# BASIC SILVER SOLDERING

by Bruce Davey

**Successful silver soldering is actually quite easy once you know how. Bruce tells you how to avoid the problems which could give you trouble ...**


## RESUME

Make it, clean it, flux it, apply heat and solder, cool it, clean and inspect it.


It is easy to produce successful silver soldered joints if a few basic rules are carried out and materials and tools chosen carefully. Practice first on some spare pieces of material before attempting to solder your finished components. In this way you will not risk spoiling the job.

## Joint design

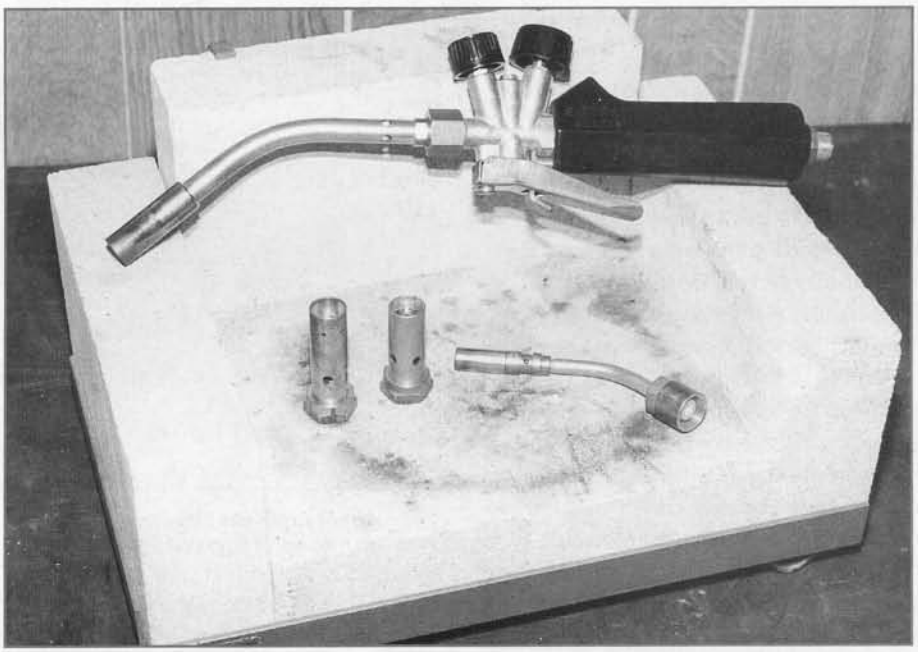
The best joint is one in which there is an overlap of the components in the form of a lap or sleeve join.This leaves a small gap between the parts to be joined whereby the silver solder can flow in by capillary action. Normally 4 times the thickness of the thinnest component is best overlap.

Gap between the components

This depends on the design of the structure and stage of construction which, in turn, determines the type of silver solder used. A list is given at the end of this article with details of solders and fluxes and recommended gaps.

## Choice of silver solder

Generally silver solder can be of high or low melting temperature, free flowing or plastic flowing and can produce fine joints or ones with filleted corners. It is an alloy containing silver with additions of copper, cadmium, tin and zinc. Some structures require step soldering, a typical example of this is in a locomotive boiler where the firebox and rear tubeplate are soldered first with high melting point solder and then fitted into the boiler shell with a lower melting point solder so that the first part does not become unsoldered during the second operation.



*A brazing hearth suitable for soldering small boilers and fittings etc. The hearth shown is available from Crowhurst Engineering. Also shown in this photo is a Sievert handle fitted with a neck tube and burner, and also a selection of differemt sized burner heads. The small pencil burner on the right has its own built-in neck tube and is useful for really small and delicate work.*

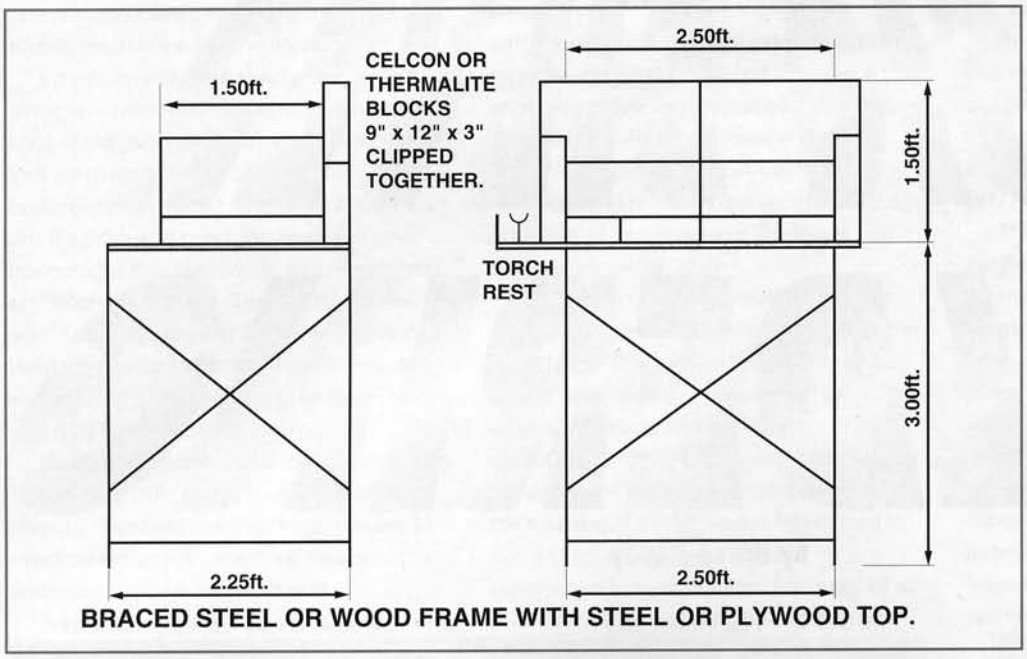
## Cleanliness

Cleanliness is absolutely essential, all parts should be clean of grease and preferably mechanically cleaned with medium grade emery cloth or similar. For non ferrous metals and alloys, i.e. copper and brass, scrub in hot water with detergent and scotchbright pan scourers and rinse well with hot water just prior to fluxing and assembly; oxides on these metals can be removed by pickling in a solution of citric acid or other acids. (See Pickling). Steel is best prepared by abrasive cleaning.

## Fluxing

Flux is a material that cleans the surface of the metals being joined and covers them whilst working to prevent further oxidisation. It is usually supplied in the form of a powder or paste. The choice of flux is most important to match the properties of the chosen silver solder and the size of the work. The flux must melt and be active by the time the silver solder melts therefore for Easy Flo2 solder the use of Easy Flo flux is required. The flux must be capable of removing oxides from the metals to be joined and special fluxes are available for certain steels and tungsten carbide tip tools.

Fluxes, like most things, have a finite life and can become exhausted depending on how hot and for how long they are heated. If ▶



**BRACED STEEL OR WOOD FRAME WITH STEEL OR PLYWOOD TOP.**

the flux residues turn black and glassy then a flux with a higher rating should be used. If, part way through a job, the flux becomes exhausted then the addition of more flux will often enable one to finish the job. Generally speaking there are two fluxes which are most suited to model engineering work, Easy Flo and Tenacity 4a. Easy Flo for lower temperatures and Tenacity 4a for higher temperatures and longer heating times.

EASY-FLO flux :- normal general purpose flux for all low temperature silver solders not exceeding 800 degrees C. It will successfully flux most materials used in our hobby, including stainless steel, and its residues may be cleaned off by soaking in hot water.

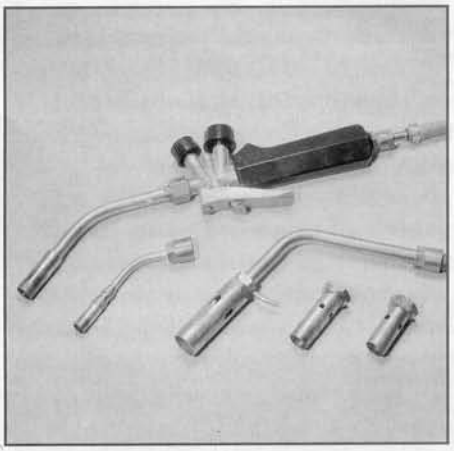
TENACITY 4a flux :- A higher temperature rated flux with longer life suited to larger boiler making, will also work with most materials used in modelling and its residues can be removed by pickling in a mild acid. Other fluxes are available but their removal after soldering is difficult.

FLUX APPLICATION :- flux is best mixed with cold water and a drop of detergent to a creamy consistency and applied by brush to joints during assembly prior to soldering. Too much flux will rarely hurt but too little can ruin the work. Inadequate fluxing prevents the capillary action of the solder into the joint. Extra flux may be added during soldering by dipping the hot end of the solder into the dry flux powder and then transferring it to the work.

Heating and soldering (also see hearth)

The work should have its temperature raised quickly so that the flux does not become exhausted. For small work, such as fitting olives on copper pipes up to 3/8" dia. or small tee pieces and boiler fittings, a typical domestic DIY type blowlamp using disposable gas cartridges like the Taymar, with a nozzle 7/8" dia., is adequate. Small boilers up to 2" dia. x approx. 5" long may be soldered using two of these.


*A convenient size of gas bottle for smaller work is shown here with a hose and gas torch fitted.*


*The Sievert gas torch with a range of neck tube burners.*

For larger work it is best to invest in a large propane gas bottle from Calor gas or Shell along with a Sievert neck tube burner. These consist of a handle to which different size bumers can be fitted and are normally supplied with a long flexible hose complete with a burst hose protector and flash back arrestor for connecting to the gas bottle. The advantage of this type of burner being that the neck tube draws its combustion air in well away from the flame thus enabling the burner to work in confined spaces such as a firebox without blowing out.

It is very difficult to be precise about the size of burner required for a particular job as conditions vary considerably, i.e. inside a workshop or outside with a gale blowing. Briefly, for boilers up to about 5" dia. x 10" high a 1.25" burner will suffice, for 5" gauge loco boilers use a 2" burner and for really big boilers get two of the 2" burners. Oxy Acetylene is to be avoided unless one is really skilled in it's use, even then only a soft white flame is used to avoid burning the parent metals. Brass fittings tend to melt instantly with the use of this type of heat source. The main drawback to oxy acetylene is it's high concentration of heat in a very small area, the larger propane flame gives a better spread of heat which is essential when working with copper boilers.

As a guide to temperature, the state of the flux or the colour of the metal may be used. As the temperature rises the flux becomes clear and fluid and runs over the joint area, the solder rod may then be applied and it should melt and run into the joint. If it does not run keep heating and after a few minutes try again, continue heating and applying solder along the joint until it is clearly all soldered.

The radiated colour of the metal also provides a guide to its temperature but it is important to always work under the same lighting conditions, I find that subdued lighting inside or in the shade outside is best. If the sun shines on even red hot metal it will appear black and cause confusion. The metal should glow a dull cherry red for Easy Flo 2 solder and up to bright red, almost orange, for high temperature Silver Flo 24.

If using a higher viscosity solder (such as SF24) follow the solder stick along with the flame as it is applied. As soon as the joint is completed, heating should be discontinued and the work allowed to cool naturally until at room temperature whereupon it may be transferred to the pickle bath. Quenching from the hot state is unnecessary and can be dangerous as steam generates in hollow parts of the work and can be ejected at high velocity - if acid is being used things are

worse as fumes are often given off as well. Quenching also produces thermal shock causing uneven stresses and ultimately damage to the work.

## The hearth

A soldering hearth can be made from insulating building blocks, these are available at reasonable cost from builders merchants under the trade names Celcon or Thermalite. (see sketch). They do not spoil or shatter under heating and may be easily cut or carved to hold parts whilst soldering and are usually much cheaper than fire bricks. Do not use bricks from old storage radiators as these are designed to absorb heat and you can waste a lot of time heating them up instead of the job. Insulating blocks quickly heat up on the surface and glow red thus adding to the heat input into the work by radiation. Standing spare blocks around the work will improve the heating time. Also allow space to park the blowlamp until it cools down.

## Pickling or cleaning of residues

After the soldering process it is necessary to clean the work thoroughty, this is best achieved by completely immersing the work overnight in either cold water, or in a mild acid if using Tenacity flux. I use citric acid (lemon juice), which is available as a powder to be mixed with water from Boots the chemist at about £1.00 for 3.5 oz., enough for several gallons of pickle. After pickling, rinse copiously with clean cold running water, small areas of flux remaining are easily removed with a scotchbright pad or a piece of sharpened wood to get into corners. Check from both sides, where possible, that all joints are soldered correctly - if not it is usually possible to re-flux the work and repeat the soldering process after cleaning.

Dilute sulphuric acid is also used for pickling and is quicker and more effective than citric acid. The disadvantage of citric acid is that it has a short working life although it is much safer to use. Pickling is best done in plastic containers such as polyethylene lunch boxes for very small jobs up to large polyethylene dustbins or small plastic cattle troughs for large boilers. Burnt and blackened residues are best removed by sulphuric acid pickling but, if work is required quickly, immersing the work in water at 60 degrees C will effect the removal of Easy Flo flux within 15 to 20 minutes.

If you ever need to dilute acids it is vitally important to remember that you must ALWAYS ADD THE ACID TO THE WATER as this dilutes the acid as it mixes - never add the water to the acid because this can result in an explosive situation which is potentially dangerous as anyone nearby could be splashed and burnt by the acid.

## Health and safety

Commonsense is the best thing here, never breath fumes from any source particularly if using cadmium containing alloys (Easy Flo2) - use good ventilation and stand back from the work, not over it. Flux can irritate the skin and prolonged contact should be avoided. The heat from soldering a large boiler can be overpowering and exhausting so be aware and be careful. Some people wear a so called survival blanket as an apron when working or even a sheet of aluminium foil to reflect the heat. Don't be tempted to touch anything even with gloves on unless you are sure it really is cold, always lay down sticks of solder with the hot end away from you on the hearth.

## Practice

Practice gives confidence so, before soldering your pride and joy, practice on a test piece first. I suggest a short piece of I " copper tube soldered into the centre of a piece of brass or copper about 2" square. Do one test with Easy Flo 2 and one with a higher temperature solder, if using brass be careful not to melt it.

## RESUME

Make it, clean it, flux it, apply heat and solder, cool it, clean and inspect it. ■

***SILVER SOLDERS***

| SOLDER | TEMPERATURE | JOINT GAP | COMMENTS |
|---|---|---|---|
| Easy Flo | 608-617 | 0.001 " + | universal general purpose solder very free flowing contains cadmium. Lowest temperature. Very small fillets. |
| Silver Flo 55 | 630-660 | 0.002" + | cadmium free solder nearest to EF2, free flowing, produces modest fillets, ideal for fabrication. |
| Silver Flo 24 | 740-800 | 0.002-0.005" | high temperature used as first step in step soldering. Larger fillets. For copper to copper & steel |

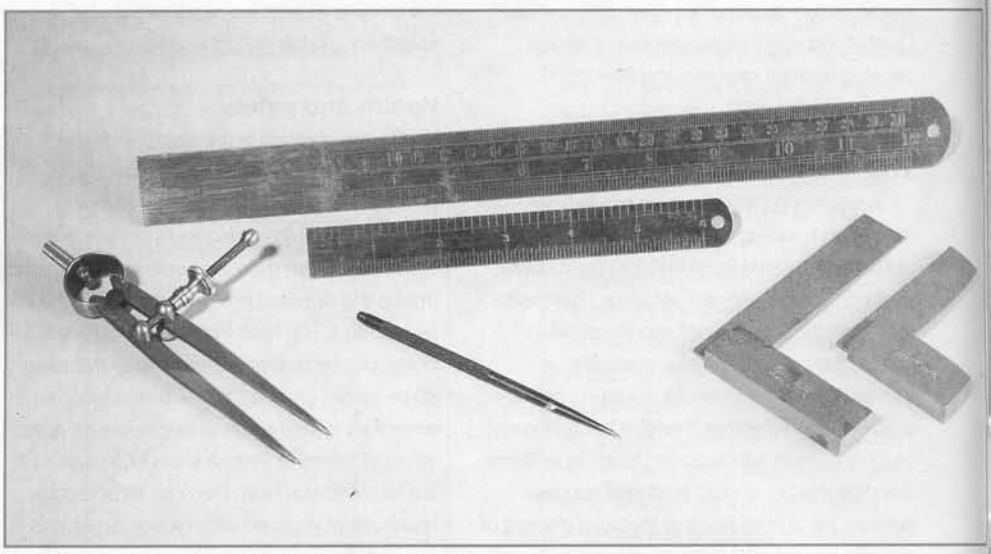
Silver solders are normally supplied in the form of a rod 1.5mm (1/16") dia by 600 mm long. Easy flo2 is also available in the form of 0.5mm wire for small fittings etc. and as a paste ready mixed with flux in a 30 gramme syringe so that parts may be assembled then simply heated.

***FLUXES***

| FLUX | TEMPERATURE | CLEANING | COMMENTS |
|---|---|---|---|
| Easy Flo | 550-800 | cold or hot water | universal general purpose flux for most M.E. applications. |
| Tenacity 4A | 600-850 | mild acid pickle hot water rinse | for high temperatures and onger working life. |

Flux is normally supplied as a powder in 250 gramme pots

# THE WORKSHOP



*Basic tools needed for marking out - (L to R) Engineer's dividers; 12" & 6" steel rules; scriber; 3" set square - the 2" one is useful for marking out smaller items.*

**You don't need to spend a fortune and have a lot of space to take up model engineering. Here we look into smaller workshops for the newcomer to the hobby ...**

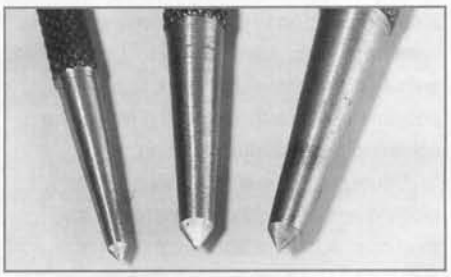
There is a popular misconception that a large fully equipped engineer's workshop is needed in order to produce good models. This is simply not true! Whilst it is very nice to have lots of space and all sorts of machines etc. it is not essential. A lot depends on the size of the model to be built - obviously large models need more room on the bench and bigger equipment in order to produce them but, on the other hand, smaller models need a lot less space and smaller equipment.

It is perfectly feasible to make many of the smaller models quite literally "on the kitchen table" (provided, of course, that your partner will allow it!). Another benefit of choosing to build smaller models is that the financial outlay is also much less, both in terms of machinery and tools as well as materials. So this article will concentrate on the smaller workshop and the facilities which will be needed in order to produce models up to about 1/16th scale.

Probably the first thing to consider is the amount of space which can be used for modelling. You may well be fortunate enough to have a spare room in the house or some form of shed or outbuilding in the garden. On the other hand, you may live in smaller accommodation such as a flat or maisonette. In this case you might actually be restricted to using the kitchen table or a small desk - the latter would be a better option as it would avoid the need to put everything away at meal times.

There always has to be a compromise with the rest of the household and their needs must be given careful consideration, otherwise your modelling hobby will be looked upon with scorn and that would take away a lot of the pleasure you could get from the hobby. It is preferable if some sort of area can be dedicated to the modelling as this would give you the chance to leave a job halfway through and return to it later without having to set things up all over again. The writer has recently been put into just this sort of situation. After several years of luxury with a spare bedroom fitted out entirely as a workshop, relocation to a smaller home has

*set of three sizes of centre punch made by Eclipse tools. (See close-up photo below for how to centre punch accurately).*



*A close-up of the points. The smallest one is used with a small hammer to just mark the position before checking with an eye glass. The 'pop' mark can then be drawn over if needed. When correct, use one of the larger ones to make the final punch mark to guide the drill.*

forced me to look at the possibilities of setting up a much more compact operation.

It will be difficult to envisage the amount of space required without first looking at the tools and machinery that may be needed, as well as the type of model you wish to make. Only then will you be able to tell what the minimum space requirements will be.

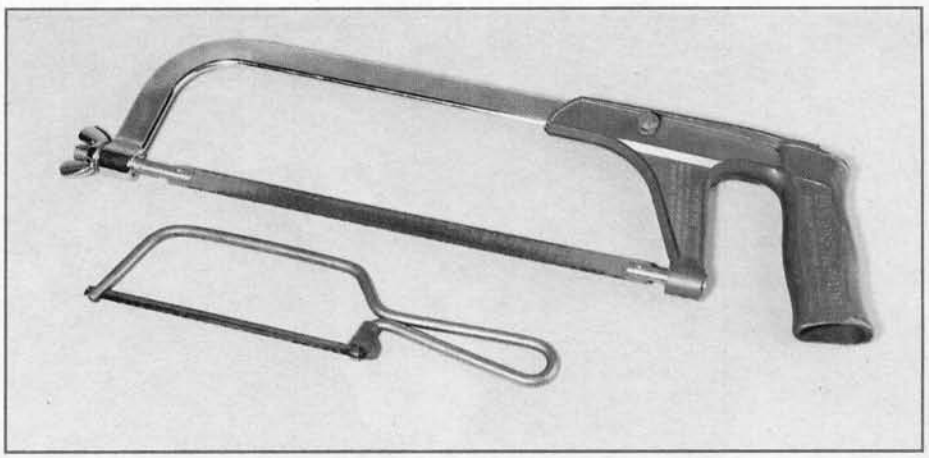
## Hand Tools

Before mentioning the tools themselves, perhaps I should mention the subject of measurements and drill sizes etc. These days there are some people, like myself, who were brought up with the "old" Imperial measurements and those who have been brought up on the metric system. In the model engineering world you will find that both systems are in use independently and also together. This may seem somewhat confusing at first but it will become clearer as you go on.

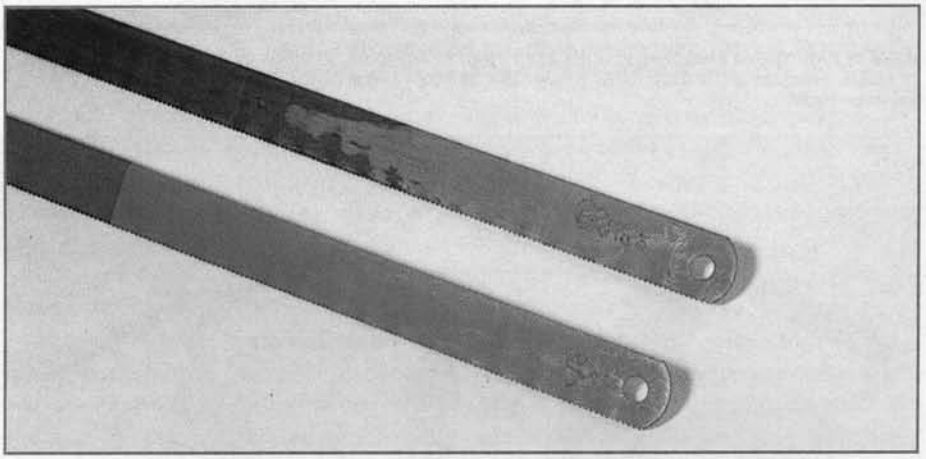
An enormous number of model drawings have been produced over the years and most of these were designed in "inches". It is impractical to convert all these designs to metric because this would entail completely redesigning most of them and so we must accept that Imperial dimensions must still be used. The other side of the coin is that most materials are now manufactured to metric dimensions and we must conform to this and therefore use the nearest available metric sizes. Some thought must be used when doing this as the nearest metric size may be a few thousands of an inch larger or smaller than required, so adjustments may have to be made to other components to compensate.

Drill sizes are another area where this might cause problems. All the modern tables of tapping and clearance drills quote metric drills as "preferred" sizes. As these tables have been drawn up by various Standards organisations it is quite in order to use the metric drills they specify. A problem arises when the drawing states the use of an Imperial letter or number drill. Sometimes the modern tables do not make any reference to these at all, so the modeller must find out for himself. I would recommend the purchase of a set of tables which do include the letter and number size equivalents.

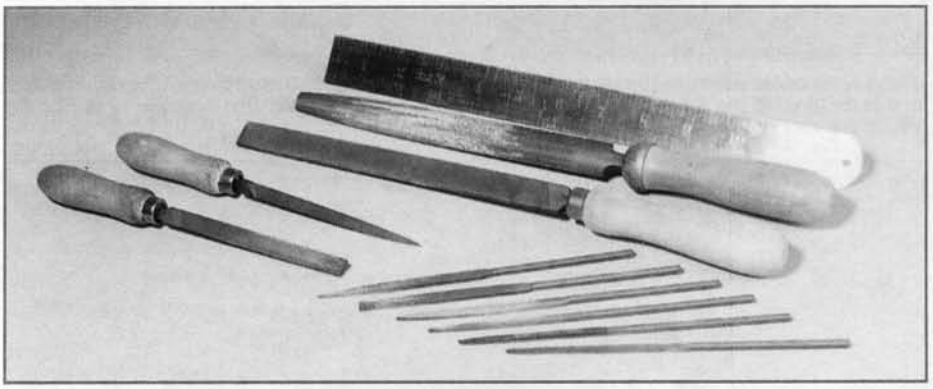
Back to the tools themselves, basic items to start with will be 6" and 12" steel rules (15cm & 30cm for those of you who can cope with metric!). Rules which have Inches down one side and metric down the other are useful. A 3" try-square, a scriber, a pair of engineer's dividers and a small centre punch and hammer will be needed for marking out. Depending on your eyesight, a magnifying glass of some sort might also be useful as well!



*An adjustable hacksaw frame fitted with a 12" blade for general use and a junior hacksaw for cutting smaller items.*



*A close-up of two 32 t.p.i. hacksaw blades. Use a new blade for cutting brass and then relegate it to steel cutting when the brass does not cut cleanly. Mark them with a felt pen.*

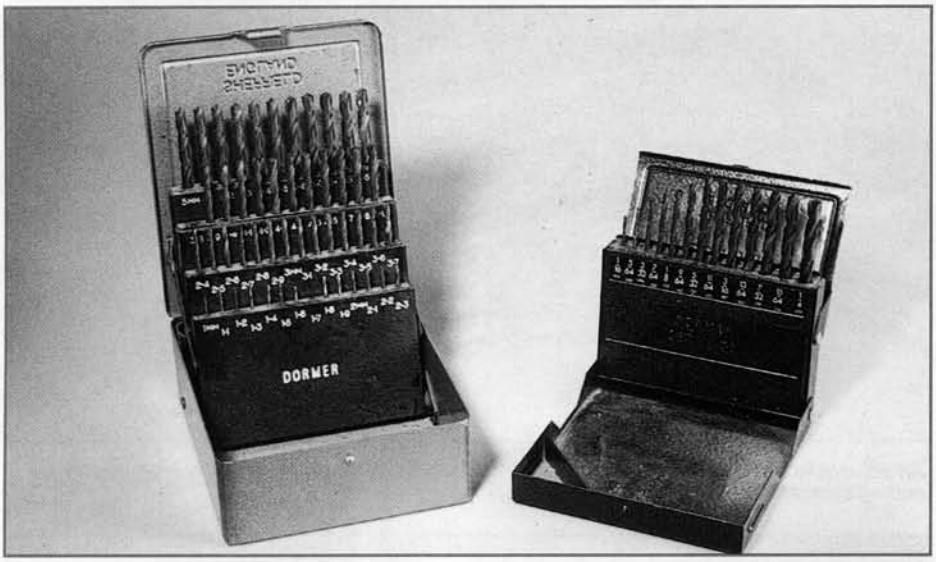


*A selection of files will be needed. From L to R clockwise - 6" smooth cut flat & half-round: 8" second cut flat & half-round; a set of needle files. (The 12" rule is included as a guide to sizes.)*

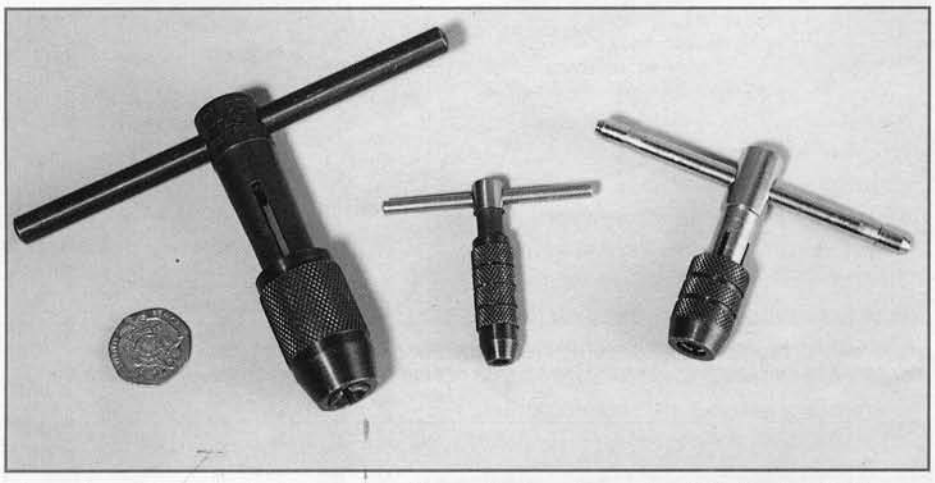
For cutting out you will need a 12" hacksaw with blades of around 28 or 32 tpi. I would suggest using two blades, one for steel and the other for brass. (It is better to use a sharp blade on brass and steel will quickly take the "edge" off a blade). A junior hacksaw will be handy for cutting smaller items.

To get nice straight edges and a good finish you will need a selection of files. I would suggest 8" second cut flat and half-round files for general use and 6" smooth flat and half-round for finishing off. A set of needle files will also be handy. Don't use your "model engineering" files for jobs around the house or car, they will only become blunt or clogged up and will not give the better finishes you desire for your models.

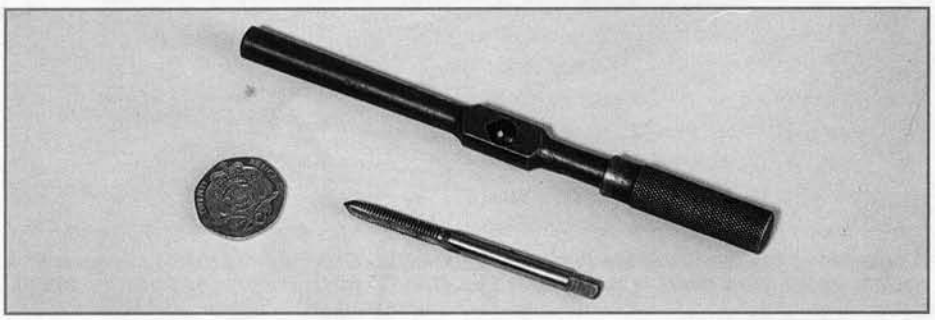
A wise investment would be a new set of drills, again to be kept solely for model engineering use. A set of high speed steel metric drills from 1mm to 6mm diameter in steps of 0.1mm will be well worth the expense. There is nothing worse than being part-way through making a component and ▶



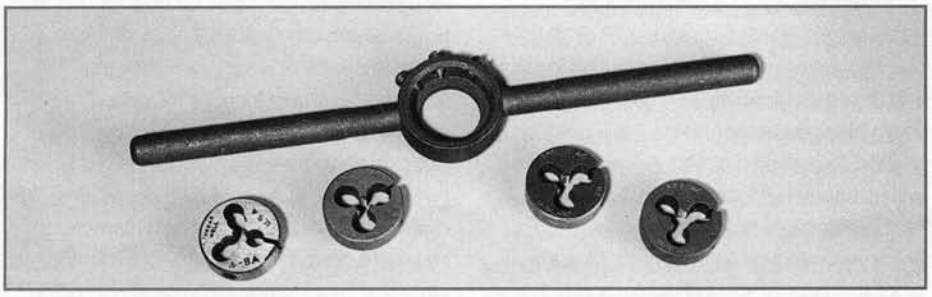

*A set of high speed steel Metric drills from 1mm to 6mm dia. in steps of 0.1mm (left) and a set of H.S.S. Fraction drills from 1/16" to 1/4" dia. in 1/32" steps (right) will cover most requirements.*



*Three sizes of tap wrench - the larger one is used for taps bigger than 1/4" dia., the right hand one is for most of the BA and ME series and the smallest is for really fine taps like 10 or 12 BA which are very easy to break!*



*This photo shows a flat type of tap wrench. Be careful to exert pressure evenly on both ends otherwise you will risk breaking the tap.*



*Some split dies and a die-holder for cutting external threads.*

then not being able to continue because you haven't got the right size drill!

Next we come to the question of taps and dies for cutting threads. Many of the designs for engineering models will specify the use of BA or Model Engineer threads. This is because they are all fine threads which are better suited to the material thicknesses and shallow holes needed in model making. The best recommendation would be to purchase a set of BA (British Association) taps and dies which cover the range from 10BA up to 2BA, including the "odd" numbers, and supplement these with ME (Model Engineer) taps and dies from 1/8"x40 to 1/4"x40, including the 1/32" sizes. These will cover most requirements and the others may be bought as needed later on.

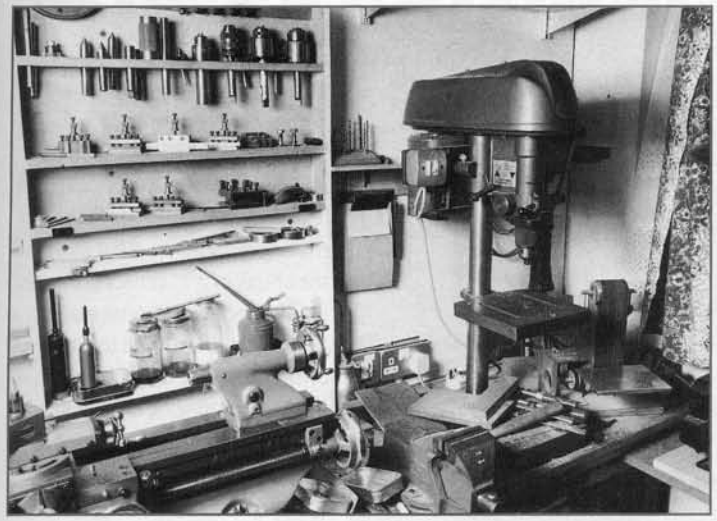
## Workshop Machines

Without doubt, the most useful machine that the model engineer can have is a centre lathe. These machines can be very versatile and, with the help of few extra accessories, can be used for turning, milling, drilling, shaping and even grinding. In a small workshop where space is at a premium the ability to use just one machine tool for most of the work is very valuable.

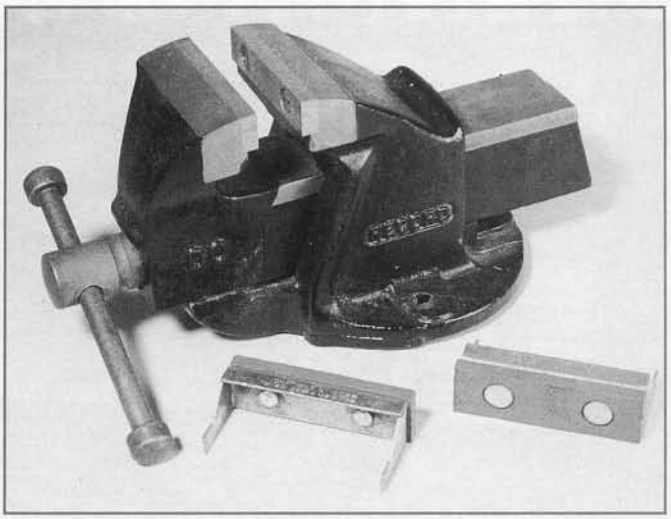
In recent years, several lathe manufacturers have introduced lathes which will accept a milling/drilling column attached at the rear of the lathe bed. This column is arranged so that milling cutters and drills will be positioned over the cross slide of the lathe and this can then be used as a milling table. In fact some makers even supply a larger milling table which can be bolted to the cross slide to provide a bigger surface. Usually, the milling head (complete with its own motor) can be tilted in relation to the lathe bed and this makes it very easy to mill or drill at an angle to the workpiece - something which is often needed in model engineering!

Elsewhere in this issue you will find more comprehensive information on choosing a lathe but I will just mention here that a lathe of around 2" to 3.1/2" (50mm to 90mm) centre height will be suitable for most stationary engines, locos up to 5" gauge, traction engines up to 1.1/2" scale and most clocks.

One other machine will be found almost indispensable in the modeller's workshop and that is a drilling machine. It is surprising how many holes need to be made in the course of building any model. The greater majority of these holes need to be accurately positioned and true to size. The only way to achieve this is by the use of a proper drilling machine. Here, again, the smaller workshop only needs a small bench drilling machine. Something with a chuck capacity of 5/16" to



*Note how the lathe tools are stored in a wall rack behind the lathe and the drills on a shelf behind the drilling machine in this corner of a compact workshop.*



*This 2" vice, normally fitted on the assembly bench, is a very useful size for handling the smaller components. Note that the vice jaws have been ground flat to protect the work and the soft fibre jaws for holding finished surfaces and threads etc.*

3/8" (8mm to 9mm) will be adequate for the scale of models we are thinking about here.

I think it is a false economy to use a typical "DIY" power drill on a bench stand unless you are desperately short of cash. (In this case it is better to struggle with that set-up and invest a lathe first). Reasonable small drilling machines are available at low cost these days and the second-hand market in these machines is well worth looking into. If you do buy second-hand, make sure there is no excessive play in the chuck spindle and also check that the chuck itself runs true. You'd be surprised how easy it is to drill square and oval holes with a worn drilling machine!

A small bench grinder with 5" or 6" (12cm or 15cm) diameter wheels would be a useful machine to have, although it is not absolutely necessary to start with. Its main use would be to resharpen drills and lathe tools. If you start with new ones they will only need touching-up with a hand stone for some time before you will need to resort to a grinder. Then you might be able to get a friend to sharpen them for you.

Whilst a milling machine would be a nice thing to have, it can be classed as a non-essential item because many milling operations can be performed on the lathe with the use of a vertical slide and a bit of ingenuity. There are one or two good books available about milling in the lathe. However, if you can afford it, a vertical milling machine would make a lot of jobs much easier. A mill/drill would enable you to save space by combining the two machines into one.

A good compromise which I would recommend, if your budget will stretch to it, is to buy one of the lathes which will accept a milling/drilling machine at the back of the bed. This would make for a compact machining centre and conserve that valuable workshop commodity - space. When you get more room or a bigger budget you could then buy a compound milling table and mount the mill/drill head and column on it to make a separate machine.

## Workbench

You will obviously need some sort of bench or work top on which to put machinery and tools as well as a space for marking out and assembly as the model progresses. Whilst the "kitchen table" idea is workable, it would be better to have a separate table or desk - or better still a small bench top. If you are really stuck for space, a workable arrangement could be a second-hand office desk - older solid timber ones are better than the modern ones made of laminated chipboard on metal tube legs. A desk of around 5ft. wide x 2ft.6in. deep (150cm x 75cm) would just accommodate a small 2.1/2" lathe and a small vice.

A better option would be to build a sturdy bench and screw it to a wall for extra rigidity. A minimum length of 6ft. (180cm) and a depth of 18in. (45cm) will be quite useful, giving just enough room for a lathe with mill/drill attachment, a vice and an open area for assembly etc. A depth of 2ft. (60cm) would be much better and give room for storage at the back of the bench top. Bench height should be arranged so that the top of the vice jaws are about level with your elbow when standing up for sawing - around about 39in. (1metre) or so.

## Storage

Tools, nuts and bolts, materials, bits of the model etc. will all need to be stored somewhere. Small items are best kept in tobacco tins (which are becoming scarcer in these days of plastic packs) or racks of plastic drawers. Tools can be kept in drawers or cupboards - I find that the metal office drawer units with shallow drawers for paper etc. are ideal for keeping tools handy under the bench.

Materials are often a problem to store. Most of the model engineering suppliers seem to stick to 1ft. (30cm) and 2ft. (60cm) lengths for bar stock and I have seen many ingenious ways for storing these - narrow shelves with stripwood dividers work well, as does the use of plastic guttering screwed to the wall behind the bench. Short pieces of bar stock can be kept in shallow drawers or small boxes (plastic sandwich boxes are cheap and handy). A useful idea is to paint each end of a length of bar stock with a colour code to identify the type of material - say:- no colour for mild steel; yellow for free-cutting mild steel; red for brass; red/yellow stripe for stainless steel; blue for silver steel; green for phosphor bronze; and white for hexagon bar of BA nut sizes (brass or steel) - (This code is taken from "The Model Engineers Handbook" by Tubal Cain (with due acknowledgements) and has served me well in my own workshop for several years. I would also recommend this book to be on every model engineer's bookshelf, it is published by Nexus Special Interests under ISBN 085242-715-8 - Ed.)

Sheet metal is best kept on edge against a wall or behind a door. A simple wooden rack will suffice for this but remember that a large sheet will eventually end up in lots of smaller pieces, so allow for this when arranging the rack.

On the wall above the bench, fit a narrow shelf which is just wide enough to take your intended model. This will be a convenient place to put the parts and assemblies whilst you are working on other bits and it will be to hand for checking measurements etc. as you go.

▶

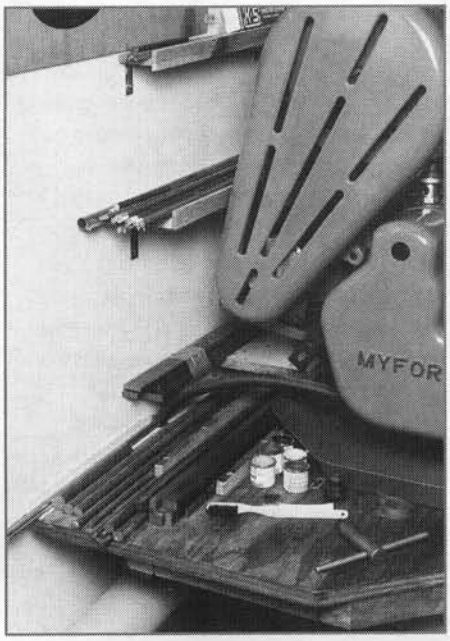

***Small items such as BA nuts and bolts, springs, screws, shim washers, etc. may be neatly stored in tobacco tins and plastic drawer units on narrow shelves. The use of adjustable shelf brackets allows for alterations when needed.***

## Lighting and Power

Unless you know exactly what you are doing - and are conversant with the recent electrical safety standards - you should leave all electrical installations to qualified people. Apart from the obvious hazards to yourself, you could get into legal "hot water" if you get things wrong.

An independent 13 amp supply will be better for the workshop and it is safer to have this fitted with a circuit breaker or "trip" which will cut off the power if any problems arise. You will never seem to have enough wall sockets in the workshop area, so try to ensure that there is a least two double 13 amp sockets in the bench area. I find it is best to have fixed items like machines and desk lamps plugged in at the wall behind and above the bench. That way there will be less cables lying around over the front of the bench top. I also like to have at least one double socket at the front edge of the bench for plugging in soldering irons etc.

Good lighting is essential in the workshop area. In a small workshop you may be able to manage with one "anglepoise" type of lamp carefully positioned so that it may be swung over to cover the lathe or workbench as needed. Ideally, one light over each machine plus one over the "assembly" area would be better. Bear in mind that fluorescent lighting can have a stroboscopic effect which can make rotating machinery look as if it is stationary. This could lead to a nasty accident, so don't put fluorescent lighting near lathes, mills etc.




***Raw bar materials in 12" or 2ft. lengths stored behind the lathe. Stripwood dividers separate different materials which are also colour coded for quick reference.***

## Workshop Safety

A word or two about safety in the workshop area will not go amiss. You should always remember that engineering tools and machines are potentially dangerous. Given reasonable care and common sense you will come to no harm but you should always be thinking about your own safety and that of other people around you.

The more obvious dangers are those associated with moving machinery. Do not wear loose clothing which could get caught up in the lathe or the milling machine. Always make sure that chucks are securely tightened before starting a machine - and NEVER leave a chuck key in the chuck at any time. (I remember learning about that whilst serving my apprenticeship - I left a key in the chuck of a 7" lathe. I got a very painful shock and some nasty bruises when I turned the lathe on!). Also NEVER clear swarf from a moving cutter - it is too easy to get caught up and could lead to serious injury (I know - I've seen it happen!).

Make sure all your files are fitted with proper handles, a bare file tang can cause nasty damage if it gets jabbed into the palm of your hand. Chisels and punches should have any burrs ground off where they have been hit with the hammer, and never use a hammer with a loose head. Always make sure hacksaw blades are tensioned properly before use. And always use the correct size spanner for nuts and bolts etc. - apart from damage to your knuckles if it slips off, an ill-fitting spanner can damage the nut and spoil your model!

Be careful about trailing leads and cables, tripping over one could be painful. Similarly, keep the floor clear of obstructions - especially near machinery. Sweeping the floor after every session will stop swarf spreading all over the house, and be careful with swarf if you have young children or animals about. If you are likely to have young children around it would be wise to isolate the electrical supply to the workshop or, at least, the machinery.

A reasonable size fire extinguisher or fire blanket would be a wise precaution, especially if you intend to use a gas torch for silver soldering etc. If you want to use a pickle for cleaning brass and copper after soldering, I would suggest the use of citric acid (available from chemists for wine making use) as it is less corrosive than sulphuric acid. If you dilute any concentrated acids ALWAYS ADD THE ACID TO THE WATER as this dilutes the acid as it mixes. NEVER add water to acid as this may cause an explosion.

This may all seem rather frightening (especially to other members of the family) but I think it is better to be aware of the dangers and take care to avoid them, rather than to have an accident. If you use common sense and are careful you will come to no harm and enjoy your hobby all the more.

So, good luck in your new workshop - and enjoy your modelling. ■

# THE FASCINATING WORLD OF STATIONARY STEAM ENGINES

by Anthony Mount

**Anthony Mount gives an insight into the large variety of stationary steam engine types which you may like to choose for your modelling project ...**

Though our colleagues building steam locomotives have an amazing array of locomotive types to choose from, apart from some of the early examples most of these follow a similar arrangement of horizontal cylinders driving direct onto the wheels. Stationary steam engines, on the other hand, have a great variety of different configurations - although it must be said that most of them are similar in that they at least have a cylinder or two!

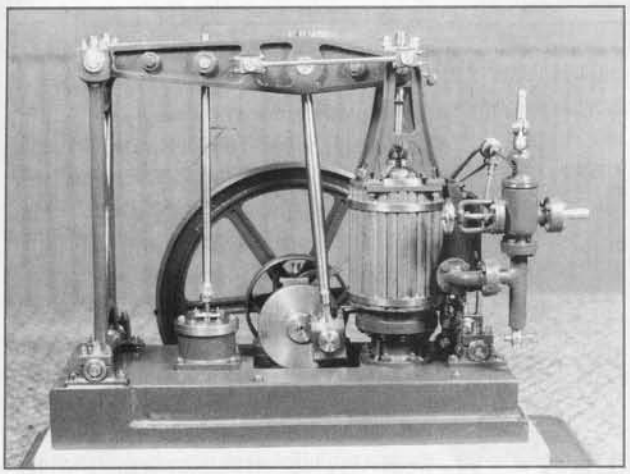
## Single Cylinder Engines

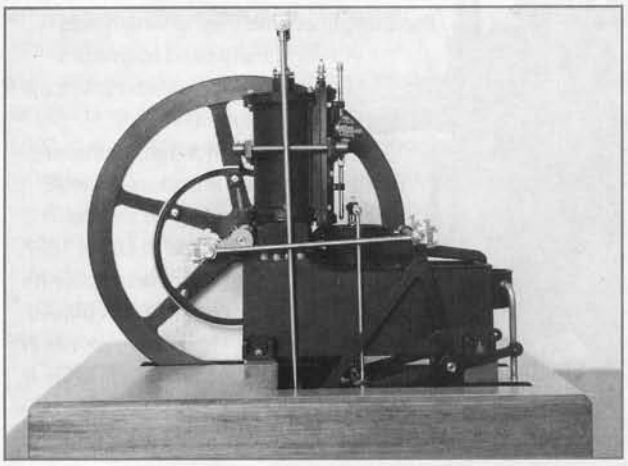
First in the field at the beginning of the eighteenth century was the beam engine of Thomas Newcomen (see Fig. 1). This had a vertical cylinder coupled with chains to one end of a beam pivoted in the middle. On the other end, also using chains, was suspended the pump rods. The piston going down drove the pump rods upwards and the weight of the rods pulled the piston back up on its return stroke.

Towards the middle of the eighteenth century we come to another beam engine (Fig. 2), now double acting and using a parallel motion to connect the piston rod to the beam. The other end of the beam has a connecting rod which drives a crank giving rotary motion to a flywheel and crankshaft. This development was by James Watt.

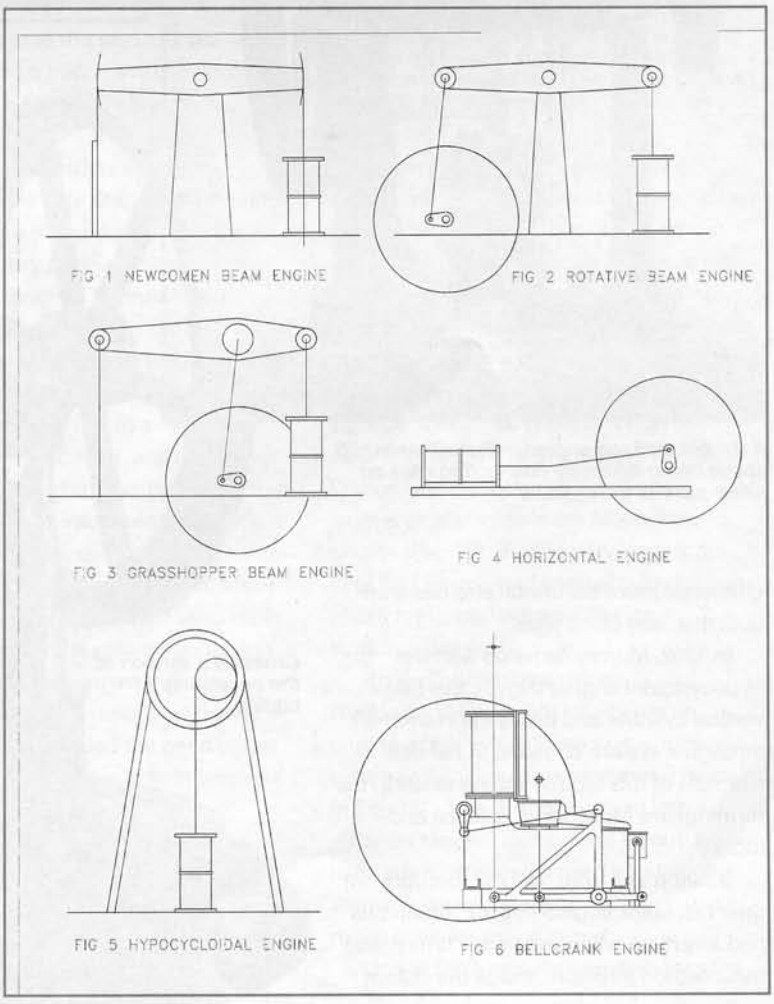
At the beginning of the nineteenth century Watt's patents ran out and development came thick and fast. To continue with beam engines we have the half-beam or grasshopper motion (Fig.3) attributed to Evans. Here the beam is pivoted at one end, the cylinder is at the other end and the connecting rod is positioned about a third of the way along the beam. Used mostly in the smaller sizes, it lasted until the end of the nineteenth century.

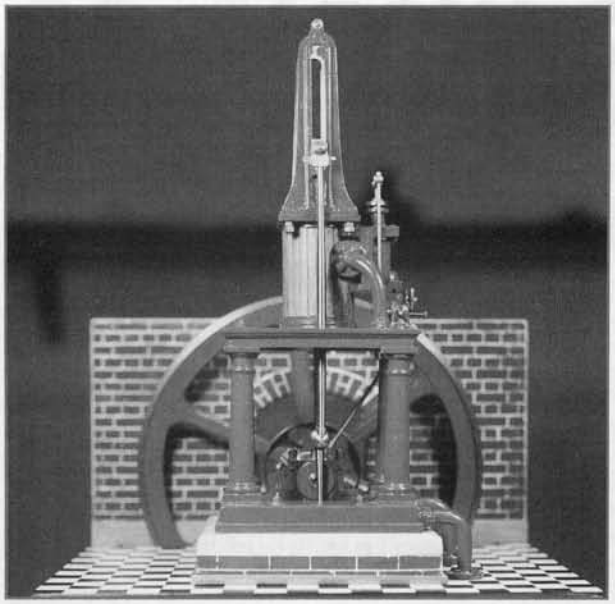
It was also at about this time that Trevithick introduced high pressure steam and the horizontal engine (Fig. 4);



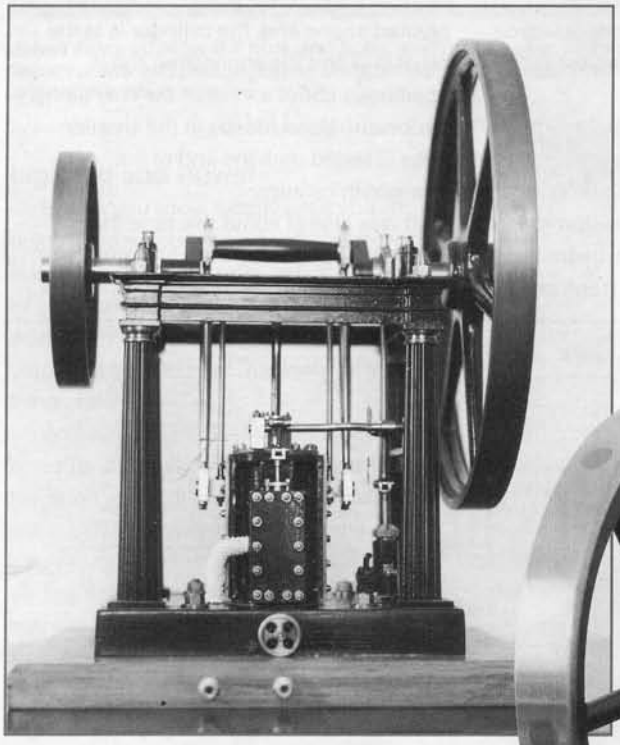


*An example of a half beam, or grasshopper, engine (fig.3) is shown above, while the lower photo is of a bell crank engine .*

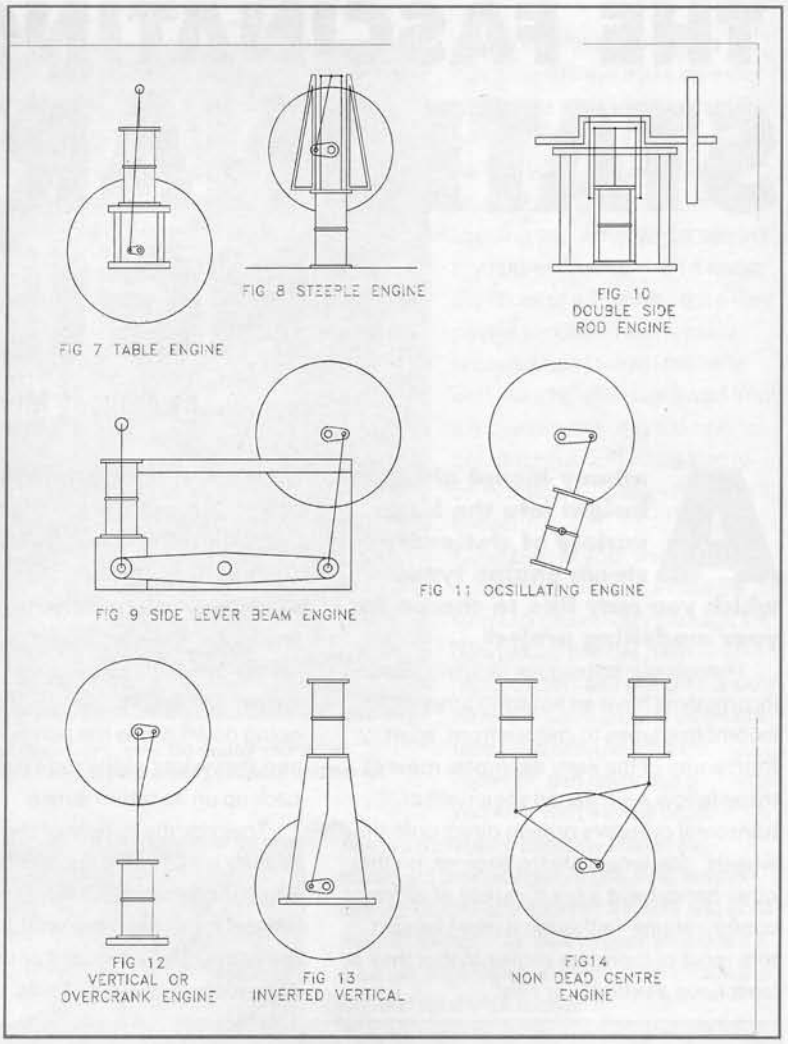




*This side view of a table engine (fig.7) shows the need for additional support of the crankshaft on the outside of the flywheel - hence the supporting wall behind.*



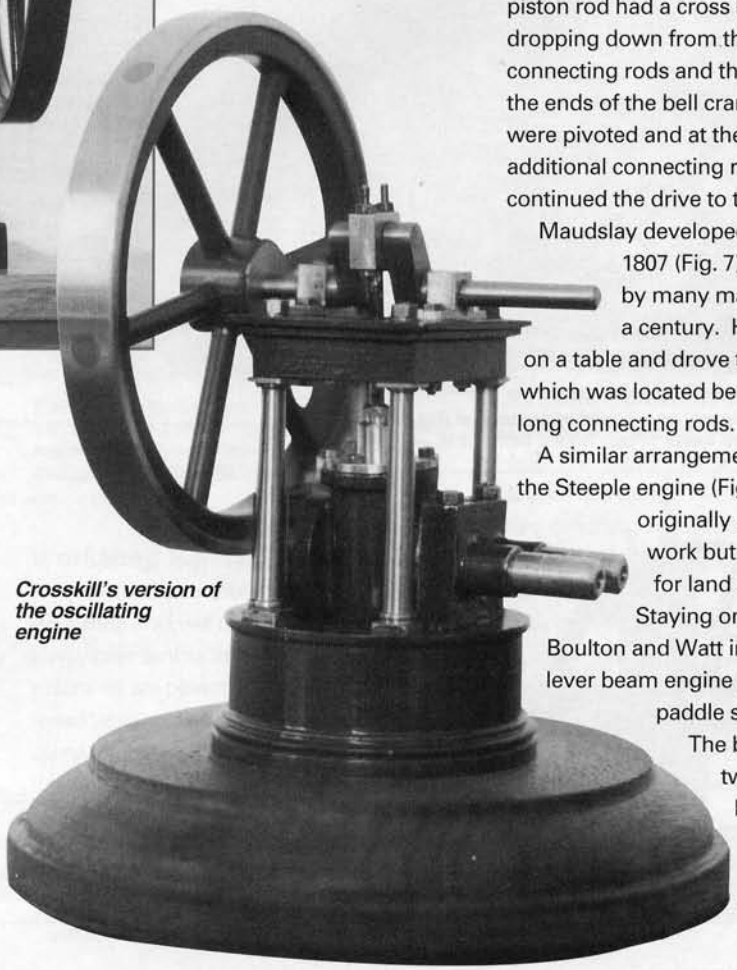
*A double side rod engine with the crankshaft above being driven by connecting rods on either sid e of the cylinder*




ultimately more horizontal engines were built than any other type.

In 1802, Murrey came up with the hypocycloidal engine (Fig. 5), this had a vertical cylinder and drove the crankshaft through a system of gears. A full size example of this type of engine exists in the Birmingham Museum of Science and Industry.

Boulton and Watt, in 1797, brought out their bell crank engine (Fig. 6). Again this had a vertical cylinder, but this time it was mounted on a cistern. Inside the cistern was a condenser and an air pump. The piston rod had a cross beam at the top, dropping down from this were two connecting rods and these connected with the ends of the bell cranks. The bell cranks were pivoted and at the other ends were additional connecting rods which continued the drive to the crankshaft.



*Crosskill's version of the oscillating engine*

Maudslay developed a table engine in 1807 (Fig. 7), which was copied by many manufacturers for half a century. Here the cylinder sat on a table and drove the crankshaft, which was located below the table, with long connecting rods.

A similar arrangement was utilised in the Steeple engine (Fig. 8) which was originally used for marine work but was later taken up for land use.

Staying on a marine theme, Boulton and Watt introduced a side lever beam engine (Fig. 9) for use in paddle ships in about 1827. The beam was split into two and was placed low down on either side of the engine. This, too, was later used for land

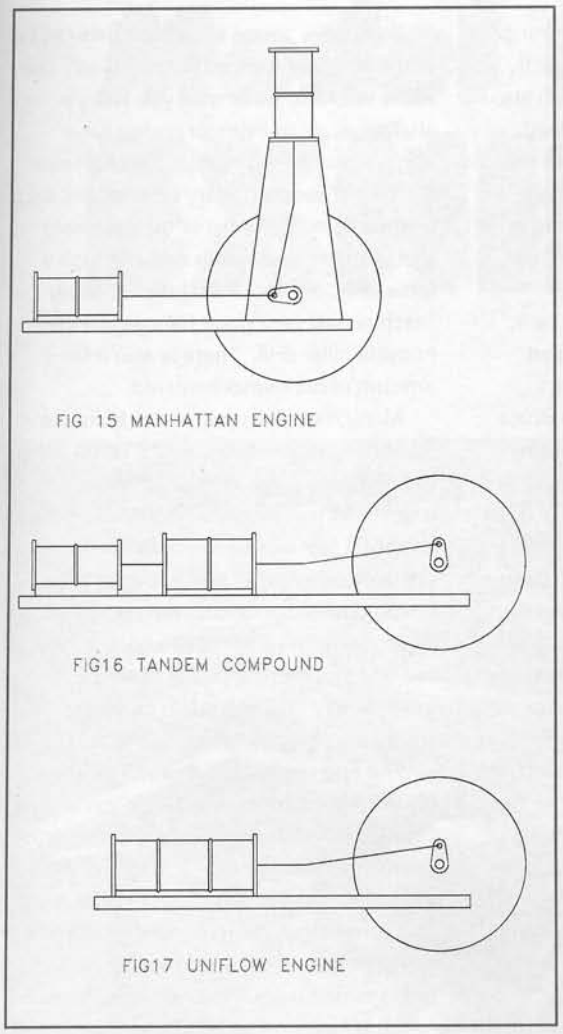
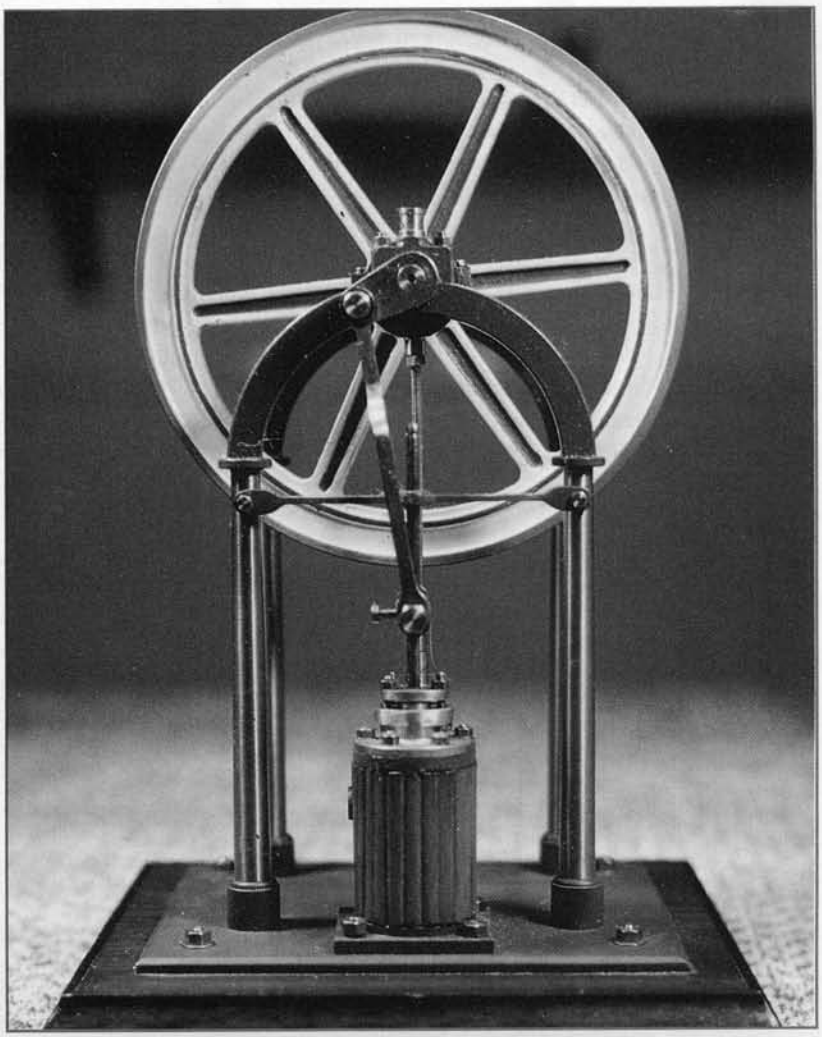


FIG 15 MANHATTAN ENGINE

FIG16 TANDEM COMPOUND

FIG17 UNIFLOW ENGINE



*This photo of an overcrank engine (fig 12) shows the curved supporting beams for the crankshaft and the drive to the valve on the side nearest the camera.*

engines.

A development of the table engine was the double side rod engine by Tuxford's (Fig. 10). Here the cylinder is placed below the table and a pair of side rods drop down from the crossbeam over the cylinder and run in guides attached to the sides of the cylinder. Coming up from the crossheads are connecting rods which drive the crankshaft which is placed over the cylinder. This arrangement obviously necessitates a long crankpin.

A completely different design, and one of the simplest, was the oscillating engine shown in Fig. 11. The piston rod is directly connected to the crankshaft and, as the engine turns, the whole cylinder pivots. Normally used for the smallest engines, it was also paradoxically used for the very largest in marine work - cylinders of up to 100" in diameter were used to drive paddle wheels.

Another simple engine was the vertical or overcrank engine (Fig. 12). Here the cylinder was mounted vertically on the floor and drove upwards to a crankshaft which was often mounted on columns or "A" frames. The connecting rod on this type of engine was usually forked.

Later came the inverted vertical engine (Fig. 13), in this case the vertical cylinder was mounted on a frame and drove downwards to a crankshaft below.

## Multi-cylinder Engines

So far we have only seen single cylinder engines but from the middle of the nineteenth century multi-cylinder engines came into use, both as "simple" and "compound" engine types. "Simple" engines used the same pressure of steam in all the cylinders, whereas "compounds" used the initial steam first in a high pressure cylinder and then, again, at lower pressure in a larger diameter cylinder. This was later developed into three cylinder triple expansion engines and even quadruple expansion engines. Some four cylinder engines were actually run as triple expansion by using the steam in one high pressure cylinder, one intermediate cylinder and two low pressure cylinders. This arrangement avoided the need to use a colossal diameter for the lowest pressure cylinder.

An interesting development was the non dead centre engine shown in Fig. 14, many of these being built by Mugraves. They were inverted verticals of two, three or four cylinders, and the piston rods were connected to a triangular frame which drove onto a single crankpin. They had an advantage in that they would start from whichever position the crankpin was left in (in other words, they were self-starting). Many other engines had to be barred over to position the piston just after dead centre on the power stroke before they would start. A full size example of a non dead centre engine exists in the Northern Mill Engine Society's museum at Bolton.

In a similar vane is the Manhattan engine (Fig. 15). Built to very large sizes, they had an inverted vertical cylinder and also a horizontal cylinder driving a common crankpin.

An evolution of the use of compounding brought into being an engine using two cylinders on a common piston rod, the tandem compound (shown in Fig. 16). This further evolved into a different tandem compound layout which used a left hand and a right hand engine with a flywheel between. This type was much used for mill engines.

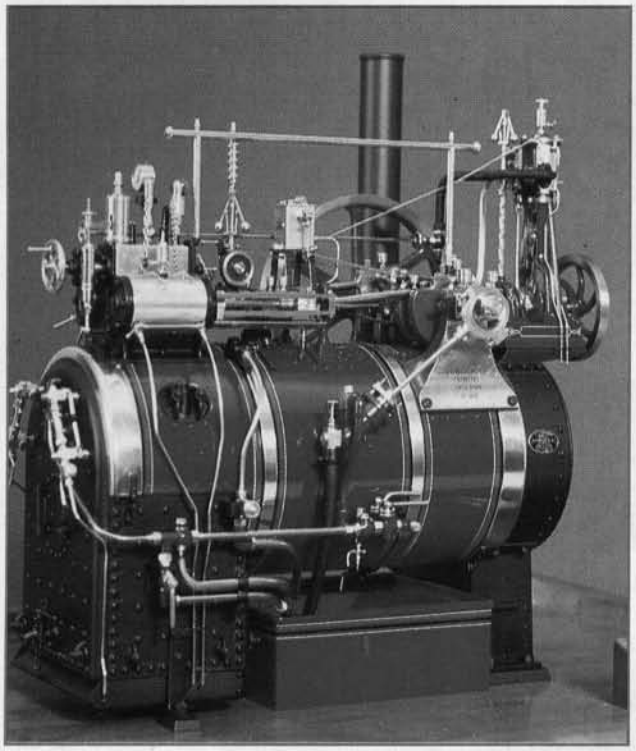
One of the last developments was the ▶

uniflow engine (Fig. 17). Often configured as a single cylinder horizontal engine, the steam was introduced at each end of the cylinder by drop valves but exhausted through a series of holes in the centre of the cylinder. This arrangement required the use of a long piston but these were some of the most economic reciprocating engines ever produced.

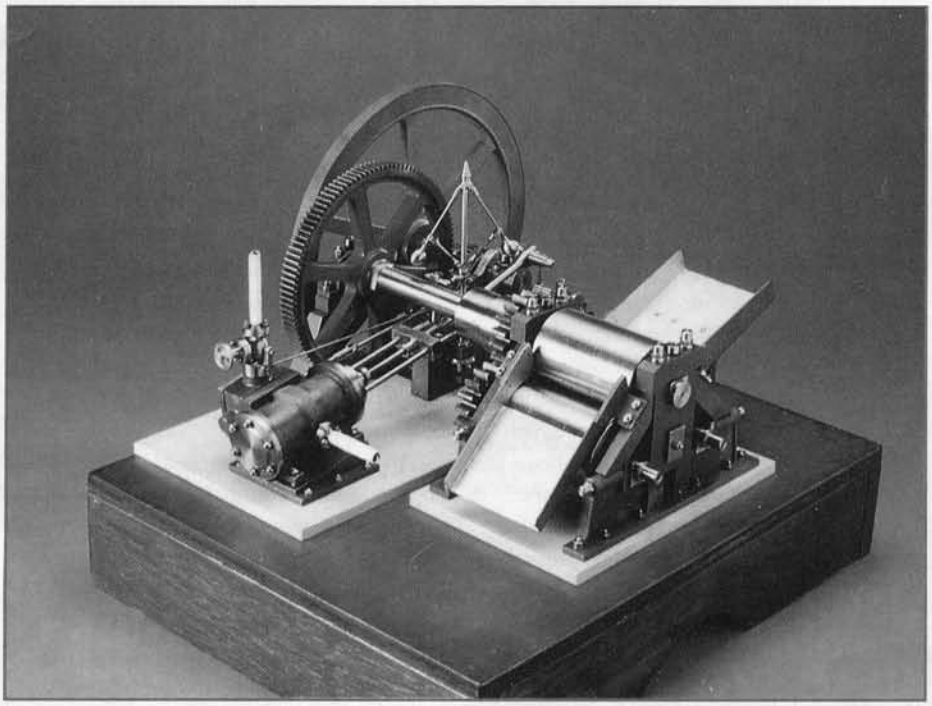
## In Summary

I hope I have whetted your appetite with the examples described above. There were many other designs of stationary engines for use on land, some having very strange arrangements indeed, and I have hardly mentioned the marine engines which also came in all shapes and sizes or, indeed, the rotary engines of which there are also a great variety. So if you fancy building a model of an interesting engine having an attractive motion I can do no more than suggest one of the above.

Examples of grasshopper, overcrank, bellcrank, oscillating, double sided rod, rectilinear, rotary piston and curved cylinder engines are available from Bruce Engineering. Vertical, horizontal, beam, table and grasshopper engines are available from Stuart Models. In addition, A.J. Reeves also do beam engines and Brunel Engineering have a side rod engine, overcrank engine, and the Coomber rotary engine. Southworth Engines have mill and pumping engines. Philcraft, specialising in very small engines, do a beam engine and vertical oscillating and horizontal oscillating engines with boilers.



***Left: Cherry Hill's beautiful model of a Savage Centre Engine mounted on its boiler shows just what may be achieved by the stationary engine modeller.***



***Below is a 1/16th scale model of 10 h.p. inclined cylinder sugar cane mill engine of the type used in the West Indies.***

Stationary steam engine models can be of the simplest design which will only take a few weeks to build or, if you fancy a challenge, multi-cylinder corliss valve engines will keep you occupied for years. Building these stationary engines will also take you through most of the processes met with in engineering and although a lathe will do most of the jobs, a milling machine will be a great help as will the humble pillar drill. There is also a fair amount of handwork involved.

Many modellers just like to build the stationary engine itself, whilst some prefer to build the engine along with the associated machinery which it would have driven. A few excellent examples of complete engine houses showing the building itself containing the engine and its steam plant have also been built, so you can see that there is plenty of scope for individuality and interest in building stationary steam engines as a hobby!

The end result of all this will be several hours of enjoyment in building the engine, coupled with the satisfaction of seeing the engine run and the pleasure in watching the attractive motion of the valve gear etc. as it runs. In addition to this you will also have created a memorial to all those who built the original full size engines, many of which no longer exist and their names are disappearing into the mists of time. Perhaps we can prolong their existence and introduce them to future generations to marvel at their creativity, and maybe inspire them to design new motive power units for the future. ■

## List of useful contacts:-

Bruce Engineering, Hollow Tree, Penny Lane, Walton Bridge Road, Shepperton, Middx. TW17 8NF - Tel: 01923 245529

Brunel Engineering, Maple Works, Northgate, White Lund Industrial Estate, Morecambe, Lancs. LA3 3AZ
Tel: 01524 843270

Philcraft, Springhead Farm, Amberley Road, Storington, West Sussex RH20 4JD
Tel: 01903 742777

A.J. Reeves & Co., Holly Lane, Marston Green, Birmingham B37 7AW -
Tel: 0121 7796831

Southworth Engines, 6 Kennet Vale, Chesterfield, S40 4EW -Tel: 01246 279153

Stuart Models, Braye Road Industrial Estate, Braye Road, Vale,
Guernsey, Channel Islands GY3 5XA
Tel: 01481 49515

# Model Engineering EXHIBITIONS

by Mike Wade

*This view of the International Model Engineer Exhibition was taken from the balcony of the main hall at Olympia and shows a scene which is typical of many such shows.*

**How can you make the most of a visit to a Model Engineering Exhibition? This article gives you some ideas**

How many times have you been to an exhibition and come away totally bewildered? The classic case is when you go to a major show like the Ideal Home Show or one of the big Motor Car Shows (or even the International Model Engineering Exhibitions!) and spend a whole day there wandering around trying to look at everything there is. At the end of the day you end up sitting in a traffic jam, or on the train, on the way home and start thinking about what you have seen at the Exhibition. You will find that you have probably scanned the show but have not actually registered very much in the way of details. It is a form of "shell shock" brought about by the vast number of things on show - your mind just cannot take everything in and just becomes confused. That is all very well if you just wanted a day out, perhaps with the family, but it is not much help if you really wanted to get some information and details on a particular item.

If you are reading this magazine you are probably interested in taking up model engineering, or are maybe looking for a different subject to model by way of a change from your usual interests. One of the most useful ways to find out about the model engineering hobby is to visit model engineering exhibitions. There will be plenty of models on show and the people manning the stands are actually there to answer your questions and to give help and advice. But it is no good just wandering around trying to take the whole show in. The best way is to go to the show with some sort of plan in mind.

## What Do You Want To Model?

If you have got absolutely no idea about what sort of subject will interest you then it will obviously be difficult to prepare a plan but here are some guidelines which may help.

**1.** Visit a good newsagent and look at the various modelling magazines. You should be able to draw up a list of possible interests in this way and the diary section of the magazine will give details of forthcoming exhibitions and shows.

**2.** Buy a couple of issues of the relevant magazine and read it! Try to get some idea of what it is possible to do in that branch of the hobby. Reading the trade advertisements will give you an idea of what is available and whether you will have to make everything from scratch or if some items are available (such as pre-machined castings etc.). You may even find that some books are available which might help with your "research" into the hobby.

**3.** Having decided on a particular area of interest, your next quest should be to see some models of that type and, perhaps, talk to other modellers who are actually involved. A visit to a local club (Secretary's telephone number from your local library) would be well worth while.

**4.** By now you should have a fair idea of what type of modelling you would like to have a go at. Now is the time to go to a model engineering exhibition with a "plan of action" to further your quest for more detailed information.

There are two types of modelling exhibition - the smaller "local" shows where modellers from your own area will be on hand with their models, and the large "National" or "International" shows where the very best models will be on display and there will also be club and trade stands from all over the country. Both types of exhibition are well worth visiting. The bigger shows will have a larger variety of models and the big Traders will usually be present. This type of show is ideal if you are looking to purchase tools and machinery because you will be able to shop around and compare prices and quality.

Don't be put off by the superb quality and workmanship of the models you see at the bigger shows - remember that most of these have probably been made model engineers who have been involved in the hobby for many years and have gained an enormous amount of experience over that time. Everyone had to start from scratch at some time as a "beginner" and I am sure that even the best model engineers will admit to some mistakes and rough work in their early years! ▶

Although the local shows will have a more limited model display and only a few of the smaller Traders, they are also well worth a visit. There is usually a more relaxed atmosphere and less crowds and the stewards on the model stands will have more time to talk to visitors in detail. You will also be able to get closer to the models and a word with the stewards may even give you the opportunity to examine them even closer!

*College Engineering Supplies is one of the specialist model engineering suppliers who sell castings and raw materials for the modeller.*

## A Plan of Action

By now you should have established what branch of model engineering you are most interested in. Let's assume, for this example, that it is model traction engines (although this plan will suit almost any subject). What do you need to know? Well, you need to find out what different types of full size traction engine there were and then decide which type you want to model. Then comes the question of size of the model. What are the usual scales and how big a model will they make? How heavy will it be? What size of lathe will you need? Are there any milling operations involved - if so, can they be done on the lathe? Are any drawings available? What about castings and other raw materials? How long will it take to build the model? Do you want to be able to actually use the model (perhaps for carrying passengers) or will you be happy with a model in a showcase?


*A typical array of machine tools as seen at an exhibition, in this case by Warren Machine Tools. This is where you will be able to get help and advice on what type of machine would be suitable for your needs.*

You can see how all your questions will build up - and there will be more and more of them as you proceed! So, where to start? The answer is draw up a list of queries on a sheet of paper - don't trust it all to memory as you will forget the important ones as you go round the exhibition! Armed with your list and, if possible, a camera and film (any 35mm camera will do as long as you know what its closest focusing distance is) set off for the exhibition with the following itinerary:-

## Stage 1

**1.** Arrive at the show and purchase a copy of the show guide, if there is one. (If there isn't a show guide you will have to skip item 3 below). It is not a bad idea at this stage to politely ask the show organisers if there would be any objections to you using a camera at the show for your own reference purposes. It is most unlikely that you will be refused but it is more polite to ask first.

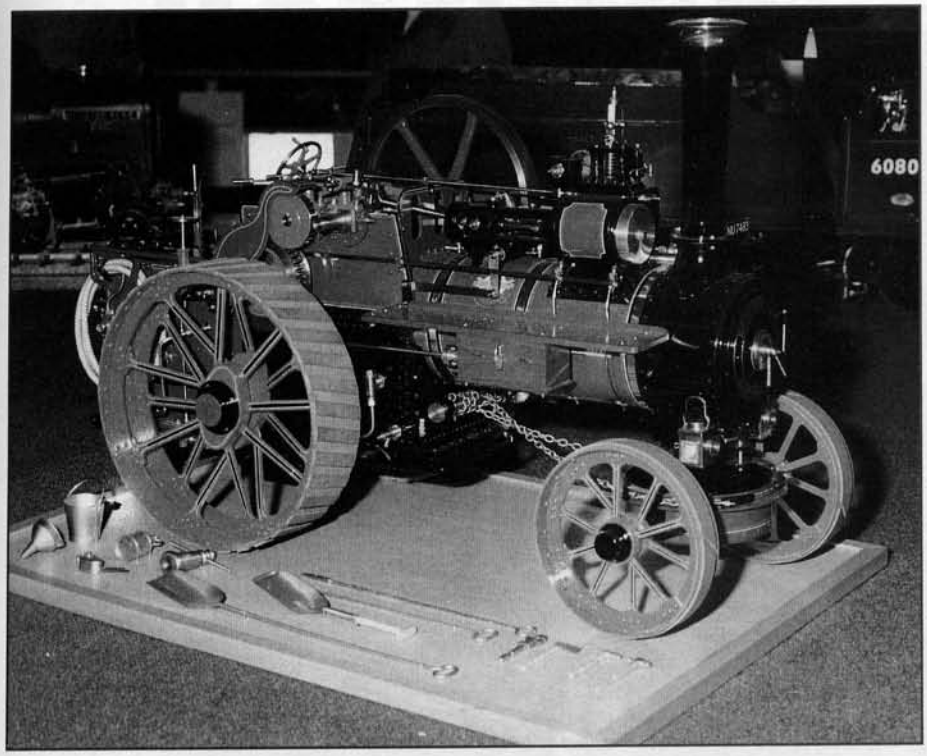
**2.** Avoid the temptation to go in and look at everything first! This may be quite difficult but you will find that it will be well worth it in the end.

**3.** Find somewhere quiet to sit (maybe with a cup of coffee) and look through the show guide, marking off all stands and areas which have some connection with traction engines (or whatever you specific interest is). The exhibition plan is useful for this. Also mark the book stands for later reference.

**4.** Now, after finishing your coffee, you may actually go into the Show and start looking at the models etc. Again, avoid the temptation to look at everything else - doing so will only waste time and prevent you from getting your questions answered.

**5.** Aim for the section with models of traction engines. Show organisers often group similar models together in one area. Have a quick overall look at this section to get an idea of what is there. You may well find at this stage that one or two models draw your interest more than the others - make a note of these in your notebook and return to them later for more detailed examination. (It's not a bad idea to jot down nearby "landmarks" such as a trade stand etc. if the show is a big one - makes it easier to relocate things later).

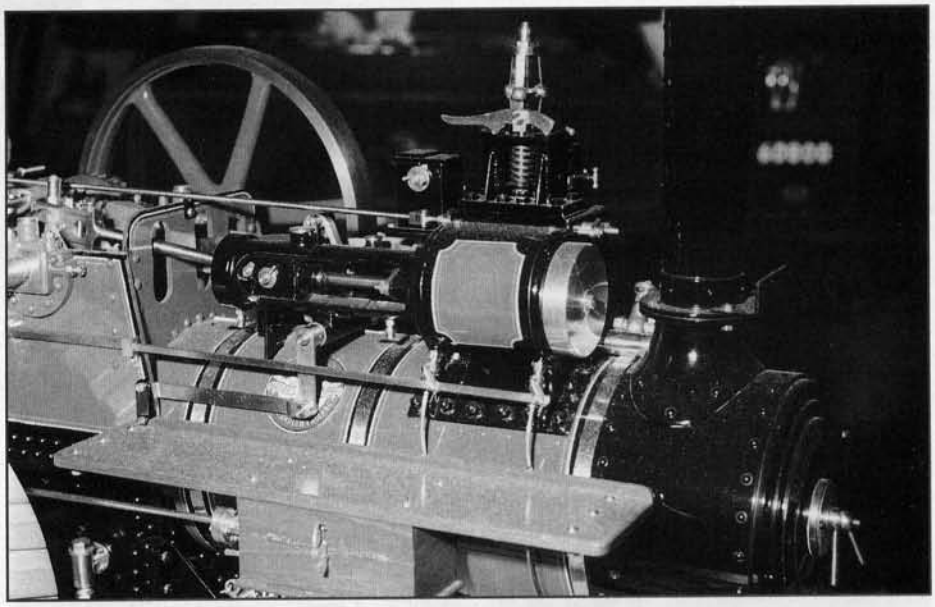
**6.** Now, head for the club and society




*This sequence illustrates the type of photographs to take when you visit a show for information on particular models. First of all take an overall shot of the model (left) and then take closer photos of the details, such as the cylinder and valve gear (below) and the hind wheel and steering column (bottom). These shots will provide handy reference as you build your own model later on.*

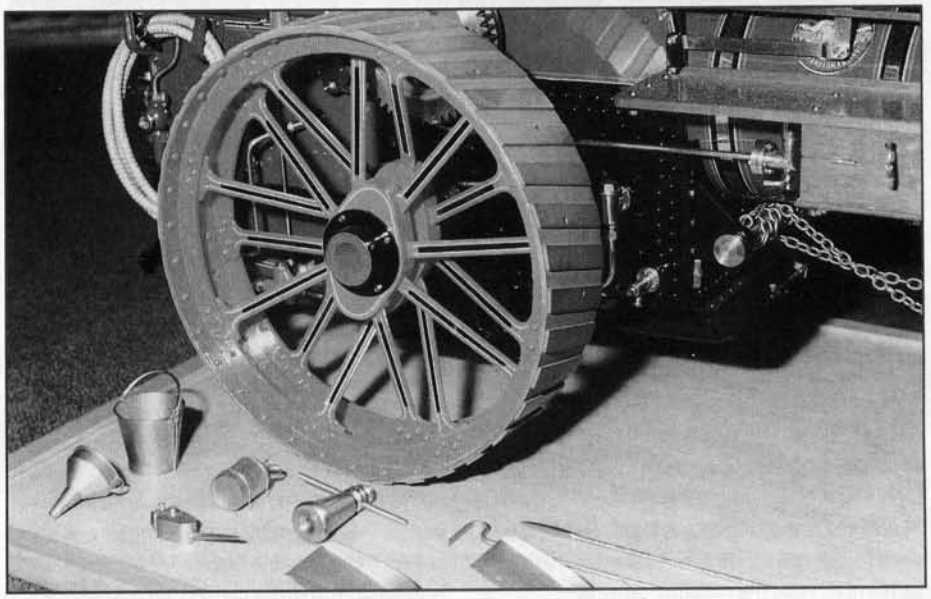
stands and repeat item 5 at each of these stands. Just look for traction engines again and have a quick overall look, noting down any particular models you want to study later on.

You will now be in a position where you have briefly seen most of the traction engine models at the show and will have a list of, perhaps, half a dozen which hold extra interest for you. Take a few moments in a quiet corner to think about those particular models. Why did they register more than any of the others? Was it the size of them or was it the type of engine? Are some of them different models of the same prototype? Your answers to these questions will prepare you for the next stage in the Action Plan.



## Stage 2

**1.** Return to the club stands and choose one of the traction engine models which you found to be of more interest. Ask the club members there if the builder of the model is present or if anyone knows about it. In that way you will get to talk to someone who knows the subject. Now is your chance to ask some of the questions which you have got on your list - i.e. what scale is the model? What size of lathe would you need to build it on? How long did it take to build? Did the builder only work on one or two evenings a week or was he retired and able to work on it "full time"? You will soon get into conversation about the model and the club members will be only too pleased to give you all the help and advice that they can. They may even take it off the display stand so that you can see things more closely. Ask if you may



photograph the model - you will be surprised how much help this can be when you are trying to figure out how things go together later on. The club stands are where you will be able to get the most help about modelling traction engines (or whatever your chosen subject might be).

**2.** By now you will need a break in order to let your mind absorb the wealth of information which has just been crammed into it! So, head for the coffee bar (or whatever your favourite beverage is!) and spend quarter of an hour or so sorting out your thoughts. This process will bring up yet another string of questions, probably about the tools and machinery you are going to need. Don't despair! You will be able to do it but maybe not all at once! At least you will have a better idea about the size of lathe which you will need and whether or not you will need some sort of milling facility. Armed with this information it is now time to take a look at the Traders who sell machine tools. Even if you can't afford to buy one yet or, indeed, will need to buy second-hand, it is still worth having a good look round at what is available.


***A visit to the book stands, such as Camden Miniature Steam Services seen here, will provide a wealth of information on the prototype as well as how to build your own models.***

**3.** Head for the relevant Trade stands and take a look at the machinery. Talk to the people on the stands. Although they are mostly salesmen, they realise that model engineers need to see what is available and get a lot of good advice long before they can actually buy expensive items like lathes etc. Most of the Traders who deal with model engineers will freely advise on what is best for each individual modeller's needs and they will not be "all out" to make a sale at the show. Ask to see the lathes and do ask about anything you do not understand - this is a golden opportunity to see and find out about the many different makes of machinery and to see which will be the most suitable for your particular needs when the time comes. Gather together some literature and price lists from the Trade stands to enable you to study the subject further in the comfort of your own home.

**4.** The last thing to do before you leave the show, if you have time, is to take another look at all the specific models which took your fancy right at the beginning (in Stage 1, item 5) and study them in more detail. Thinking back to our traction engine example, try to remember how the different parts go together and try to figure out how it all works. Can you work out what all the control valves do? Following the pipe runs, if you can see them, will help with this. Take an overall photograph of the model and then take some close-up shots of specific details such as the cylinder assembly, the valve gear, the chimney, safety valves, steering gear etc. Remember that most "compact" cameras can not focus any closer than 3ft. (1 metre) so bear this in mind when taking the close-up shots.

**5.** If you still have some time left, it would be worth a look at the book stands before you leave. By now you will probably be fired with enthusiasm and feel that you really are ready to make a start on building your own traction engine (or whatever). So find the book stands and seek out some of the books on the subject. With the knowledge that you have gained from talking to people at the show you will have a better idea of the subject as you browse through the books. Try to find a "beginner's" type of book and look at it in some detail to see if it will actually be of help to you. Look at the contents page to see what is covered and then pick one particular section to briefly study in more detail. If you find something that will be useful - buy it! It may prove difficult to trace the book through your local booksellers. If you can't afford it - make a note of the title, author's name, publisher and the ISBN number (this can all be found on the fly-sheet at the front of the book). This information will help to trace it later on. Many of the book Traders also operate a mail order service, so make sure you get a note of their name and address as well.

**6.** Now you can leave the Show and make for home with the peace of mind that you have actually achieved something at the exhibition. All the information which you have been given should have registered in your brain in some sort of order and you will be able to recall it later when you need to.

## In Conclusion

I hope that the above plan will be of help when you next visit a model engineering exhibition and that it will help you to collect together all the information you need and will also get some of your questions answered.

Model engineering is a fascinating and very rewarding hobby but it does involve a lot of technical information and needs to be approached in a methodical manner. No-one can be expected to know (or learn) everything at once and it can be quite daunting for the novice when he/she first starts looking into it. Don't be afraid, though, because there is help around every corner and most model engineers will go out of their way to help anyone who needs it.

Above all, do give it a try. I know of many people who have been surprised at what they can actually do once they make a start. Believe me, many things are quite easy once you have a go. Can you remember what you felt like the first time you sat in the driver's seat of a car and wondered what all the pedals and levers were for? And that didn't take you long to get grips with, did it?

So, good luck and happy modelling! ■

# MODELLING HORSE-DRAWN VEHICLES

by David Inkel


*A fine model of the stage coach which used to run between London and Brighton.*

**There is a fascinating variety of different vehicles which were drawn by horses and modelling these can be a most interesting and pleasing hobby ...**

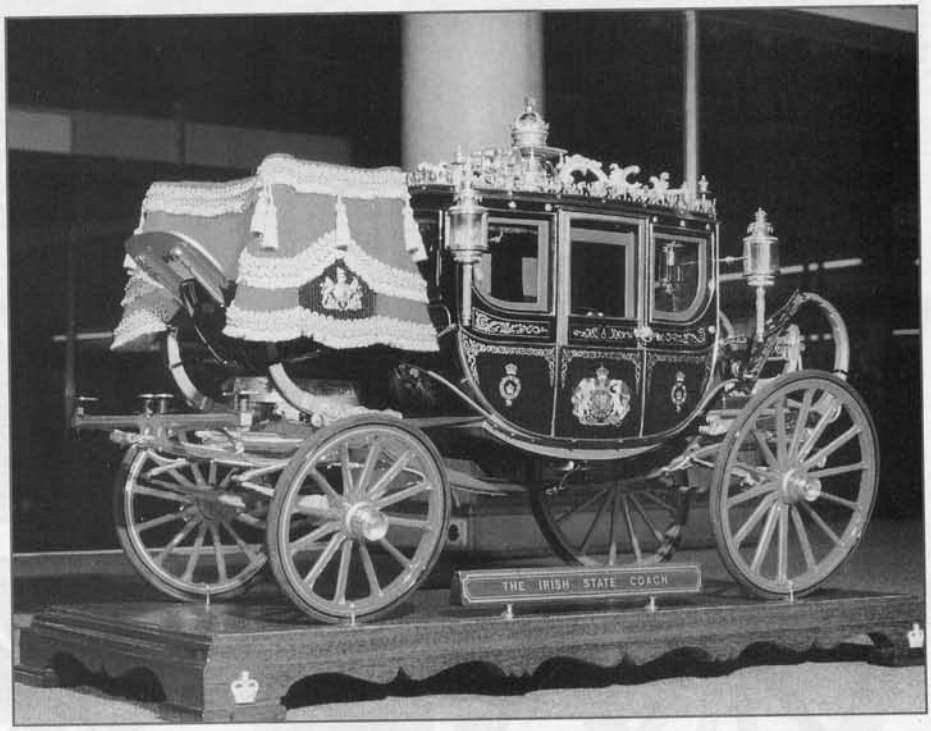
When posing the question "Why model horse-drawn vehicles?", the answer must inevitably include the word "nostalgia" and the satisfaction which results from the reproduction in miniature of one of these fascinating vehicles. This is the same driving force behind the interest in modelling railway engines, sailing ships and other transport of yesteryear, all well supported by commercial industries and clubs. However, modelling horse-drawn vehicles is a minority interest and the final part of the answer to the above question must be "because the hobby needs you!"

The variety of subject matter for the modeller is staggering and would surprise anyone whose only contact with horse-drawn vehicles has been seeing a roadside gypsy waggon or farm cart rotting in a field. Since the early 1970's there has been an upsurge in carriage-driving, together with the collecting and restoration of vehicles. The interest in modelling them also increased in that period and continued to grow thanks to the efforts of John Thompson, David Wray, Barrie Voysey and Lenham Pottery, who between them made commercially available the plans, books, horse carriage and harness parts so necessary to the beginner. The hobby is still principally of a scratch building nature, utilising both metal and woodworking skills.

## Types of Vehicle

Starting with the humble farm waggon and cart, it would not be impossible to find regional types resulting in over fifty varieties. Some of these make ideal first models whilst others have sweeping body lines which require a little more skill.

Gypsy waggons ('caravans') number about six in basic design and - whilst they may hold obvious attractions - as first models they do involve a lot of repetitive carving and much intricate paintwork. Another class of vehicle of moderate difficulty for the modeller is the trade vehicle; almost all tradesmen having had their own specialised type; e.g.: the covered delivery van, milk float, builder's cart, hay cart, fishmonger's, baker's and butcher's carts, brewer's dray, coat cart




*This beautiful model of the Irish State Coach, from the Royal Mews Buckingham Palace, was built by Peter Smith and was awarded a well deserved Gold Medal at this years Model Engineer Exhibition at Olympia.*

etc. These are a good test of the modeller's lettering and lining skills.

Then there are various forms of public transport such as the pair-horse omnibus, the station omnibus, the stagecoach and mail coach, the beloved hansom-cab and the charabanc. As specialist items, the fire-engine, horse-drawn tram and hearse all make interesting but more difficult subjects. There is an abundance of coachman and owner-driven private carriages, some of which are open, some closed, whilst others are convertible. Some are two-wheeled and some four-wheeled. The mixture of these possibilities, coupled with new varieties named after specific maker's improvements, means that there are some two hundred recognised and named types of carriage of British origin alone, according to one of John Thompson's books. Carriage types include ralli-car, dog-cart, wagonette, gig, trap, landau, brougham, barouche, park drag, victoria, break, phaeton, chaise, chariot, curricle, cabriolet, clarence, etc.

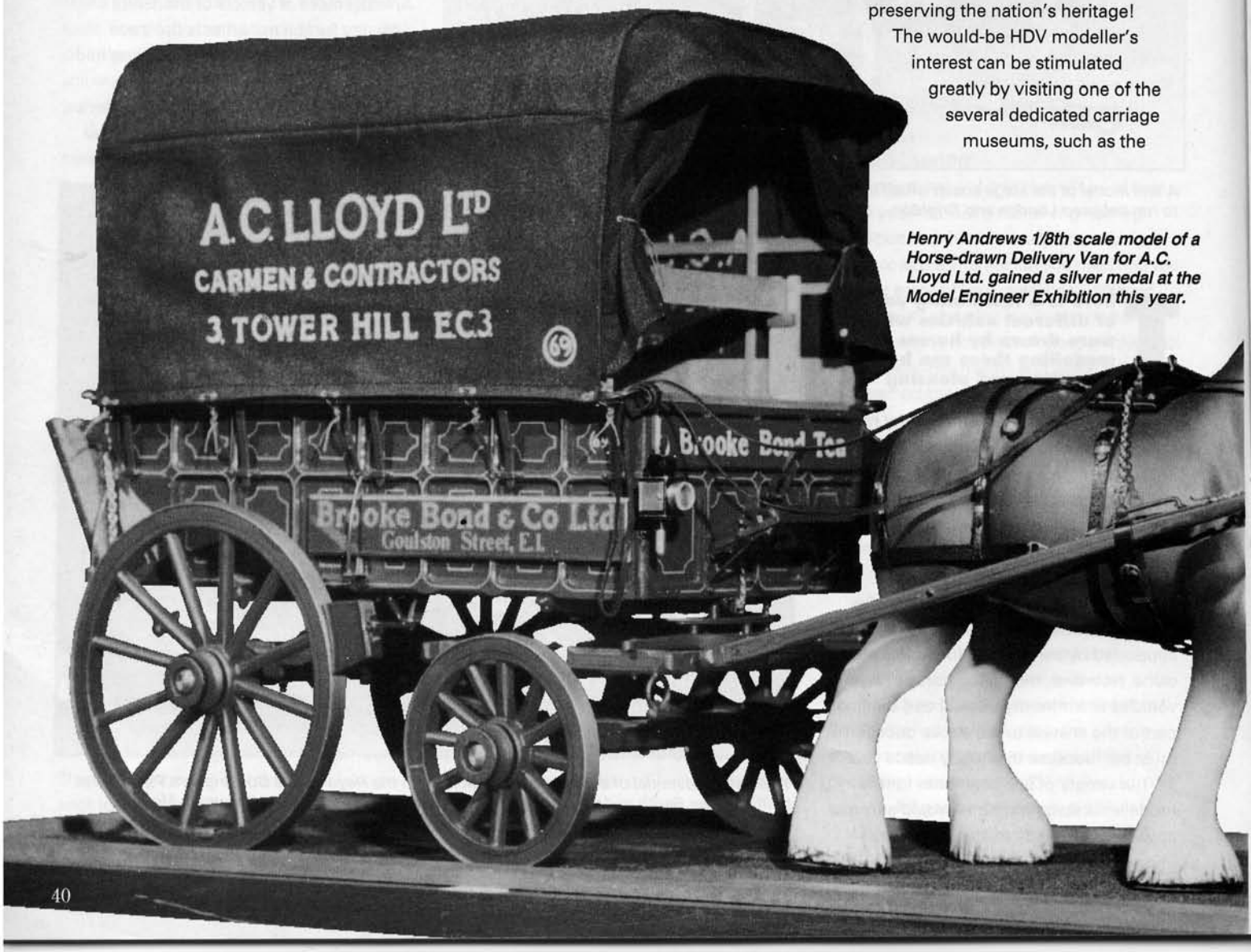
The most difficult carriages for the modeller are the State coaches and nobleman's dress coaches: the best examples of which may be seen in the Royal Mews. If all these types are not enough to keep the modeller happy, he only has to turn to the rest of the world to discover a host of other different and unusual types.

## Scope of the Hobby

There is perhaps more flexibility on offer to the beginner in this branch of modelling than that found when considering a beautifully engineered live steam model locomotive, for example. Behind this miracle of engineering in miniature lies the hidden cost of a competitively equipped machine shop and relatively expensive materials, together with the investment of many hours of work. On the other hand, the horse-drawn vehicle modeller can choose a simple farm cart, built in twenty or so hours using 'scrap' material and the basic skills of the model wheelwright - or, when experienced, turn his hand to a Royal State carriage which could take fifteen hundred hours to complete and involve a good knowledge of the trades of the old-time workmen such as:- sawyers, draughtsmen, body makers, carriage makers, wheelwrights, blacksmiths, spring makers, carvers, trimmers (upholstery), coachpainters, brace and harness makers, heraldry painters, lamp makers and the all important labourers (especially for tea and biscuits to relieve the many hours spent in solitary confinement in the shed!)

In reality, part of the fun and skill is in finding materials and ways to convincingly represent the work of the various trades without actually spending a life-time learning them (!) although the research is itself interesting and is reflected in the accuracy and air of nostalgia apparent in the finished model. The flexibility also extends to that important starting point: the plans. These can be purchased either with pattern sheets showing the shape of each part; or as scale drawings taken from full size carriages etc., which will need interpretation by the modeller in order to determine the true shape and size of individual parts. The third method often involves lying for a couple of days on a cold damp barn floor whilst juggling with pencil, paper, camera and tape measure. This is a test of the modeller's determination and is best countered by the thought that, despite the pneumonia, he is preserving the nation's heritage!

The would-be HDV modeller's interest can be stimulated greatly by visiting one of the several dedicated carriage museums, such as the

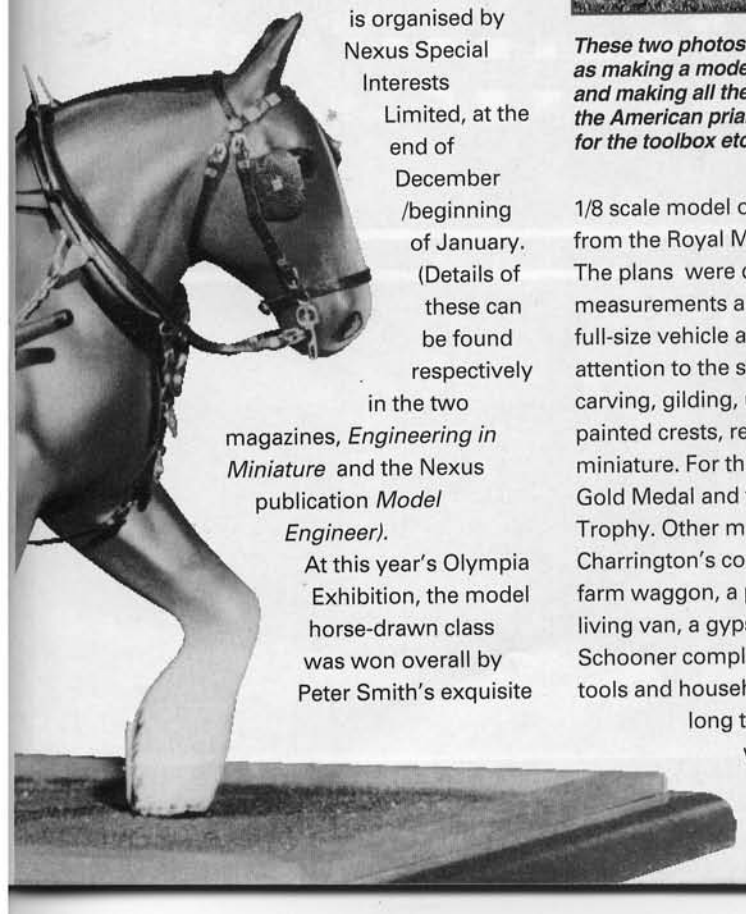



***Henry Andrews 1/8th scale model of a Horse-drawn Delivery Van for A.C. Lloyd Ltd. gained a silver medal at the Model Engineer Exhibition this year.***

Mossman Collection at Stockwood Country Park, Luton; or the Red House Stable Working Carriage Museum, at Darley Dale, Matlock, Derbyshire. Some County museums and stately homes also have small collections, in addition to which there are the less accessible privately owned collections. A modeller showing a genuine interest and appreciation of such vehicles may be able to gain access for purposes of measuring and photography at some of the more public collections by writing to the owner/curator. It is also worth visiting the Reading Carriage Sales, held at Reading Cattle Market by the auctioneers Thimbleby & Shorland, where over one hundred vehicles go under the hammer four times a year. Country fairs and Agricultural shows also have their share of horse-drawn vehicles, both on static display and in competition.

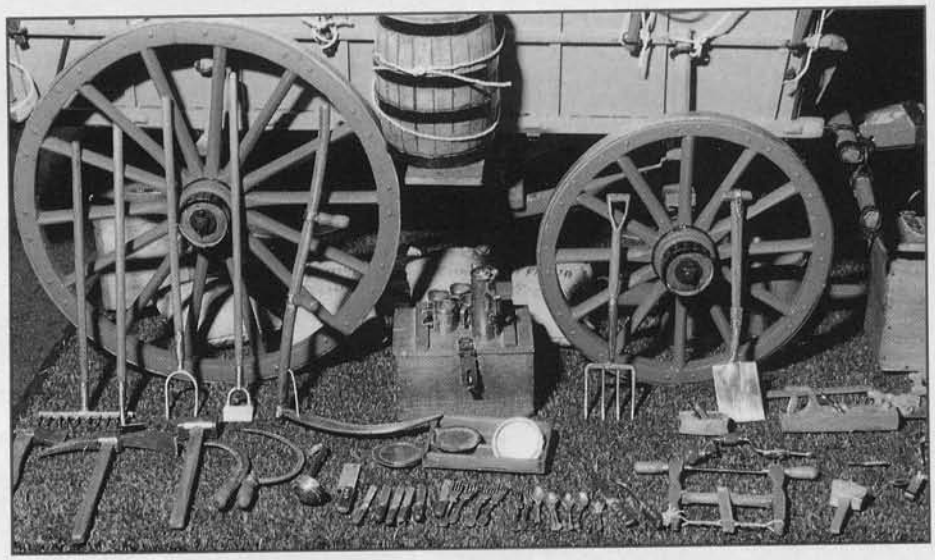
## For Show or Competition

Once the first model has been completed, the new recruit to the hobby has several choices as to what to do with it. Perhaps it will gather dust until inspiration strikes again; or maybe the competitive urge will strike instead, in which case there are two events a year in which he can enter and compete. The first being the Midlands Model Engineering Exhibition, at the National Agricultural College's Royal Show Ground, Stoneleigh, Warwickshire in October, and the second is the International Model Show and Model Engineering Exhibition, at Olympia, which is organised by Nexus Special Interests Limited, at the end of December /beginning of January. (Details of these can be found respectively in the two magazines, *Engineering in Miniature* and the Nexus publication *Model Engineer).*



At this year's Olympia Exhibition, the model horse-drawn class was won overall by Peter Smith's exquisite 1/8 scale model of the Irish State Coach from the Royal Mews, Buckingham Palace. The plans were drawn by him, from measurements and photographs of the full-size vehicle and Peter's careful attention to the smallest detail, be it carving, gilding, upholstery, or hand-painted crests, resulted in a superb miniature. For this, Peter was awarded a Gold Medal and the John Thompson Trophy. Other models included a Charrington's coal cart, a delivery van, a farm waggon, a phaeton, a showman's living van, a gypsy caravan, and a Prairie Schooner complete with over fifty tiny tools and household items needed on the long trek west. This latter model was probably the most popular model with the public.

Non-competitive exhibiting of the models can be another outlet worth consideration and the modeller should contact the Guild of Model Wheelwrights. The Guild is a group of enthusiasts dedicated to the precision scale modelling of horse-drawn vehicles and related items, as an interesting, non-commercial hobby. They exhibit a wide range of members' models, mainly in 1/8 scale, at a variety of country fairs and exhibitions throughout the year, where attending members are willing to discuss techniques, locations of original vehicles, where to obtain modelling supplies, etc. (For further details, contact the Secretary, John Scott on 01727-857327). ■



***These two photos show the wealth of detail put into Timothy Smith's Prairie Schooner. As well as making a model of the schooner itself, the builder has spent very many hours researching and making all the tools and equipment which would have been carried on the journey across the American priaries in the 1850's. Timothy even went to the extent of making working fittings for the toolbox etc. The single furrow plough is a work of art in itself!***