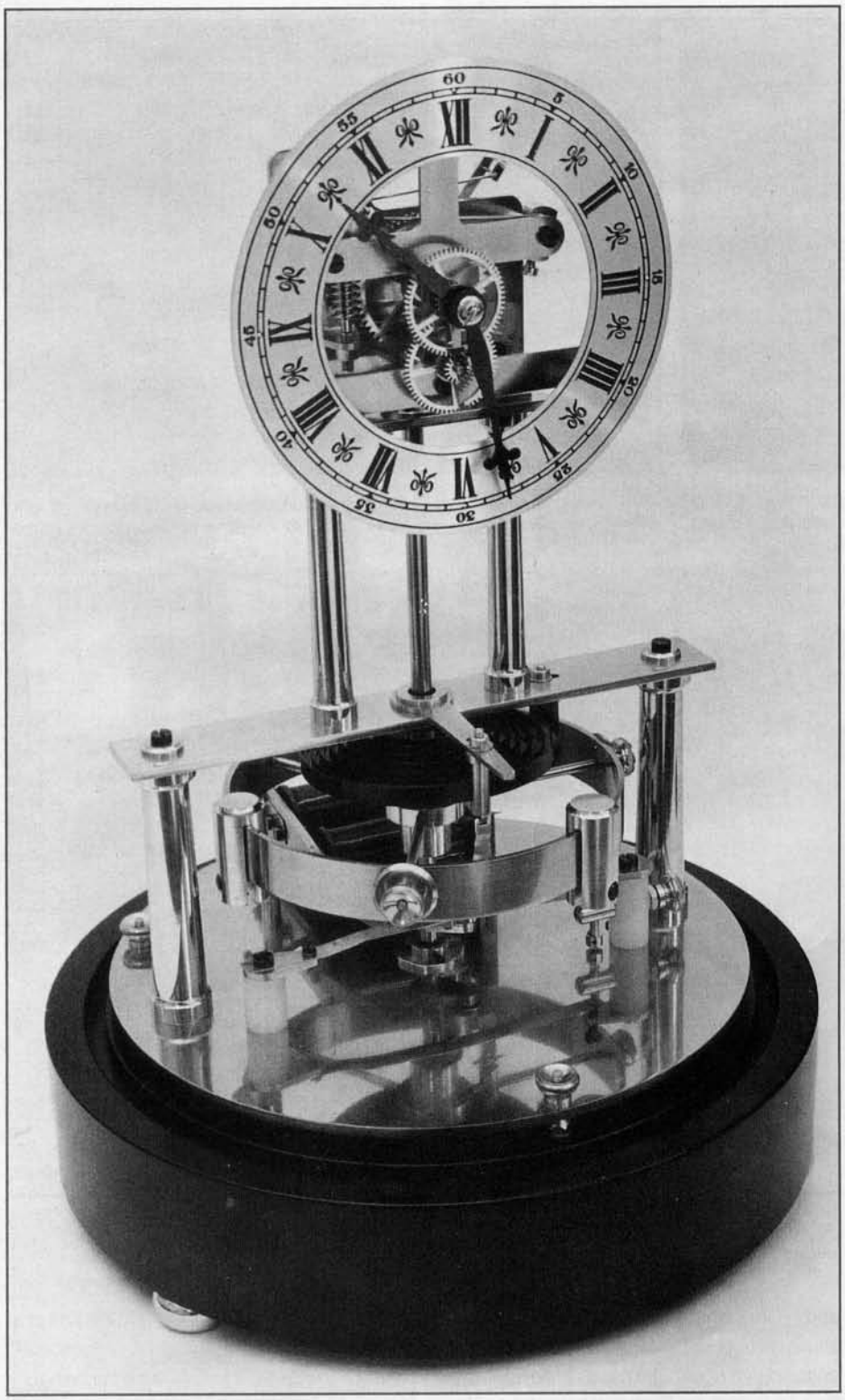


Fig. 10 An electric balance wheel clock. This clock has a spectacular action when it is going.

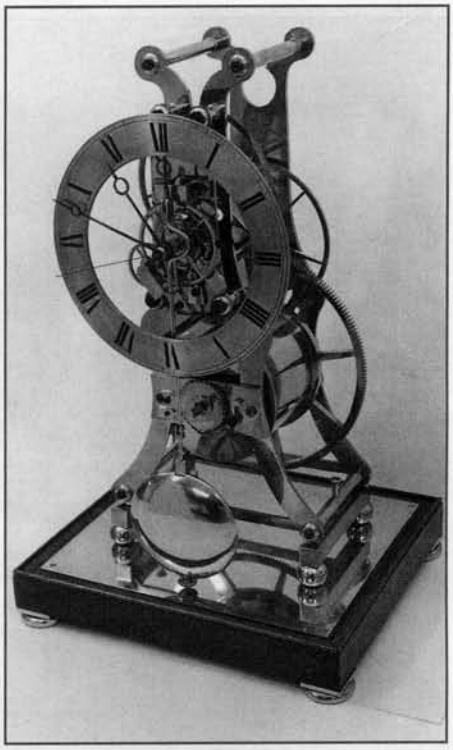


Fig. 11 A "Year Going" skeleton clock made by Claude Reeve.

readily available from the trade (4). In Fig. 20 I show two wheels being checked for their meshing engagement, the wheels being mounted on the spindles of the depthing tool. When this is correct the distance will be transferred to the clock plate by means of the hardened points shown in Fig. 19.

Whereas many models made by the model engineer only need to work for limited periods, your clock will be working 24 hours a day, month after month and this is very satisfying. When you have reached the stage of setting the clock going and you swing the pendulum to hear the first beats from the escapement, it is almost as if you have created a new life.

The biggest cause of failure in clockmaking is getting the train too tight. It must be absolutely free. To obtain this freedom, pivot holes are drilled undersize and broached to fit the pivot with a taper broach. This practice of running a parallel pivot in a tapered hole worries engineers who find this principle

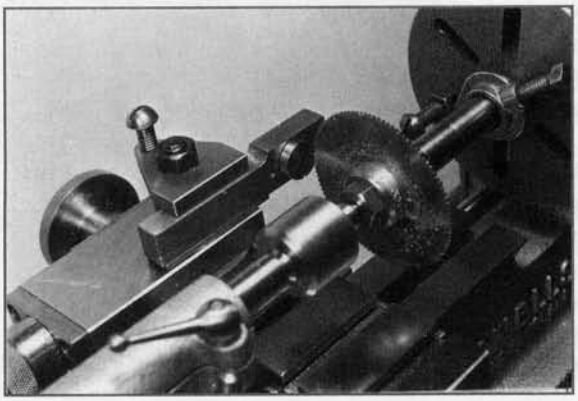


Fig. 12 Using a slitting saw in the Cowell lathe for forming the slot in a pillar screw.

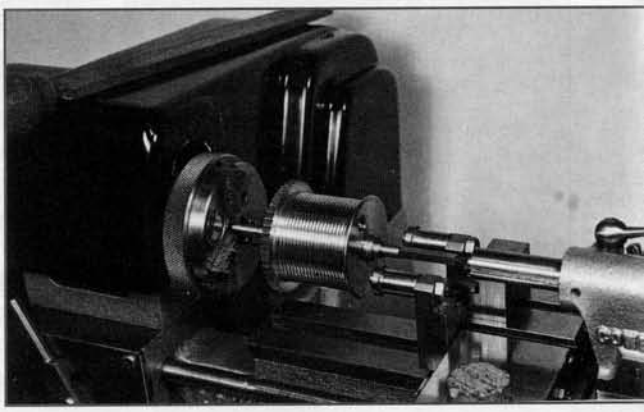


Fig .13 Using the lathe roller filing rest to form the winding square on the barrel arbor of an English Regulator clock.

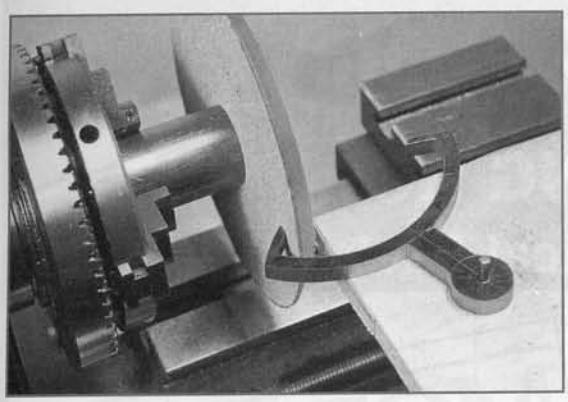


Fig. 14 Lapping the impulse faces on dead beat pallets.

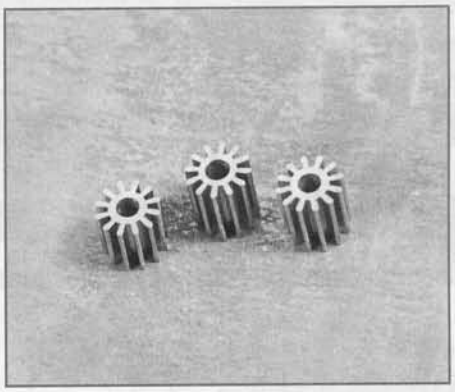


Fig. 15 A group of pinions made on the Cowell lathe.

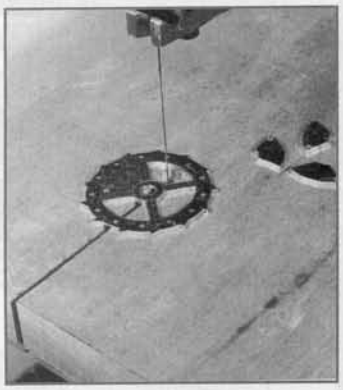


Fig. 16 Crossing out a clock wheel.

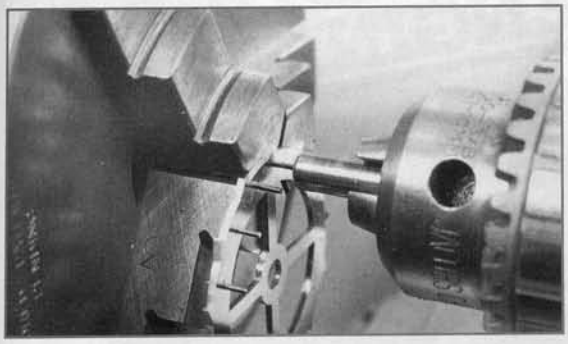


Fig.17 Using the lathe as a press tool for "pinning" an escape

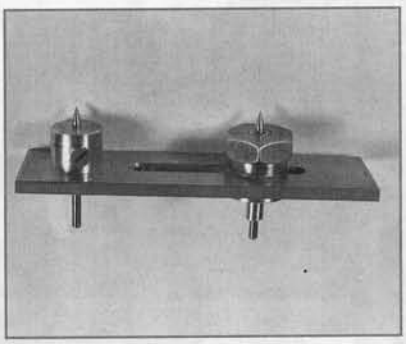


Fig. 18 A home-made depthing tool.

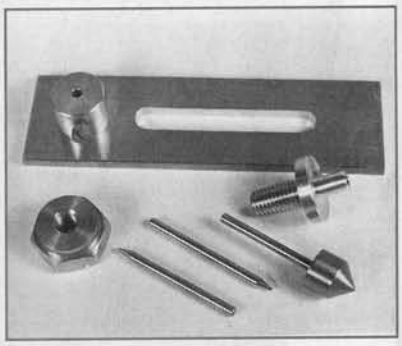


Fig. 19 The home-made depthing tool showing the individual parts.

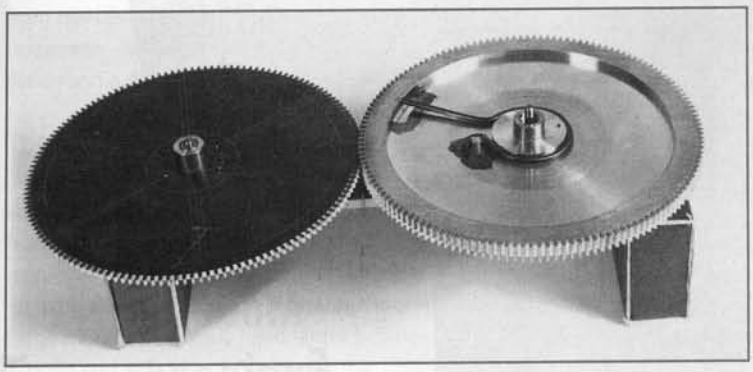


Fig. 20 Two large clock wheels being meshed in the depthing tool.

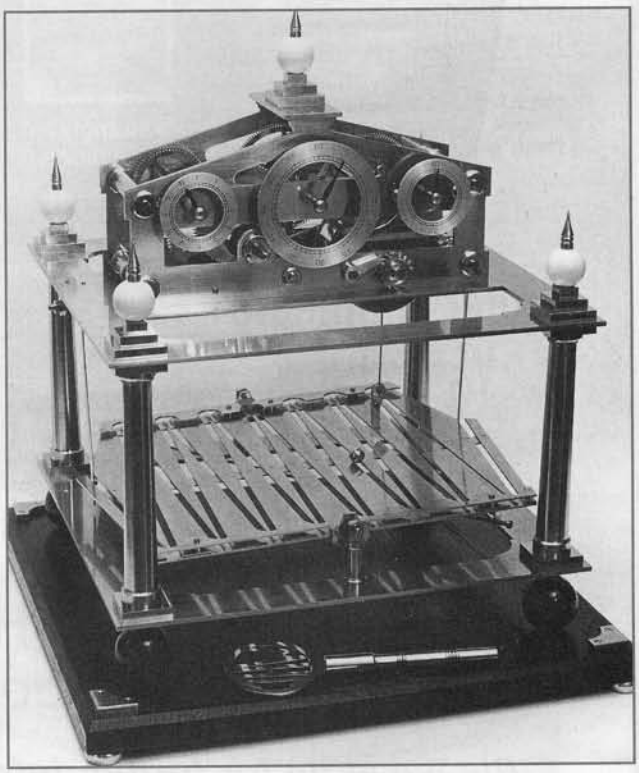


Fig. 21 A Congreve rolling ball clock. One of the most fascinating clocks ever made. The steel ball rolls down the inclined plate and trips the mechanism at the end of the run which then tilts the plate so that the ball rolls back again. The movement runs for 8 days on a winding.

difficult to accept but it has been in use in clockmaking for centuries and provides a very free running bearing with minimum resistance from friction.

The one clock which always appeals to the model engineer is the Congreve clock, shown in Fig. 21. The ball rolling down the track backwards and forwards always attracts a lot of interest. It is not an easy clock to make and I would not normally recommend it for the beginner. Having said that, I once awarded a Congreve clock the first prize in the clock section of a Model Engineering Exhibition. Afterwards the owner came up to me and said he was thrilled with his award and that this was his first attempt in metal work of any type! Which only goes to show that you will not know your abilities until you give them a try.

References

(1) & (3) Chronos Ltd. - supplier of engineering and horological tools, 95 Victoria Street, St. Albans, Herts. AL1 3TJ. Tel: 01727 832793.

(2) P. P. Thornton Ltd. - manufacturer of wheel cutters, The Old Bakehouse, Upper Tysoe, Warwickshire CV35 0TR. Tel: 029 588454.

(4) J.M. Wild FBHI - manufacturer of clockmaking tools and supplier of parts and materials for the clock maker and repairer, 12 Norton Green Close, Sheffield S8 8BP.

(5) There are books on the construction of nearly all the clocks illustrated here. These books include all the necessary drawings and, in the case of skeleton clocks, full size drawings are included.
Write for a free list to
Meridian Clocks, Wheelwrights, Hillgrove, Lurgashall, Petworth, W. Sussex GU28 9EW. ■

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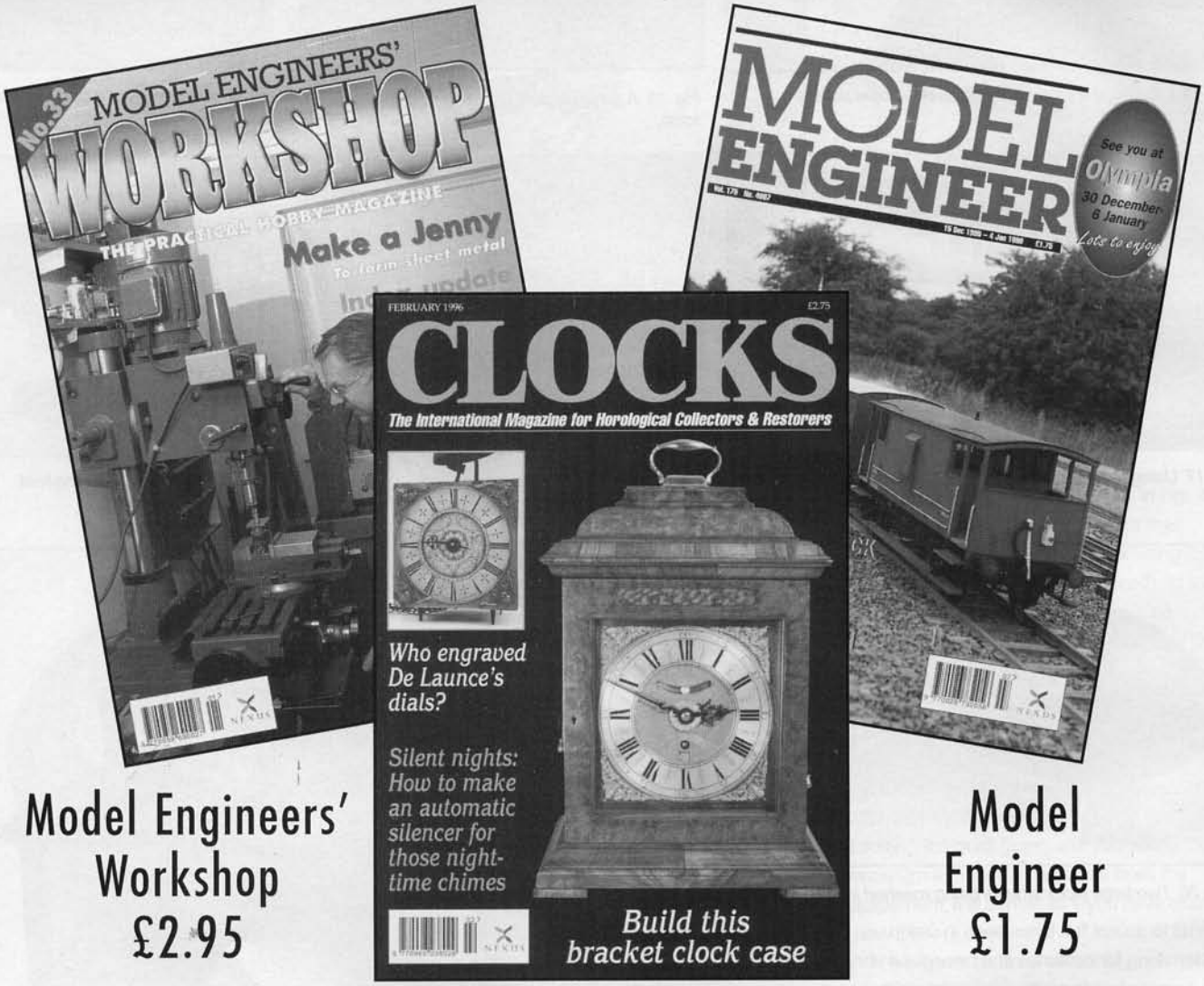

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Choosing a lathe

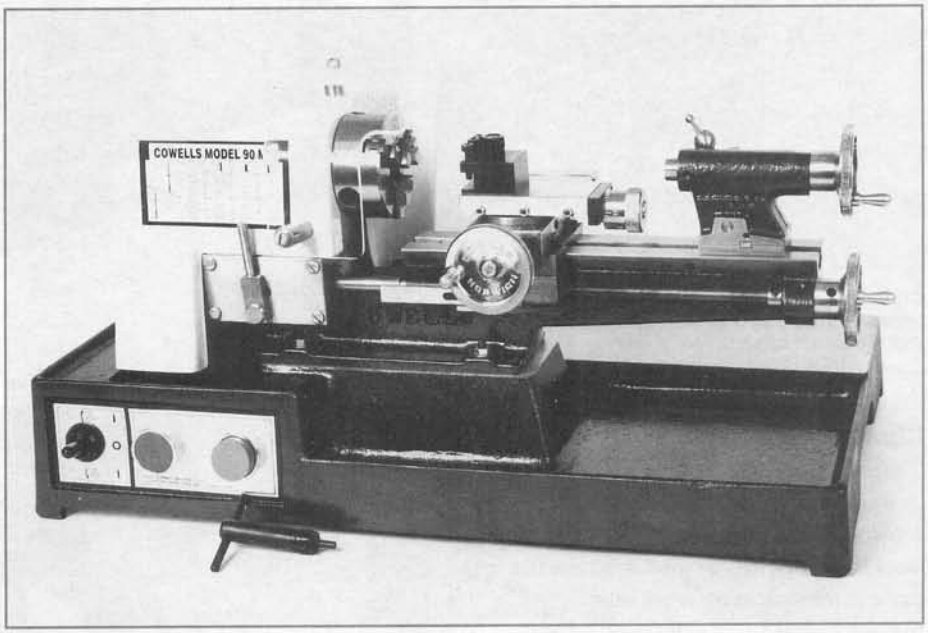
by Graham Nickson

Some advice on what to consider when buying your first lathe ...

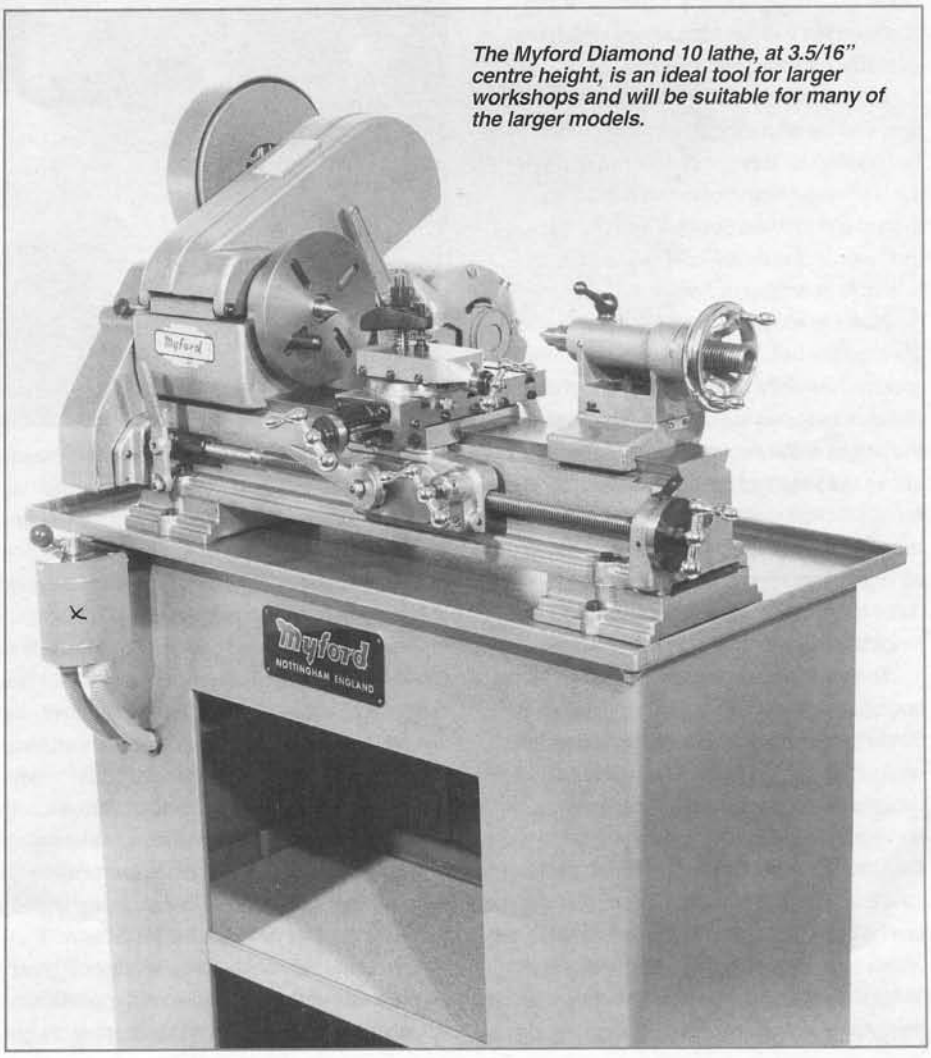
So you've decided to become involved in model building. Maybe you've been to an exhibition and been attracted to one of the many modelling disciplines on show. Maybe you have some kit building "from the box" experience and wish to develop your skills by building a model not available as a kit. Alternatively, you may need to make or modify parts for commercially available models.

Once you have decided to progress from the "built from the box" kit, workshop equipment will be required. The type and quantity of equipment will be largely dictated by the scale and type of models and hence the size of individual components for your model.

An "engineered" model - a model built from raw bar stock, castings, sheet metal, timber etc. - will require the use of a lathe, a bench and a drill press.



The Cowell 90ME lathe, with a centre height of 1.3/4", may be used as a "table top" machine in a smaller workshop.



The Myford Diamond 10 lathe, at 3.5/16" centre height, is an ideal tool for larger workshops and will be suitable for many of the larger models.

The Workshop

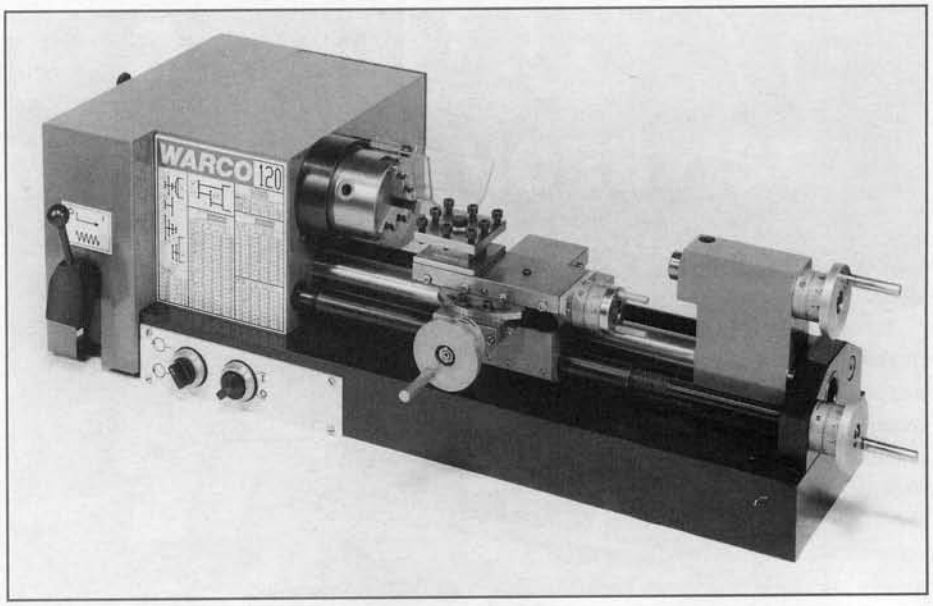
The ideal is, of course, a dedicated building, but this is not necessarily essential. A spare room, garage or shed, can be employed and many of the hand tools required may already be in the garage tool kit. Large models obviously need larger facilities to build and store them. Wherever the working space is to be located it must be comfortable to work in, provided with adequate lighting and heating. Details for constructing a workshop are covered in the Nexus Workshop Practice Series No. 23.

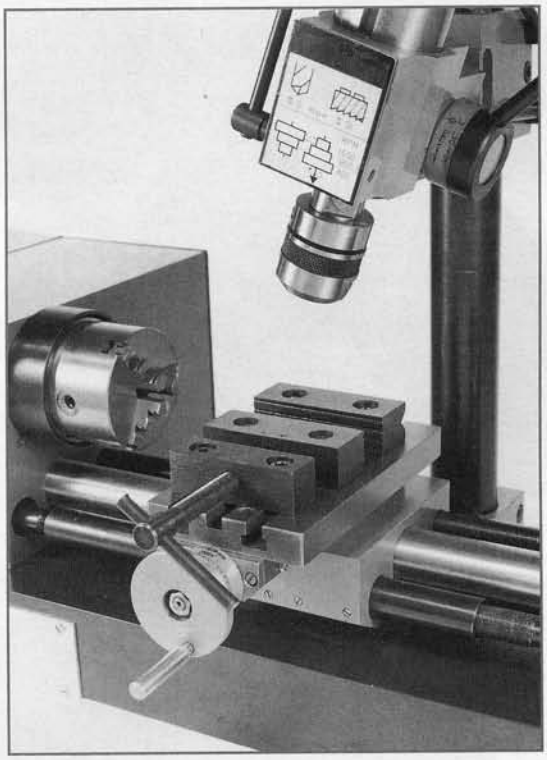
Hand Tools

A selection of hand tools is essential even if most of the work will be carried out on a lathe. Files will be needed for fitting, shaping and profiles. Small needle files, which can be obtained in similar sections to larger engineer's files, will be found useful. Engineer's and soft-faced hammers, screwdrivers, centre and pin punches, hacksaws and junior hacksaws will also be required.

Any general tools used in the home or garage will be found of great value. Look in a tool catalogue, the kind supplied by model engineer's suppliers, and choose tools to suit your own particular needs.

Considered by many as the "Rolls Royce" of lathes is the Myford Super 7, seen here on its metal cabinet base.





A recent addition to their range is the Warco 120 lathe (above) with a centre height of 2.7/16". The Warco 120 milling/drilling attachment (left) can be fitted to the rear of the 120 lathe bed to make a complete machining centre.

Choosing the Lathe

To many model engineers the lathe must be a jack of all trades. It must be capable of carrying out operations which, in industry, would be performed by specialised machine tools. In most cases the small lathe manufacturer is aware of this requirement and provides a wide range of accessories to make the lathe as versatile as possible. Obtain the manufacturers' catalogues and check on the various accessories which are available for specific machines.

It is sometimes difficult to foresee the set-ups, and therefore the accessories, which will be required for a proposed model, especially if it is a model from your own research, rather than to a published design which may have the "words and music" of how to build it available in articles or books.

How big must the lathe be, or what should the capacity be? Manufacturer's literature will specify the height of the centres and the distance between the centres. That is to say, the height of the centre-line of the machine above the lathe bed, and the longest bar that - for all practical purposes - may be turned between these centres. Mounting a chuck or other work holding device will reduce this distance. Small diameter bar can, of course, be passed through the hollow lathe mandrel.

The most popular centre height for model engineers lathes is probably 3.1/2" (or 90mm). Many model kits, published model designs and workshop accessories are designed with this centre height in mind. If it is envisaged that castings will be machined, then this is the minimum recommended centre height. The Myford 10 Series lathes can be accommodated in a spare room without too much trouble and will easily tackle projects designed with this centre height in mind.

Many "table top" lathes of around 2" centre height (50mm) have been produced over the years. These are suitable for making models in the smaller scales. They are not generally provided with "back gearing" to run at low speeds for screwcutting or machining castings, but they are wonderful for making those tiny parts like 16 BA bolts and small diameter shafts and pins. These machines can be used on a table top where you can be seated and get close to the work. The Unimat 3 and the Unimat PC are provided with an unbelievable range of accessories to choose from. These are ideal machines for model railway work up to Gauge "0" and can handle quite a lot of the work needed for Gauge "1". With this size of machine the "workshop" can be put away at the end of the working session if space is limited in the workshop area.

Quite obviously it is impossible to machine large work on a small machine, but small work can be accommodated on a larger machine. Lathes of 5" or more centre height (125mm upwards) are very nice, but proportionally more expensive and heavy and require a dedicated workshop with a solid foundation for the machine. Some, even quite small scale, stationary steam engines will require a lathe of this capacity in order to machine the flywheel. Therefore, before deciding what to buy, consider the larger items which will need turning - driving wheels for locomotives, flywheels and road wheels for traction engines and so on.

Available lathes

The following gives a starting point from which further investigation can be carried out. Amongst the smaller lathes are the following examples. These machines all have centre heights of around the 2" (50mm) area and their compact overall size makes them suitable for use in situations where they may have to be "portable" enough to be put away after each working session.

The *Toyo* machine seems to be very diffcult to obtain these days but, no doubt, second hand ones can still be found and would be most useful. The *Unimat 3* is no longer manufactured, but there are still plenty about and it is continuing to be supported

with spares and accessories.

The following smaller lathes are current stock items and large selections of accessories are available for all of these machines.

The **Cowell's 90 ME** has a centre height of 1.3/4" (45mm) and is fitted with back gearing for running at low speeds, when cutting threads and machining castings etc. A vertical slide mounted on the cross slide can be used for milling operations.

The British made **Peatol Micro Lathe** has a centre height of 2.1/4" (57mm) and is supplied in basic form as an easily assembled kit of finished components or completely assembled and ready for use. A milling attachment is available which bolts to the cross slide and utilises the headstock spindle to hold milling cutters.

The **Sherline model 4000**, manufactured in California, U.S.A., has a centre height of 1.3/4" (45mm) and comes with a variable speed motor wich supplements the two speed pulleys and belt. Spacer blocks are available to fit between the headstock and bed to increase the centre height to 2.3/4" (70mm). Milling can be achieved with a vertical slide, or with a vertical milling column attachment.

The **Unimat PC,** with a 2" centre height, is the successor to the ubiquitous Unimat 3 and is a very versatile machine with a good range of accessories. Milling may be accomplished with a vertical slide or by use of a milling column attachment.

The following machines are in the larger 3" to 3.1/2" centre height range and are more suited to a permanent set-up where they can be mounted properly on a workbench.

The **Emco Compact 5**, from Austria, is a big brother to the Unimat 3. With change wheels for screwcutting, the Compact 5 has a swing of 5" (130mm) and can be fitted with a milling column to create a machining centre.

The **Warco 120 Lathe** is a recent addition to their range and has a 2.7/16" (62mm) centre height. It is fitted as standard with a four-way toolpost and thread cutting facilities and comes complete with a 3-jaw chuck. A milling column can be fitted to the rear of the bed to create a machining centre. A 120 mill/drill milling machine is also available from Warco and there is a good range of accessories for both machines. The compound table for the 120 mill/drill is available separately for those who may wish to convert the milling column from the lathe into a milling machine at a later date..

The **Myford Diamond 10** is a British made lathe with a centre height of 3.5/16" (84mm). It has a back gear for the slower speeds and screwcutting facilities. Milling operations can be performed using fixed or swivelling vertical slides and a vertical milling and drilling attachment is also available. As well as a large range of standard accessories from the manufacturer, many designs for suitable additions to this lathe have also been described in *Model Engineer* over the years.This machine is also capable of handling quite large workpieces for the larger scale models. Developed from the well known ML10 lathe, the Diamond 10 is aimed directly at the model engineer and is only available direct from the Myford factory, this is being done in order to offer the usual Myford quality but at a more affordable price.

The Warco 120 Mill Drill can also be supplied complete with its own compound table.

The **APTC 460 Lathe** from Axminster Power Tool Centre. With a centre height of 3.3/4" (95mm) and a large range of chucks and other accessories, this versatile machine is also provided with change wheels as standard. The **APTC 9180 Lathe** has a centre height of 4.1/2" (114mm) is a somewhat heavier machine provided with hardened bed.

The **Chester TR20 Lathe** is also a heavier machine with a centre height of 4" (105mm) which is capable of handling even larger workpieces. A four way toolpost and 3-jaw chuck are supplied as standard. Again a large selection of accessories are available.

A range of milling/drilling machines are also available to complement most of these lathes.

Used or New

Used equipment can be obtained via various routes - from advertisements in local newspapers or the model engineering press, ▶

from second hand dealers and from model engineering club sales and auctions.

When considering a used machine, take along an experienced friend or club member. Look at the general condition of the machine; look for damage to the bed/slideways. If the bed looks like it's been used as an anvil, move on. It's difficult to check for wear, and any inaccuracies this may cause, as a lengthy test procedure is required. Try to establish the age of the machine and the type of work it's been used to produce, factory or home use, experienced or inexperienced owner. This should give a good indication of wear.

If you are a member of a local model engineering club, then it is often possible to obtain a deceased member's equipment. In most cases this will have been well cared for and would be a good investment.

New equipment will obviously cost more but, if in the very unlikely event that there is a problem, service will be available through your supplier. A new machine will come with a spare parts manual which gives the location and name of every part; this could be important if ever you need to identify a part for service or replacement.

A cheap second hand machine, well used and with "loads of gear" might prove a poor investment if you don't possess the skills to put it right.

Getting Started

Now, at last, you've got your "new" lathe at home and unpacked and checked it. If it's a new machine then it will probably have arrived with standard accessories and a toolkit. Standard accessories normally consist of a faceplate, centres, change wheels, work driving pin and a carrier or lathe "dog" - and you can't do very much with those! Some manufacturers include a 3 jaw self-centring chuck, which helps a bit.

So now you need a number of basic accessories to get you started. A tailstock drill chuck is essential, together with a set of drills. Imperial or Metric? If you want to work from Imperial drawings and cut Imperial threads then an Imperial set is useful, but with a "Zeus" chart of tables you can convert drill sizes easily. (It might be easier for the beginner to buy Metric drills because the current tables of tapping and clearance drill sizes all specify Metric as the "preferred" size - Ed.) A "live" or revolving centre to support long workpieces would be useful, and a 4-jaw independent chuck is essential for square or irregular work. The 3-jaw is really a convenience device for round or hexagon materials. Your supplier should be able to furnish you with a set of lathe tools or HSS (high speed steel) tool blanks to grind the shape yourself. If you are a beginner, arm yourself with the appropriate textbooks on lathework. Better still, find a model engineering evening class at a local college. Join a club, meet other model engineers, share difficulties and get advice. Read textbooks and hunt for back copies of *Model Engineer, Model Engineers Workshop and Engineering in Miniature.*

Don't try and obtain everything at once. Obtain tools and materials as required for the job in hand. Buy taps and dies for threading as and when they are called for on the drawing. If you intend to perform milling operations on the lathe, a vertical slide will be required for this. As this involves resetting the machine, your work must be planned to avoid unnecessary resetting and consequential waste of time. For many of us time is limited and must be put to the most effective use. "He who carries out many different types of operations on his lathe must often reset".

Materials

From the outset it is desirable to build a small stock of useful sections of steel, brass and aluminium. A lot will depend on the individual's modelling interest which, to a certain extent, will control the material stock. Addresses of suppliers will be found in the model engineering press, so obtain their catalogues and start to build a technical library. Some of the suppliers sell bundles of different sizes of materials at reasonable prices and this would be a useful way for the beginner to start his material stocks. A visit to a local small engineering company will often prove fruitful because the short lengths of material which they throw away as "scrap", because it is too short for their machines, is ideal for the model engineer's lathe etc. Eventually you will learn to use the model engineer's most useful technique - scrounging!

Conclusion

If you are a beginner, the machining of a particular component may look rather daunting, if not impossible. Remember that the models described in the model press and published plans have all been built before, some many times, and often by beginners. It's important to realise from the beginning that a disciplined approach must be followed. This can be observed by reading and trying to understand the constructional articles in the model press.

Start with something simple involving just a few parts. Making your own tools or lathe accessories are a good way to start to acquire skills, even before you make a start on a model. Above all, be patient and do give it a try!

KT 350 LATHE

As this issue goes to press, I have just been informed of a new British made lathe to be distributed by:-

Hegner U.K., Unit 8 North Crescent, Diplocks Way, Hailsham, East Sussex. BN27 3JF.

This new machine will have a centre height of 3" (75mm) and a distance between centres of 13.3/4" (350mm). Speeds will range from 85-3710 r.p.m. A large cross slide table of 80mm x 178mm will give room for mounting a rear toolpost or vertical slide which will be available, together with a good range of accessories. Another useful feature will be an auto-stop for the saddle feedscrew for use when cutting up to a shoulder etc. An indexing arrangement built into the headstock will also be another useful refinement.

A full range of accessories will be available to complement the lathe. The machine will be competitively priced and appears to be well specified. Due for release in mid summer 1996, further information will be available from Hegner U.K at the address shown above.

(The prototype lathe which was on show at the recent Model Engineering Exhibition at Olympia certainly looked very promising - Ed.). ■

Contact Addresses:-

APTC Lathes from:- Axminster Power Tool Centre, Chard Street, Axminster, Devon. EX13 5DZ Tel: 01297 33656

Chester Lathes from:- Chester U.K. Ltd., Waverton Business Park, Waverton, Chester. CH3 7PD Tel: 01244 336100

Cowell's Lathes from:- Cowell's Small Machine Tools, Manor Workshops, Little Bentley, Colchester, Essex. C07 8SE Tel: 01206 251792

Myford Lathes from:- Myford Ltd., Wilmot Lane, Chilwell Road, Beeston, Nottingham NG9 1ER Tel: 0115 9254222

Peatol Lathes from:- Peatol Machine Tools, 19 Knightlow Road, Harborne, Birmingham B17 8PS

Sherline Lathes from:- Millhill Supplies, 66 The Street, Crowmarsh Gifford, Wallingford, Oxon. OX10 8ES Tel: 01491 838653

Unimat PC and Compact 5 Lathes:- Emco, 9 Woodshots Meadow, Croxley Business Park, Watford, Herts. WD1 8YU

Warco Lathes from: - Warren Machine Tools, Warco House, Middleton Industrial Estate, Guildford, Surrey. GU2 5KX Tel: 01483 33361