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CLOCKS

Making clocks is a side of the model engineering hobby that everyone seems to admire, and, indeed, why not? There is also something of a tendency to fight shy of clock-making, probably due to the fact that, when one looks at a fine clock the workings all seem so very mysterious, calling for an extremely high degree of accuracy. In point of fact this is not strictly true. Far less accuracy is required in making a clock than is needed to make many models. For example, some model internal combustion engines, the quorn grinder and many other items spring to mind as needing extremely high standards of accuracy. These are certainly not needed in making clocks although, of course, watchmaking is a different matter altogether.

There are certain advantages in clock-making for the modeller working

Gold Medal winner at the Model Engineer Exhibition 1986, Thomas Dance's 8 day striking Bracket Clock is a superb example in all senses.



Clockmaking has always fascinated the model engineer — and it's not hard to see why

in the home. Firstly, the work is comparatively light, and clean! Much lighter workshop equipment is needed. For example, clocks can be made using some of the smaller lathes that are on the market, and, in fact, Cowells even made a special version of their 90 model lathe at one stage with the clock-maker in mind. But even this is not entirely necessary and the ordinary basic lathes can be used quite easily. Benches can be kept clean and, if a section can be covered with green baize, then this will facilitate things no end.

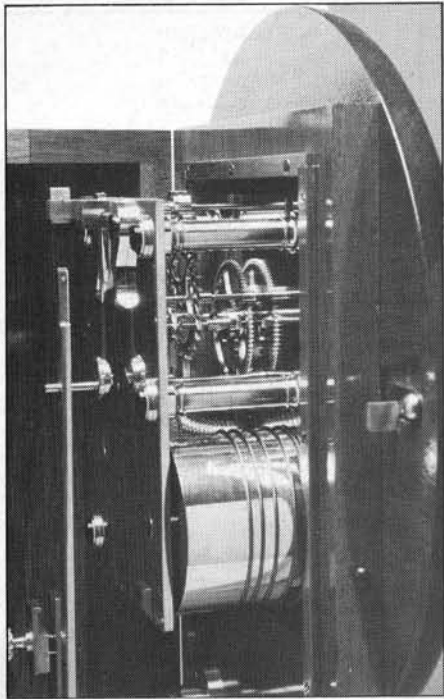
An 8 day Drop Dial Wall Clock by P. Baker of Northampton; simple in its design, but see the interior!

Certain special little tools and jigs will also help but these are usually easily made in the home. Some means of dividing will also be needed in order to facilitate the making of the gear wheels which are, of course, so much a part of clock-making, but even this can be something that uses the lathe change wheels. One other essential is good lighting. Visit anyone who makes clocks and you'll discover they have lights at every possible point. Such lighting need not be expensive to



install; department stores supply Anglepoise lamps which cost no more than a few pounds if purchased without a base. They come with a clamp that enables them to be held to a bench exactly where required. A further aid is a magnifying form of Anglepoise light.

Many modellers have been delighted with the results when they have turned to clock-making, often not realising that it was not going to be a terribly difficult exercise. One such modeller, Ralph Ley, was mainly interested in fine locomotives and traction engines. He has built a grandfather clock, more-or-less as a "joke". At the time he built it he had not been involved in modelling and had only hand tools, hack-saw, files, hand drill, etc. It was with these that Ralph built the clock, everything



being fashioned purely by hand and the divisions on the gears being simply worked out by careful measurement. If anything is likely to offer encouragement to the would-be clockmaker then surely this story does. It proves beyond doubt that clockmaking is not some deep mystical art but simple metal-work. The clock is

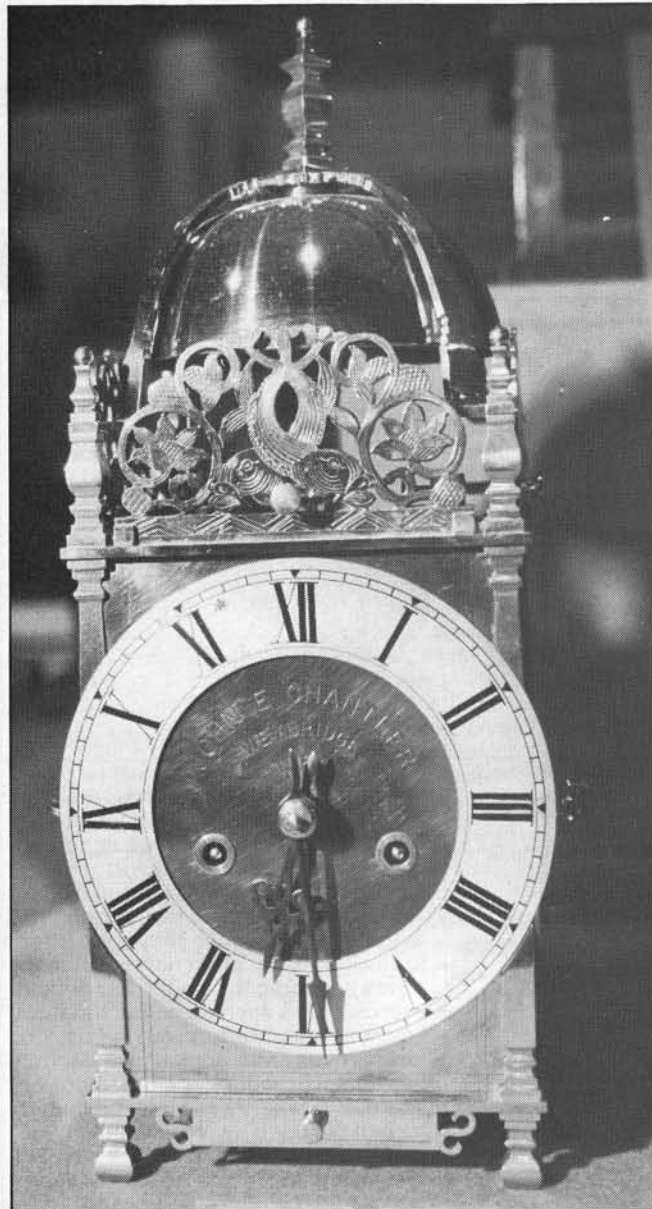
pretty accurate and, no doubt, has given Ralph and his family a great deal of pleasure over the years.

So there it is. For the experienced, or less experienced metal worker, clocks are a highly satisfying pastime. Perhaps those who have not attempted such things before might now be inclined to try ...

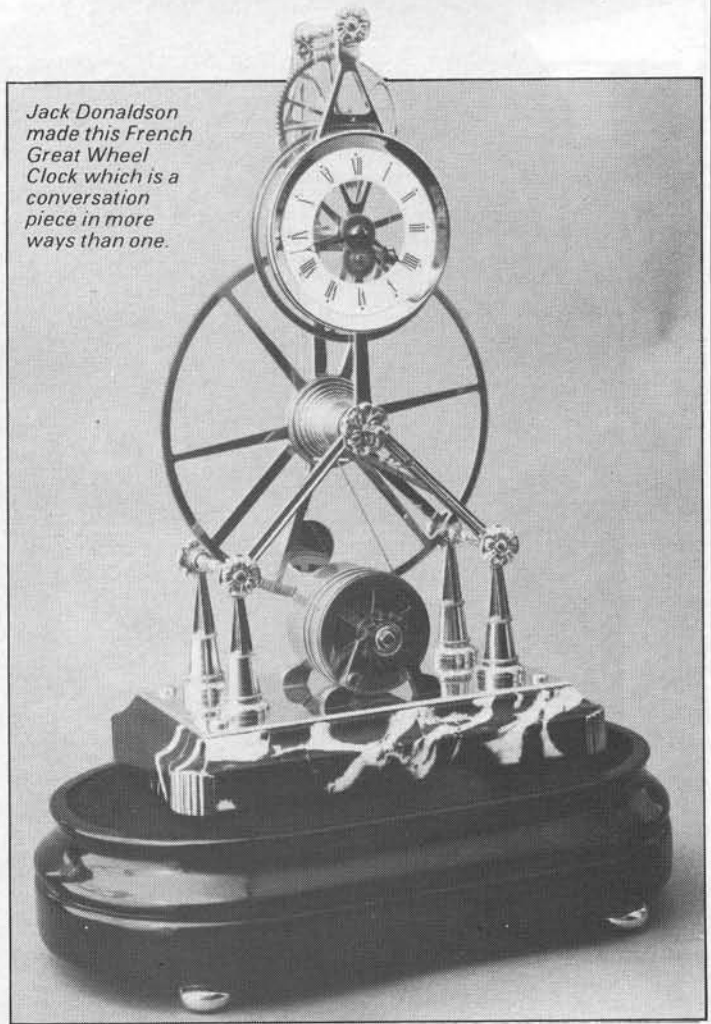
Left: interior of the Wall Clock reveals the motion, and excellent workmanship.

Right: This Bracket Clock has a chronometer detent escapement seen when viewed from the rear of the glass framed case. It was made by R. Stephen.

Below: The Lantern Clock offers full opportunity to the brass worker, in this case, J. E. Chantler of Weybridge.



Jack Donaldson made this French Great Wheel Clock which is a conversation piece in more ways than one.



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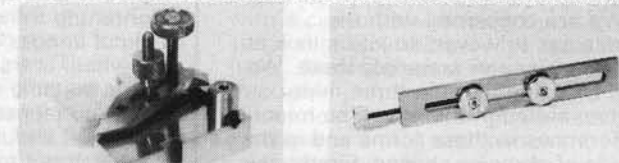
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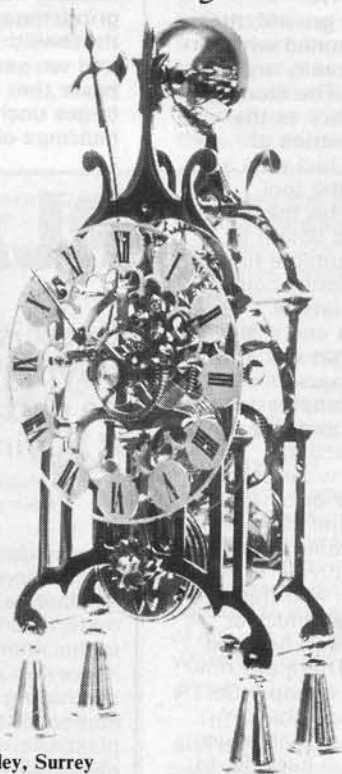
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ABRASIVES

Polishing, sharpening and burnishing are all common model engineering activities

It is quite surprising how many abrasive materials we use in our everyday lives, quite apart from those we use in the workshop. The use of such material is far from new; stone age man is known to have used sand to smooth down tools, etc., that he had made and pumice stone and pumice powder has been in household use for so many years that it is impossible to say when the use of such materials started.

We are concerned with the workshop, however, so let us look at how we use the materials there. We will be using them in three main forms, although there may be minor differences in those forms and in the grade of abrasive chosen. Firstly, the grindstone. This is an abrasive material held together with adhesive and formed into a convenient shape for rotating on a machine. Perhaps that is making it sound somewhat basic, but that really is what it is!

Next are abrasive papers and cloths, such as emery papers and most readers will be familiar with these. A more modern trend is to stick these to rubber discs and use them in that way, or, going a little bit further, the abrasive is sometimes interwoven with a heavy cloth to produce a much more rigid disk that can even be used for cutting metal if so required. Sometimes emery cloth is used in the form of a band and placed on a machine. Finally, model engineers use abrasives in powder or solution form such as grinding paste and metal polish. These are extremely useful for getting that nice final finish on the metal.

There are three main abrasives used for grinding wheels, viz. aluminium oxide, silicon carbide, and white bauxite. All are prepared in the same way, by heating and then crushing to form the range of grain sizes required. Of the three types, the white bauxite is only used for precision grinding; it is very brittle and therefore not suitable for normal grindstone work.

In point of fact, the grades themselves are divided and subdivided many times over and again to discuss them all here would be confusing. For the sake of convenience for home work we usually describe them simply as coarse, medium or fine. Nevertheless, all wheels should carry a code which states the grain size, type of bond, grade, etc., if one takes the trouble to get to know the exact type that is required.

When a grinding wheel is purchased it comes with two paper washers one each side, one probably carrying the data relating to the

wheel. Do not remove these as they are important to the strength of the wheel. If, for any reason, they do become lost or damaged make two new ones from thin card. When fitting the wheel do not over-tighten as this can damage the wheel and cause it to break.

From time to time the wheels should be checked to ensure they are not cracked. A grinding wheel that explodes and flies into pieces is a frightening thing and there is a distinct danger of this happening if the wheel is fractured. If held loosely with a suitable mandrel through the hole, and tapped lightly with a pencil, the wheel should ring. If it does not it is as well not to re-use it on the machine. It will still, however, be useful for working with by hand in certain situations.

Never run a grinding wheel faster than its permitted speed which should be shown on the paper washers at the side and always make sure that the grinder has a suitable guard. Do not run wheels on open spindles and be sure to wear safety glasses while using the wheels. Most cheap grinders sold through DIY shops, etc., lack thrust washers and so the periphery of the wheel only should be used and never the side. Using the side could cause the wheel to break up — remember it is only grit particles held together with adhesive.

When tools have been ground, the cutting edge is usually stoned with an abrasive stone which is really only a very fine flat grindstone. The stoning is, however, very necessary as the grinding wheel, being a series of small particles of grit, in fact puts a rough or pitted edge on the tool. Minute as those pits may be, they need to be removed in order to obtain a good finish and here a suitable fine stone should be used. Stones come, like grindstones, in a variety of grades, sizes and shapes and it is worth getting a couple that will suit the tools you are likely to use.

Abrasive sheets are graded similarly to grinding wheels. Wet and Dry papers being bonded to special waterproof paper with a waterproof bond. This enables water or oil to be used with the abrasive and can result in an enhanced finish. Paper or cloth should always be used with a backing pad of some sort and this can take the form of a wooden block or strip. Alternatively, they can be used folded over a hand file. There are now some excellent and very cheap little plastic holders available on the DIY market which are used with abrasive sheets that have adhesive backing. In my experience, they work very effectively.

Sometimes it is convenient to lay the abrasive sheet on a flat surface such as a piece of plate glass or a surface paper and rub the work on that. There is invariably a danger of a rocking motion setting up when working in this way and so components should be rubbed over the sheet in a figure of eight motion to prevent this happening.

Powder and liquid abrasives are used in a variety of ways, the fine ones such as metal polish purely for getting a very fine finish on the work. Grinding paste can be very useful for finishing in awkward places as, for example, in the case of the flutes on a coupling rod. If a piece of wood is roughly trimmed to fit the flute and then grinding paste is rubbed up and down the flute with the wood, a satisfactory finish will result. After a short period the wood takes up the exact shape of the metal and so the grinding paste is going exactly where needed. Two or three progressively finer grades of paste plus some metal polish will result in a very high finish.

Operations involving the use of abrasives should be carried out as far away from other machinery as possible. It does not take much imagination to realise that, when any abrasive material is being used, minute particles of abrasive are breaking away continually from the backing material or from the grindstone, as the case may be. Mix these with the oils from the machine and we get a highly effective grinding paste that will cause wear if allowed to get unchecked into the slides and bearings of workshop machinery. ■

PLASTICS

Exercise caution when buying secondhand and be certain of your needs if buying new

In modern engineering there is a growing tendency towards the use of plastics instead of more traditional materials. There are many advantages in this. In many cases the cost is much lower (but not always, by any means), machining if required is easier and components are much lighter. Some plastics are extremely strong; for example, the Unimat 1 lathe, whilst only small and completely made of plastic, is very tough and capable of working in a small way as a true lathe. However, we are more interested in

Electric Motors

The growing use of man-made materials has solved a variety of modelling problems

Having previously stressed the idea of both making one's own workshop equipment and possibly buying second-hand machinery, I believe a word or two on the type of electric motor likely to be needed to run these items would not come amiss.

There are a great many motors on the market and there is also a lively second-hand market in them as well. The most obvious thing to check when buying a motor, whether new or second-hand, is that it is designed to work at the correct voltage. This may sound rather obvious but there have been many cases of motors bought already fitted to machines that were not of the correct operating voltage.

The second thing one needs to know is whether or not it will have the power to do the job. It is hard to give a ruling on what is enough power. The average 3 in. centre height lathe needs a motor of at least half a horse-power, a small milling machine a quarter horse-power or more, a power saw needs a similar amount of power while a bench grinder or a cutter grinder needs about one sixth of a horse power. These figures are, naturally, flexible, but they are a reasonable guide.

Secondhand

If buying a second-hand motor then the obvious thing is to ensure that it works! Not just that it will start up, but that it will run under some sort of load for a period of time without undue heating. Having said that, most motors run quite hot, but if you smell burning then you could have trouble.

the forms of plastic that are available as rod or sheet material from which we can make components and which we will use mainly either for their insulating properties or their very low friction. There are number of machinable plastics that can be very useful to the model engineer and it is as well to know what they are and what they do.

Nylon

First came to notice as a material from which ladies' stockings were made and brought to this country by American soldiers! It was soon to be used for other purposes, though, and next became notable when used as bearing bushes in cars, washing machines, etc., thus obviating the need for regular greasing. Older readers will well remember the days before its use when Sunday mornings had to be spent under the car searching out grease nipples placed at the most awkward points. As far as model engineering is concerned, it can be used for bushes where too much heat will not be generated, such as on tools and

Check that the casing has not rusted away, and that the terminals are in good order without a lot of frayed wire attached to them. The motor, if it is required to be reversed, should feature four terminals as, of course, should a motor purchased new if it is to be reversed.

Shaded pole motors tend to run very hot and frequently run in reverse direction to that which we require. Reversing them is possible but it means completely dismantling the motor and re-assembling it end for end in relation to the stator. They will not run on D/C current. Shaded pole motors are frequently found in old washing machines — in fact, all old washing machine motors should be treated with caution if considering purchasing one. Series wound motors are not suitable for the purposes we have in mind either.

Second-hand machinery will often be found to be fitted with a three-phase motor which can be a problem since household electricity is single-phase. However, it is possible to run a three-phase motor on single-phase electricity and Camden Miniature Steam Services can supply a book on the procedures required. If one is considering the use of three-phase motors it might be as well to invest in a three-phase converter, a device that will convert the current in your workshop into three-phase.

Considering three-phase electricity in the very briefest of terms, we are looking at a system where there is an extra positive current. We therefore have three wires plus an earth rather than the normal two. This extra wiring

allows for much easier starting of electric motors, particularly in the case of large motors, where a great deal of energy is needed in starting. Special types of fittings to the normal household variety are also necessary with three-phase systems.

Quarter horse!

Because of this heavy starting current, motors of a quarter horse power or over should always be fitted with a capacitor to absorb the starting surge that would otherwise blow the fuses. Motors should always be wired through a proper starting switch with an overload protection; just wire a machine to a plug and switch the socket on and off a few times and you will quite likely find that the terminals in the socket have welded themselves together!

Purchase a reasonable motor with a capacitor start and four terminals for reversing if required and you will not go far wrong. If you have any real problems then look up your local electric motor repair agent in the yellow pages! I have always found them very helpful and often they have spare motors that they will let you have for a reasonable price. ■

machines and it's also useful for making handles for fittings. No doubt there are many other uses as well; it machines nicely and can be glued with epoxy resins.

Acrylic

Largely used for glazing purposes, it is difficult to work with being very brittle. It can, however, make very good handles for machinery.

Polystyrene

Small plastic model kits are made of this. Some types are very brittle but others quite soft. In sheet form it is useful for preventing marking of components by steadies where it can be fixed to the steady jaws with a touch of solvent and is easily cleaned away when the work is completed.

PTFE

This is widely used for bearings, etc., and is particularly suitable for making washers for steam fittings as it expands with heat. In view of that fact, bearings, etc., made from it should be a somewhat sloppy fit so that as they warm up they take up on the shaft.

Care must be taken when machining it since, at high temperatures, the material will decompose and produce phosgene gas which is poisonous. Smoking when using it is a very dangerous practice since a touch of hot ash is all that is needed to produce the gas. It is sold in tape and strip form for sealing water fittings and is highly effective for this purpose.

Acetal

A very tough plastic material somewhat similar to nylon. It has better machining characteristics and does not distort readily with heat. It is useful for bearings and washers.

Tufnol

A general-purpose plastic that machines well and is useful for making handles of components. It is heat resisting.

Most model engineers suppliers carry some plastics in stock, some very expensive, particularly in larger diameters. College Engineering Supply specialise to some degree in plastic and carry quite a large stock. ■



METRICATION

Metrication of the measuring system has been with us for some time, but is not fully adopted. When we converted to decimal coinage a set period of acceptance time was announced and, by the end of that period, the change was completed. Metric measurement is a very different subject area. Changing over to a time limit would mean that many manufacturing firms would be left in a position of having machines which work in Imperial standards, whilst trying to turn out work with metric measurements. Not to be overlooked either is the fact that the USA, with whom we carry on a not insignificant amount of trade, have not changed, and do not look like changing to the metric system.

Let us look at what is involved for the modeller in the two systems. We will start with the model engineering side as it is here that most difficulty is incurred, although all forms of modelling have their problems. The most accurate way of measuring when machining has to be done is to let the machine which has been made to a very high standard of precision do the work for you. The various slides that move backwards and forwards and up and down on machinery operate as a result of the turning of a lead screw, and therefore in order for any machine to work there has to be one or more lead screws. The travel of that lead screw decides how much material is taken from the work by the machine because it decides how much those components move.

Manufacturers make the lead screws to set pitches. This means that

Confusion on the grand scale lies in wait for the modeller who mixes his measurements

a complete turn of the screw will make either the tool or the work travel a set distance. It follows that, if the lead screw is a metric pitch, the travel and therefore the measurement will be a metric distance. For example, suppose the screw has a pitch of 1mm. In this instance one rotation of the screw will give a travel of 1mm. Likewise if we have a pitch of 1/10th of an inch then one rotation will produce a travel of 1/10th of an inch. The craftsman therefore sets his work so that the tool is precisely at a specific point known to him. By counting the number of revolutions of the lead screw he knows exactly how much metal has been cut from the work.

Suppose he is milling and sets things so that the edge on his cutter is exactly touching the edge of the work. Then, if the lead screw is rotated ten complete times on the Imperial machine, exactly one inch has been cut from the work. Similarly, if he uses his milling machine, or his lathe come to that, to drill a row of evenly spaced holes in a piece of metal, by counting the number of revolutions or part revolutions that the screw is turned, the operator can space his holes far more accurately than he ever could by measuring with, say, a rule and dividers.

If the above paragraphs are fully understood, then the problem with the two types of measurement start to be

appreciated. There are 25.4 millimetres to an inch. If we have an imperial lead screw and want to arrive at a measurement of 35 millimetres, say, life starts to become rather difficult. To get it exactly right the screw would have to be revolved 1.1811023 times! The same situation arises in reverse when using a metric machine to get an Imperial measurement.

The answer is to decide, if possible, whether to work in Imperial or metric and to stick to the one — at least for that particular job. Never attempt to perform one part of a job as a metric measurement and another as imperial. Similarly, if you decide that you are going to build a model and the plans are Imperial, stick to that form of measurement. And if you own a metric machine, make all your measurements by outside means if building an imperial design.

Materials still come in either metric or Imperial sizes in most cases, but there are, however, exceptions. For example, it is not now possible to purchase steel angle or sheet material in Imperial measurements, only in metric sizes. Strangely enough, brass is still, at the time of writing, available in angle form in Imperial measurements. Quite a few of the model engineering stockist are now carrying both metric and Imperial sizes when it comes to bar and flat materials so it is still possible to get what you want. It is not unknown, however, to go to a steel stockist who does not specialise in model engineering supplies and to receive metric material when Imperial sizes

Imperial Threads per inch								Imperial Threads Metal Conversion							Nearest Metric Threads						
O/D Imperial	Thread Types & TPI							Pitch Metric							O/D O/D MM	O/D MM	Coarse Pitch	TPI	O/D Imp	Metric Pitch	Fine TPL
	BSW	BSF	UNF	UNC	ME	ME	MS BSB	BSW	BSF	UNF	UNC	ME	ME	MS BSB							
1/16	.0625	60	—	—	—	—	—	0.42	—	—	—	—	—	—	1.58	1.6	0.35	72.57	.0630	—	—
3/32	.0938	48	—	—	—	—	—	0.52	—	—	—	—	—	—	2.38	2.5	0.45	56.64	.0984	—	—
1/8	0.125	40	—	—	—	40	—	0.63	—	—	—	0.63	—	—	3.175	3.0	0.5	50.5	1.181	.35	72.57
3/32	.1562	32	—	—	—	40	—	0.79	—	—	—	0.63	—	—	3.968	4.0	0.7	36.28	.157	.5	50.5
7/64	.1875	24	32	—	—	40	32	1.05	0.79	—	—	0.63	0.79	0.976	5.333	5.0	0.8	31.75	.1969	.5	50.5
1/32	.2188	24	28	—	—	40	32	1.05	0.903	—	—	0.63	0.79	0.976	5.556	—	—	—	—	—	—
1/4	.250	20	26	28	20	40	32	1.27	0.976	0.901	1.27	0.63	0.79	0.976	6.35	6.0	1.0	25.4	.2362	.75	33.8
5/16	.3125	18	22	24	18	40	32	1.41	1.154	1.05	1.41	0.63	0.79	0.976	7.8125	8.0	1.25	20.32	.3150	1.0	25.4
3/8	.3750	16	20	24	16	40	32	1.58	1.27	1.05	1.58	0.63	0.79	0.976	9.575	10.0	1.5	16.93	.3937	1.25	20.32
7/16	.4375	14	18	20	14	40	32	1.81	1.41	1.27	1.81	0.63	0.79	0.976	11.112	11.0	1.5	16.93	.4331	—	—
1/2	.500	12	16	20	13	40	32	2.11	1.58	1.27	1.95	0.63	0.79	0.976	12.70	12.0	1.75	14.51	.4724	1.25	20.32
9/16	.5625	12	16	18	12	—	—	2.11	1.58	1.41	1.58	—	—	—	14.28	14.0	2.0	12.7	.5512	1.5	16.93
5/8	.6250	11	14	18	11	—	—	2.30	1.81	1.41	2.30	—	—	—	15.87	16.0	2.0	12.7	.6299	1.5	16.93
11/16	.6875	11	14	—	—	—	—	2.30	1.81	—	—	—	—	—	17.46	18.0	2.5	10.16	.7087	1.5	16.93
3/4	.750	10	12	16	10	—	—	2.54	2.11	1.58	2.54	—	—	—	19.05	20.0	2.5	10.16	.7874	1.5	16.93

These charts show the comparisons in diameters and pitch on threads per inch (TPI) between Imperial and metric threads. Reference to it will allow correct selection of threads. Please note they are comparison charts not conversions.

British Association (BA)					Metric Coarse				Metric Fine		
No.	Dia. mm	Pitch mm	Dia. Imp	TPI	Dia. mm	Pitch mm	Dia. Imp	TPI	Dia. mm	Pitch mm	TPI
16	.79	0.19	.031	133.3	—	—	—	—	—	—	—
15	.89	0.21	.035	120.5	—	—	—	—	—	—	—
14	.99	0.23	.039	109.9	1.0	0.25	.039	101	—	—	—
13	1.18	0.24	.047	102	—	—	—	—	—	—	—
12	1.3	0.28	.051	90.7	1.2	0.25	.047	101	—	—	—
11	1.5	0.31	.059	81.9	1.4	0.3	.055	84.6	—	—	—
10	1.7	0.35	.067	72.6	1.6	0.35	.063	72.5	—	—	—
9	1.9	0.39	.075	65.1	2.0	0.40	.079	63.5	—	—	—
8	2.2	0.43	.087	59.1	2.2	0.40	.086	63.5	—	—	—
7	2.5	0.48	.098	52.9	2.5	0.45	.098	56.4	—	—	—
6	2.8	0.53	.110	47.9	3.0	0.50	.118	50.8	3.0	0.35	72.57
5	3.2	0.59	.126	43.0	—	—	—	—	—	—	—
4	3.6	0.66	.142	38.5	3.5	0.60	.138	42.3	3.5	0.35	72.57
3	4.1	0.73	.161	34.8	4.0	0.70	.158	36.3	4.0	0.5	50.5
2	4.7	0.81	.185	31.4	4.5	0.75	.177	35.9	4.5	0.5	50.5
1	5.3	0.90	.209	28.2	5.0	0.80	.197	31.8	5.0	0.5	50.5
0	6.0	1.00	.236	25.4	6.0	1.00	.236	25.4	6.0	0.75	33.8

have been asked for. The differences are small and likely to go unnoticed until parts have to be assembled, so take care that you know exactly what material you are getting.

Many Imperial tools are now only available at a premium; number-sized drills, for example, are very expensive indeed. Metric alternatives are much cheaper and, as usually such drill sizes are only used for tapping, the metric size will do just as well. I know of instances where to go to a shop and ask for a number drill will result in the receiving of a metric equivalent with nothing being said. Probably no harm is done, but take care if for any reason a particular size is required.

Threads, too, are changing. At one time in England we used British Standard Fine (BSF), Whitworth (BSW), British Association (BA), British Standard Brass (BSB), British Standard Pipe (BSP), and several others as well. The Americans have Unified Coarse (UNC), as well as Unified Fine (UNF), the latter available in imperial sizes as well as a number system. There are also special fine model engineer threads with pitches of thirty-two or forty to the inch, and not so long ago sixty and eighty threads to the inch were also easily available. What a mess it all really was!

The BA sizes were based on a metric thread and were handy because various small sizes, suitable for the modeller, could be obtained. These are still available as are the model engineer sizes. I certainly would not at this stage advocate dispensing with the model engineer threads but the BA sizes can easily be replaced with metric. Even if one is working to Imperial measurements, there is no reason why metric threads

should not be used. Taps and dies are certainly cheaper than are their Imperial equivalents.

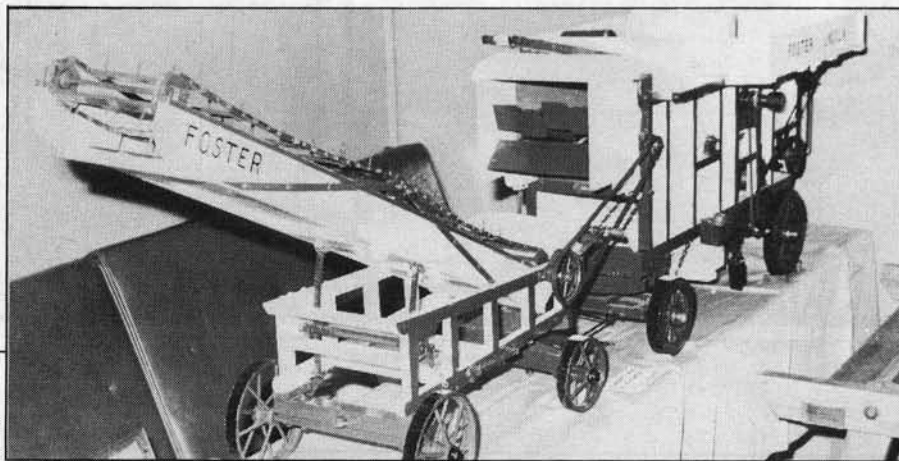
Unfortunately, most of the old designs and, indeed, more recent ones as well, still specify BA sizes. As long as the outside diameter is right and the pitch of the threads about the same it is not necessary to stick to the sizes of threads given in a design. Should you decide to use BA sizes, then drill with metric drills. Strangely enough, the BSP thread still remains popular and no serious attempt has been made to replace it. For those who do not know anything about it then the sizes refer to the size of pipe and not the thread size — a somewhat confusing situation, but one that seems to do no harm to those who use it!

It seems that, in the course of time, the change will be made in model engineering to metric measurement — a mammoth task, as it will mean

that all the existing plans will need conversion. It is not possible simply to convert measurements alone as we end up with such odd sizes that they are impossible to work to. I suppose someone at some time will have to redraw all the models, but what an enormous task it will be! In the meantime, it will be for each to make his own decision on what standards he or she wishes to work to.

It is impossible to suggest which system is the best. Many who were brought up on inches and feet do not like the idea of change and find metric measurement difficult to cope with. Those who are metric-minded believe that the Imperial system is awkward. Imperial measurements can be divided easily into halves and quarters, etc.; metric measurement calls for division by parts of ten. Is it easier to take eight tenths or three eighths of a whole? That is a matter of choice and one for the reader to decide . . .

Whatever the model, whether it's these 5/8th scale ploughing engines by Rennie Wood (opposite) or this threshing set (right), never mix your working dimensions between metric and Imperial.



'O' RINGS

This humble device has a multitude of modelling uses; here are some of them

The easy availability of "O" rings is a big boon to the model engineer. Making steam, air and oil-tight joints has now become a comparatively easy matter. Even so, when talking to modellers it becomes obvious that not everybody uses the "O" ring to best advantage. Most of the suppliers of equipment for model engineering now stock a wide range of "O" rings and there is a tremendous variety of sizes available. They can be used to seal static joints or sliding components such as piston rods, etc. They can also be used with great advantage on the pistons themselves; however, they must not be employed in quite the same way as ordinary packing materials. There are a few special rules that should be adhered to.

Let us take a look at how the "O" ring works, starting with its application in the piston where the ring needs to be positioned in a groove. It has, of course, been standard practice for many years to make a groove to take the packing which was usually graphited string, but now we need to take just a little more care in the forming of that groove. For a start, the sides must be straight and not at an angle and the bottom must be smooth and level. The groove can be made either with a special tool or with a normal parting tool.

The groove must be wider than the ring. This allows for the ring to expand sideways when compressed as the piston is positioned in the cylinder. It also allows a certain amount of movement when the motion of the piston is reversed. The depth of the groove is important as it is this that will produce the perfect seal. Manufacturers or suppliers should be able to give the correct depth for their rings, but some figures are given later with which to work if you cannot find the data required.

Whilst in theory the piston need not be quite such a good fit as normal, in

practice if it is a good fit to the cylinder wall it will make life much easier. The measurement of the depth of the groove should be taken not from the outside diameter of the piston, but from the cylinder wall. The reason, of course, is that it is at that point that the outside of the ring will fit and if the measurement is taken from a piston that is a poor fit, there is a possibility of sloppiness on the "O" ring.

It is, therefore, easier to machine the groove depth from a piston that will fit accurately, although as long as we know the diameter of the piston as against the diameter of the cylinder wall, working out what the groove depth should be is not too difficult. For example, suppose we have a cylinder of half inch bore and the piston is six thou. under-size. As long as we make the groove the right depth from the piston outside diameter, less three thou., things will work out all right. The "O" ring will easily take up the slack and, in fact, could even take up more than the amount quoted.

To fit the "O" ring in the piston, the edge over which it is to pass must be chamfered to prevent it cutting into the ring. There should also be a very slight chamfer on the groove edges for the same reason. There is really no difficulty in fitting the ring; it is simply passed over the piston and its natural elasticity will allow this to happen quite easily. It will then drop in position in the groove. Pump rams, etc., are treated in a similar way to the piston.

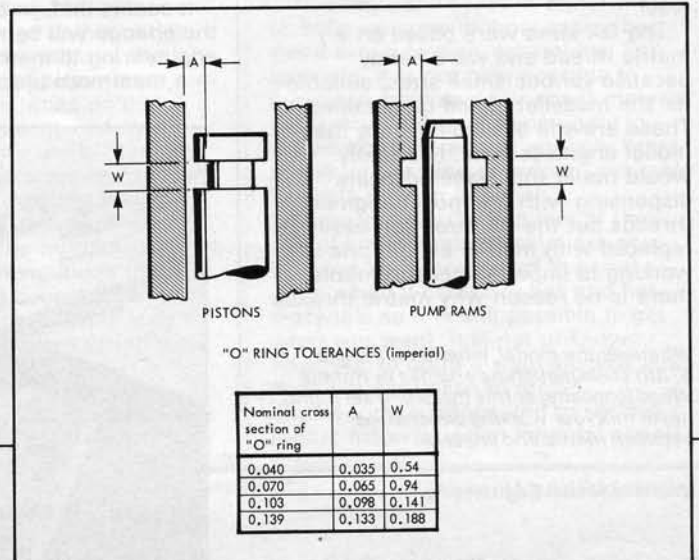
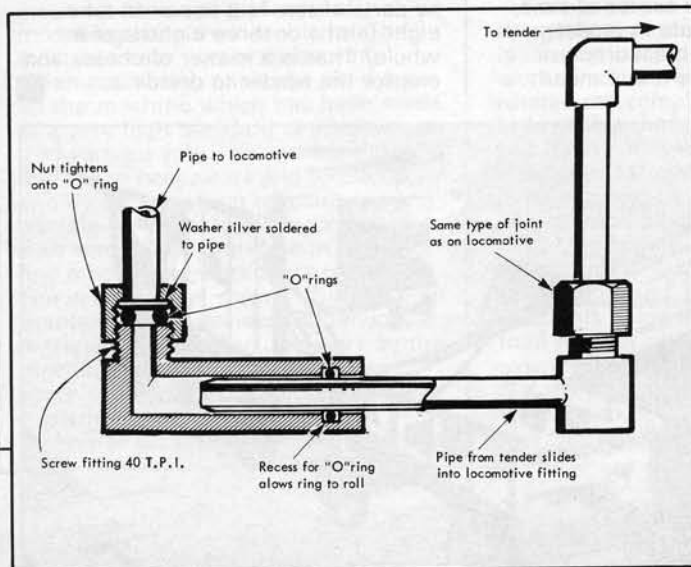
When using "O" rings for glands we need to achieve a similar effect. The outside diameter will have to be adjusted and the length of the gland nut must be such that the ring will have the same side-play as it would on a piston. This, of course, causes considerable difficulty if the gland is to be secured with studs as the majority were in full-size practice. To tighten in the normal way would

squeeze the "O" ring and a small step must therefore be machined and the studs tightened against this leaving the side movement required for the ring.

"O" rings can also be used for static seals. They are particularly useful for water gauges where normal packing has a tendency to go brittle if left for any length of time which can result in a broken gauge glass when pressure is raised. In order to prevent the need to use extra large nuts, a groove should be machined in the nut to take the ring. The ring can be fitted in the nut before screwing it to the fitting. The glass can then be passed through and the nut tightened. The hole in the nut for the glass should be about 1/64th inch larger than the diameter of the glass itself.

When making check valves, etc., "O" rings make a very useful seating. Most metal seats tend to leak as it is very difficult to get a perfect fit; with an "O" ring, however, the ball will recess into the soft material and actually increase the seal under pressure.

One or two other uses for "O" rings are less obvious. Joining water fittings from tenders to locomotives has always been a problem for modellers with a great deal of fiddling about trying to do up nuts that are somewhat tucked out of the way. A simple fitting that will slide into position and seal itself is the answer. Because of the constant dismantling it may be that every so often the "O" ring will need changing but, at the price they are, this is a very small cost to pay for such convenience — not to mention the extra efficiency. Large "O" rings are also used as belting for drives where they replace vee belts and are a very efficient form of drive. Although numerous stock sizes are made, the belting can be purchased as a strip and joined with a cyanoacrylic adhesive if you need a specific size.



Around The Workshops

Finally, let's take a look inside the workshops of some practising model engineers

Jeff Stockings

Jeff is a boat modeller and is very well-known in that field. Whilst obviously a spacious workshop would be an advantage, it is not entirely necessary. With not too much room to spare, Jeff settled for a six-foot by four-foot wooden shed and carries out his modelling in that. The shed has a bench running along the length near the window, on which all hand work is carried out.

Apart from a pillar drill which is a comparatively recent addition, most of the other equipment is portable. There is a Burgess bandsaw for heavier cutting work, and this will deal with either wood or metal. He has a Unimat lathe to take care of any turning or similar machining which might be required — the very old type of Unimat but still very serviceable. His only other machine is a Hobbies treadle fret saw; this he finds invaluable for making the more intricate parts for his models that the

bandsaw cannot deal with. Heating is by means of a small electric fire which is plugged in as required.

The fact that such a well-known modeller should find such small premises satisfactory is, I feel, something from which we could all learn. There is a tendency to over-equip workshops, some modellers being like magpies! This little shed could be used to construct virtually any type of model that will fit into its six-foot length. It is cosy and it is easy to find anything that is needed without having to make an extensive search.

John Wilkes

It is probable that one would never find another character such as John. A professional musician of some repute, he has had a life-long love affair with railways and particularly locomotives. His early modelling took the form of cardboard models of locomotives this being the only means of modelling then available to him at that stage. In 1962 he made up his mind that he would build a live steam model. The course John took is one that I would

definitely not advise for the average enthusiast taking up the hobby; John, however, is definitely not average. He decided that he would build a five-inch gauge model of a Great Western King!

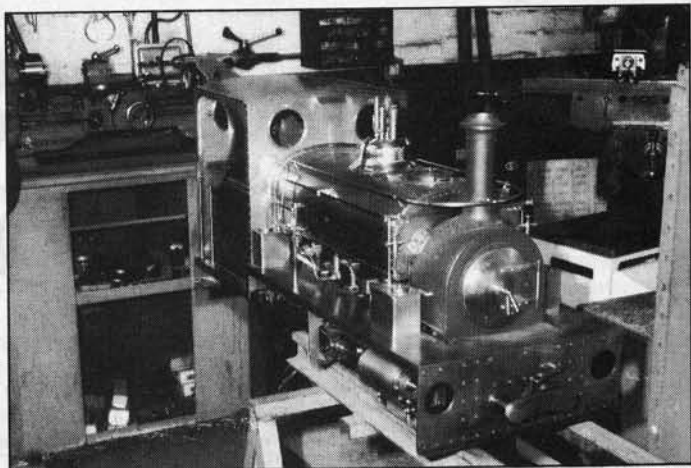
He managed to obtain a Myford ML7 and a $\frac{1}{4}$ in. drilling machine of doubtful parentage; his bench at that time was one half of the kitchen table, the other half was still used for food preparation. So with absolutely no engineering knowledge at all he started constructing the model. He freely admits to being grateful to several model engineers who have offered him advice over the years. The King started from a commercial design, but soon became a scale model being constructed from works drawings.

After a time he managed to find a bench, even if it was inclined to collapse if hack-sawing was carried out too vigorously. In spite of this he finished a model that is really of exhibition standard as well as being a working locomotive with a great deal of power.

In 1965 he decided to make a model of an LMS Coronation Pacific,

Boat modeller Jeff Stockings happily at work in his well equipped workshop.





again in five-inch gauge. By now he had a small workshop. Works plans were again obtained and a start made. No commercial castings were available and most of the locomotive was fabricated from solid metal. For example, the cylinders are cut from mild steel blocks, the bores of both cylinders and valves being lined. After four years he had to abandon all model engineering as work took him away and prevented further construction. The locomotive was finished some years later, again to the same very high standard both as regards looks and hauling power.

In the meantime the bug had really bitten, and as the result of a friendship with a modeller owning a 10¼ in. gauge railway, he decided to build a locomotive to run on that gauge. Never one to shirk a challenge, he decided that it would be a massive American Niagra. A workshop was obtained, an old barn of a place, and some second-hand machinery purchased. Because of the massively heavy work he was about to undertake the machinery had to be very large, too. It includes a couple of Colchester Lathes, a Herbert Vertical

Miller, large metal rollers, band-saw, press and surface grinder.

A start was made. There was, of course, to be no lifting the locomotive on and off the bench. It will weigh several tons when finished, and a system of rail on rollers was devised as a stand. A hoist was also installed. The locomotive is now well on the way and very impressive it looks. To tell all the dodges John has got up to to make it would fill a book, and perhaps if we are lucky he will write one when it is finished — if he is not too busy making more locomotives.

A very wise decision was to build both locomotive and tender together. How easy it would have been to have built just the locomotive and then later to have started the tender, which would then have been nothing more than a chore. Something that John has done to aid the construction is to have a lot of castings made. He insists only on very high quality from the foundries with which he deals, and most are lost wax. As a result of this he has become quite an expert on pattern and die-making and the standard is such that it could easily

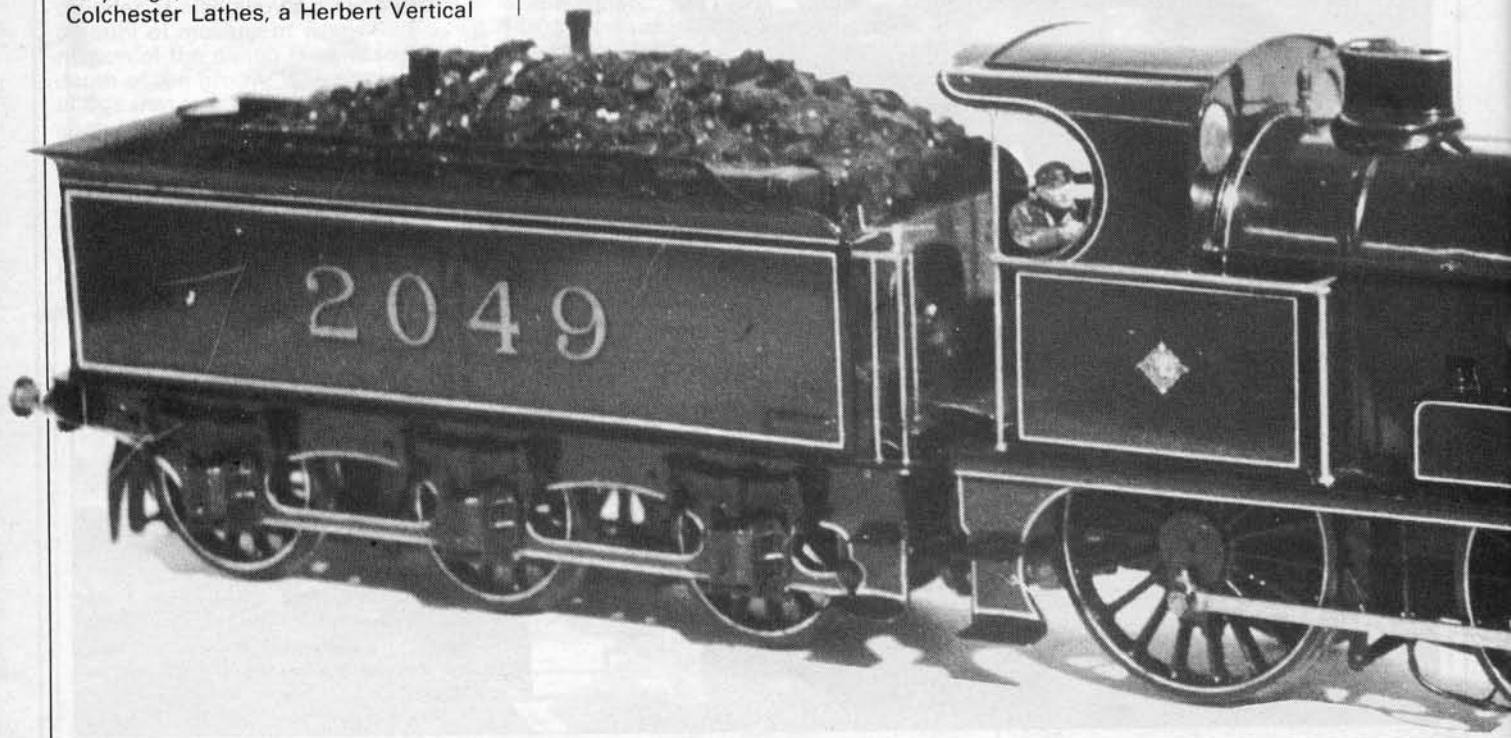
Above left, a product of the Stockings workshop is this fine working model of the "Sun XXII" tug. Above right, in sharp contrast, this superb 5 inch gauge "Hunslet" is well under way in the Moore workshop (see overleaf); it's the work of Bob Moore.

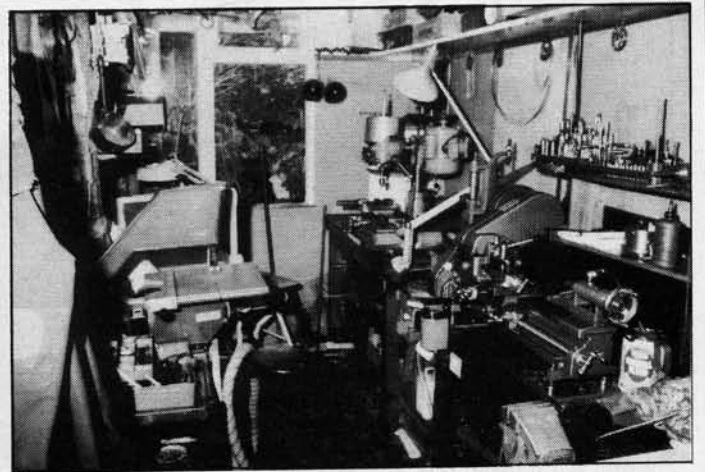
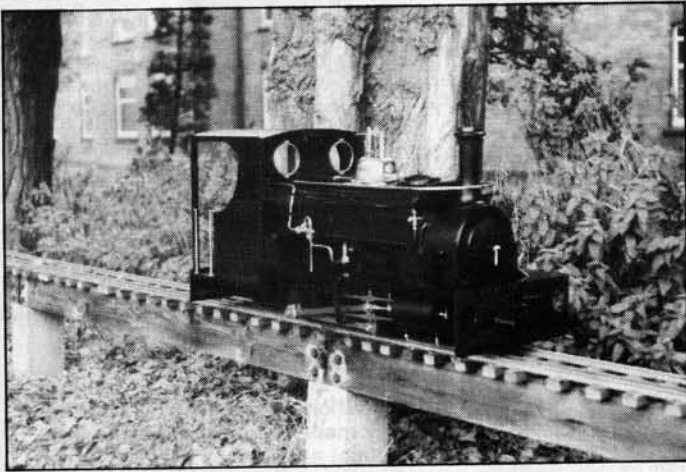
have come from a professional firm.

Just for good measure he has purchased the chassis of an East African Narrow Gauge Locomotive in 10¼ in. gauge, a massive 3 ft. gauge 2-8-4 on which he has also done some work and which will, no doubt, follow the Niagra as soon as there is time. Perhaps what John is doing is not true model engineering and should be classed as light engineering. Make no mistake, though; John is model-making, whatever the size! See pic. overleaf.

Ralph Ley

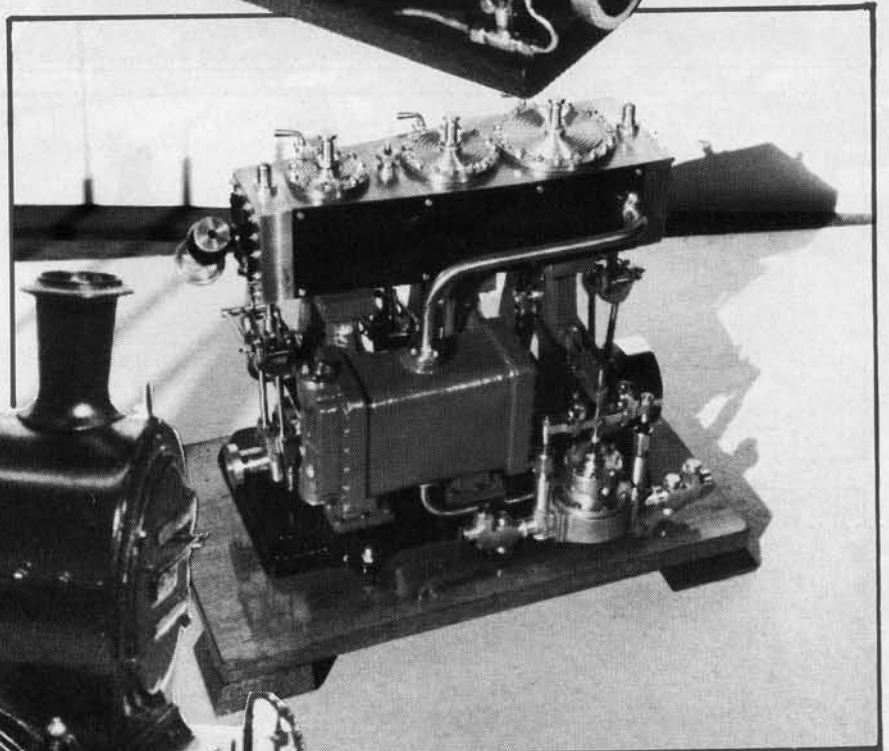
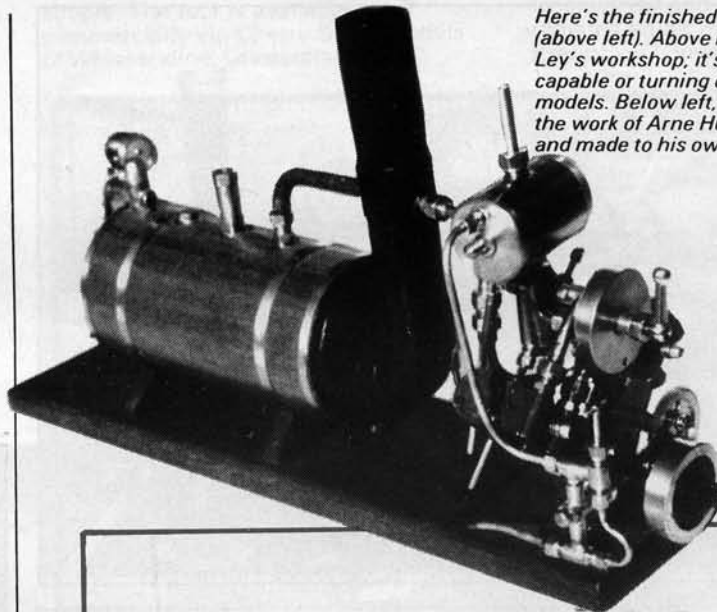
Ralph has now retired and spends his retirement, to a large extent, in his workshop. It is not large and is built out-of-doors, although it is reached from the house by a covered way





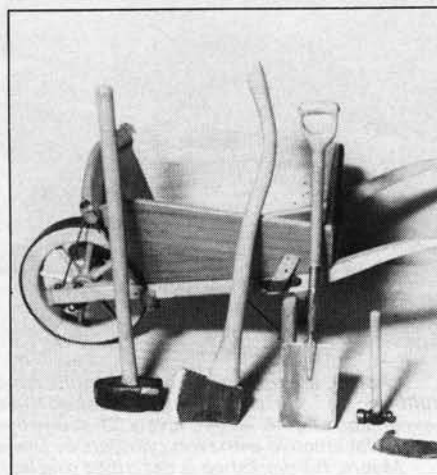
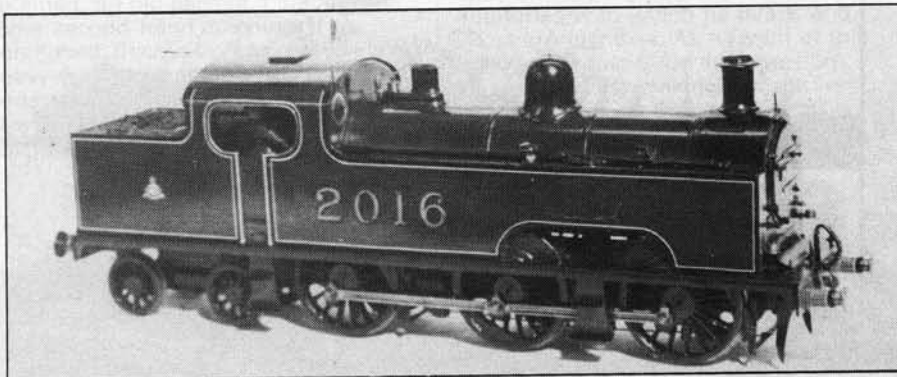
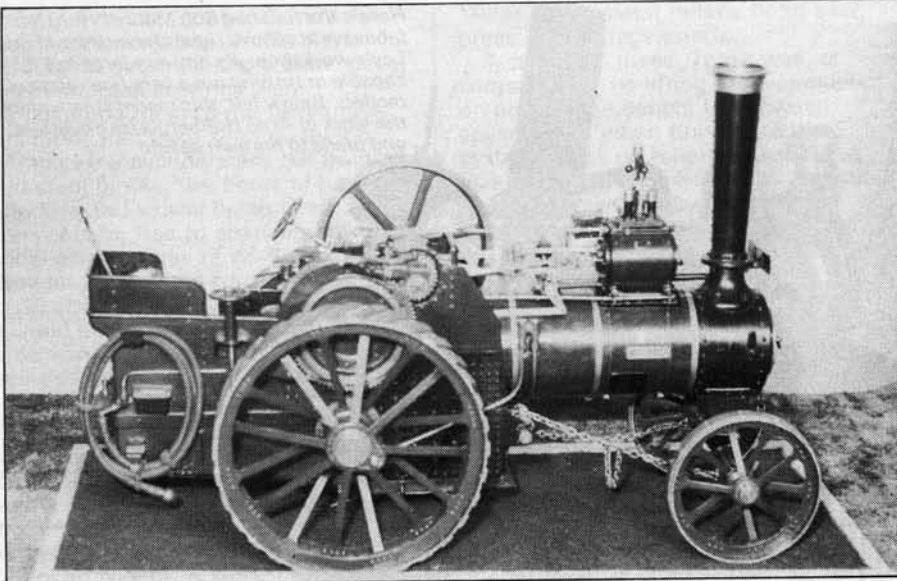
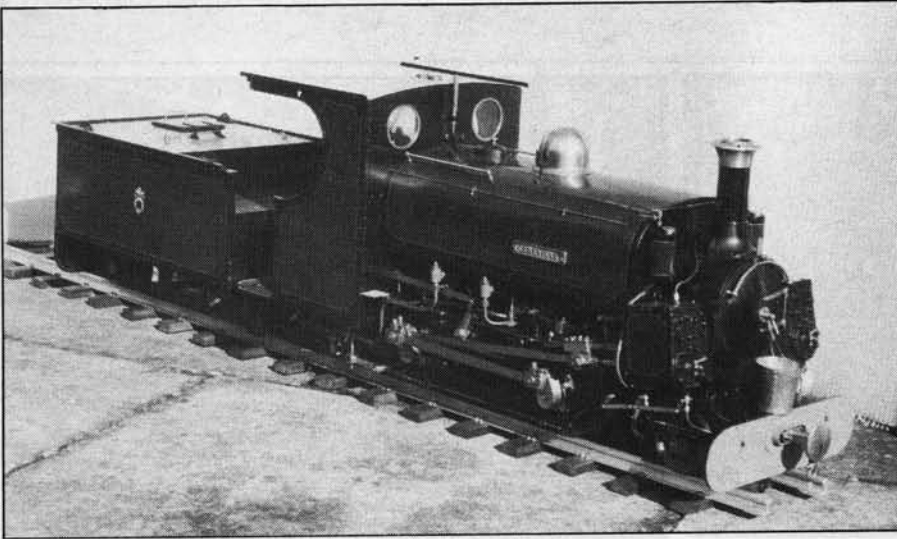
which means that he can get in and out in comparative comfort. The workshop is well lit with plenty of natural light. A lot of thought has gone into the layout of the workshop, which houses a Dore Westbury Milling machine built by Ralph, plus a Myford Speed 10 lathe as well as a bench, with a vice for hand work. Drilling is carried out either on the milling machine or by means of a DIY hand drill set on a vertical holder. All tools are kept neatly in specially made drawers. At one end is a drawing table at which Ralph, who likes doing his own thing, can sit and draw his designs as he wishes. At the time of my visit he was busy on a five-inch gauge Crampton Locomotive.

He builds his models to please himself, but all are to a high standard. Dotted around the house are delightful little models of such things as wheelbarrows, ploughs, etc. He has a narrow gauge model locomotive based on a prototype and built to the same high standard. Clever use is made, as on all his models, of castings meant for other designs. For example, Rail Motor cylinders, Reeves standard wheels, 'Heilan Lassie'



Here's the finished Bob Moore "Hunslett" (above left). Above right, the interior of Ralph Ley's workshop; it's not very large but it's capable of turning out a very fine range of models. Below left, this model steam plant is the work of Arne Hultberg's (see overleaf) and made to his own design.

Above, another model by the prolific Arne Hultberg; this one is a beautifully finished triple expansion engine. At left, lovely 'O' gauge live steam locomotive with twin cylinders by David Moore; his workshop is described overleaf.



Four superb examples of the sort of diverse models which appeal to a variety of model engineers. At the top, a Welsh narrow gauge locomotive by Ralph Ley built up from a collection of parts and castings intended for other designs. Second down, this traction engine is another example of Ralph's work; he even drew the plans himself and the model is complete to the last detail. Above, a fine 'O' gauge model tank locomotive built by David Moore; it has a single cylinder and runs on steam despite its small size. At left, more models by Ralph Ley; this lovely little wheelbarrow with complete set of tools makes an unusual choice of modelling subject but a worthy one, nevertheless.

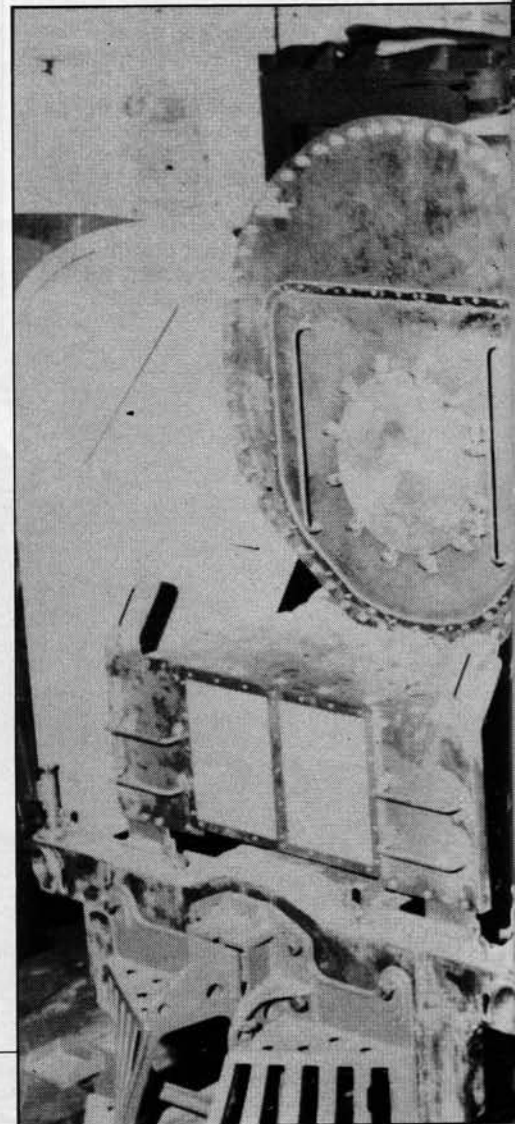
smoke-box door and a Conway dome and chimney — this means he does not need to bother with pattern-making.

His driving trolley is virtually a scale model of an LNER "Welltrot" wagon that was a speciality of that company. It is perfect for adapting to both raised and ground level running. Similarly, for running his traction engine which is about 1/8th scale, he has built a lumber wagon as per prototype. It looks far better than the normal trailer of indeterminate type and even includes correct type braking.

Ralph is certainly a man of ideas from whom the beginner could learn; every model is designed to be both practical and to look correct, whilst using the simplest possible constructional methods. Add to this an amount of workshop equipment, including the milling machine and a rotary table, and it is possible to see just how careful planning can result in some very fine modelling from quite a small workshop.

Arne Hultberg

Arne Hultberg lives in Sweden where the interest in model engineering grows rapidly. His particular interest is in making stationary steam engines and amongst his completed models is a very attractive triple expansion engine. He gives a lot of attention to detail and is also willing to re-design



parts that he finds are not quite true to prototype.

Apart from the usual hand tools, his equipment consists of a Toyo ML210 lathe with the drilling/milling attachment. This takes care of all the smaller work as well as drilling operations and milling. He also has a Fu San 450 lathe which is a type we have not seen marketed in this country; it is, as far as I know, slightly smaller than the Myford ML10 range.

As the photographs show, Mr. Hultberg takes a great deal of trouble to get the important little details correct and is a modeller of the very highest standard.

Bob and David Moore

Bob and David are well-known in the field of model engineering. Bob has taken model making up as a profession and builds and restores models to a very high standard. His son David makes live steam models as a hobby and, in particular, is interested in building "O" Gauge locomotives with which he has won several prizes for the standard of his work. At the time of my visit for the purpose of preparing this section, Bob had in his workshop an LMS O-6-0 for restoration as well as a 7¼ in. gauge

At right, Bob Moore at work in his workshop; below, this mighty 10¼ gauge "Niagara" is the work of model engineer John Wilkes.

locomotive. On a previous trip I had much admired a five-inch narrow gauge locomotive that he was just finishing.

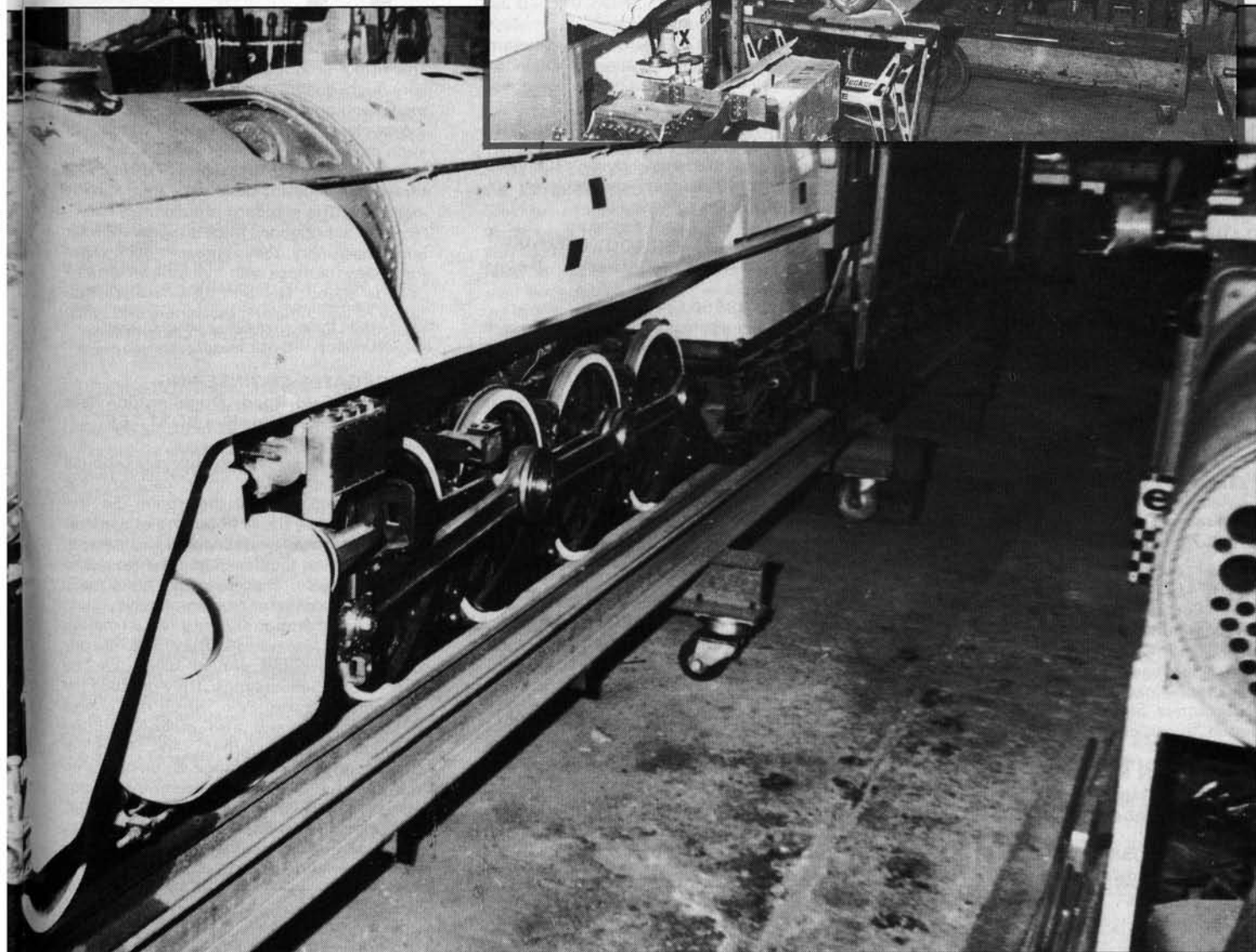
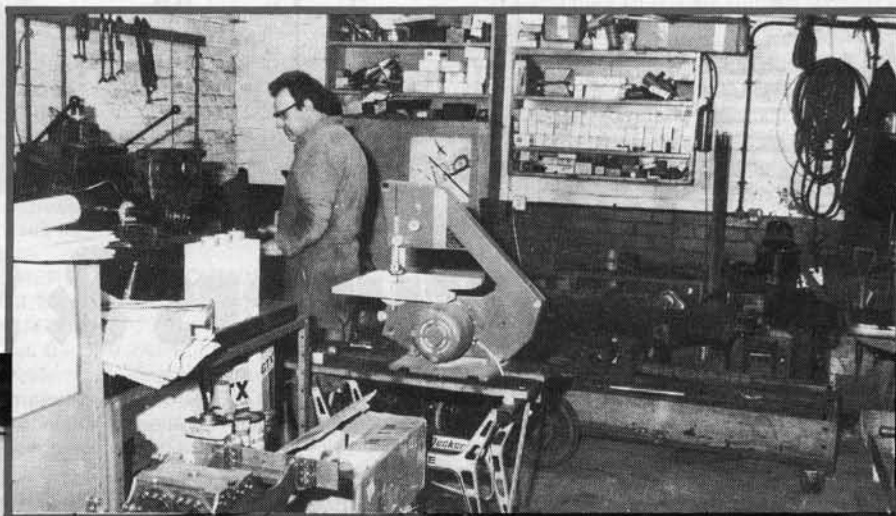
I was interested to see that, on that particular model, Bob had been using gilding metal. I am always surprised that this metal does not find more favour with modellers. This particular locomotive had several shaped sections of platework that could only be obtained by beating the metal to shape and of course, gilding metal is the perfect answer. It will also take paint better than brass which is an added advantage.

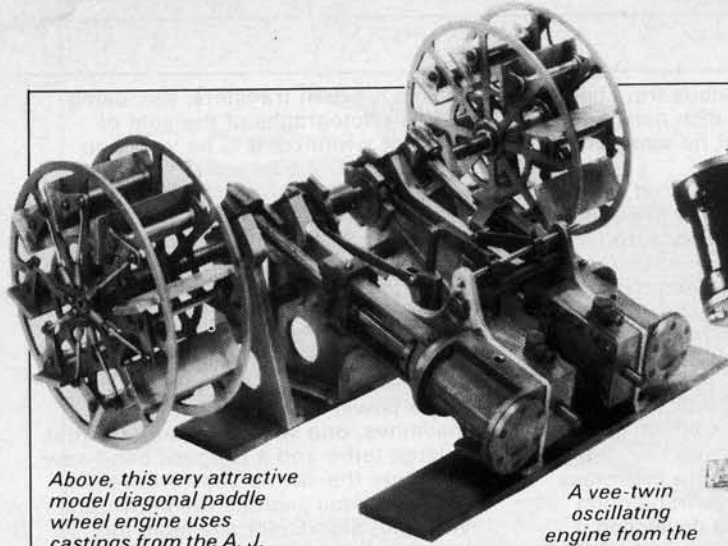
Both father and son are first-class finishers and specialise in painting and lining, Bob having developed a special tool which makes lining very simple. The tool is available now commercially via Cherry Scale Models of Whissendine, Leicestershire. He

makes his own transfers, too, using actual photographs of the coat of arms or whatever it is he wants to decorate the model with.

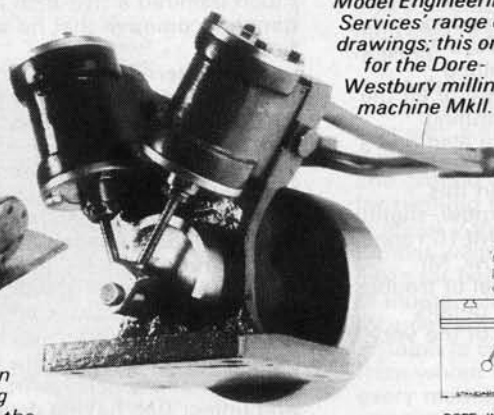
David had two locomotives in the workshop when I arrived with the camera, both LMS models and both prize-winners. The first, a tank locomotive known as a 'Flatiron' and a single-cylinder model, the second a tender engine with two cylinders.

The workshop contains a Myford ML7 with gearbox, two pillar drills and a power saw, plus two milling machines, one vertical, one horizontal. A large lathe and a Burgess band-saw complete the set-up apart from the obvious items such as the bench and vice, etc. Stands are available for constructing and moving the larger locomotives and the workshop radiates an air of quiet efficiency with everything conveniently to hand.



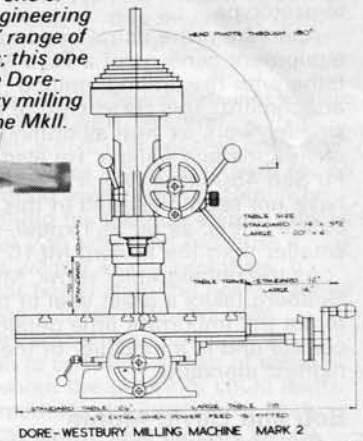


Above, this very attractive model diagonal paddle wheel engine uses castings from the A. J. Reeves catalogue. Below, part of Camden Miniature Steam Services' superb 'Shay' drawings.

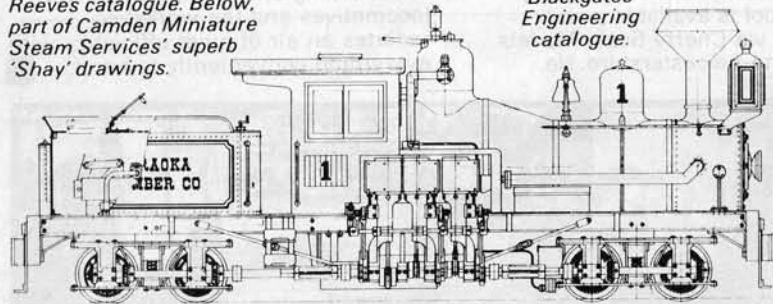


A vee-twin oscillating engine from the Blackgates Engineering catalogue.

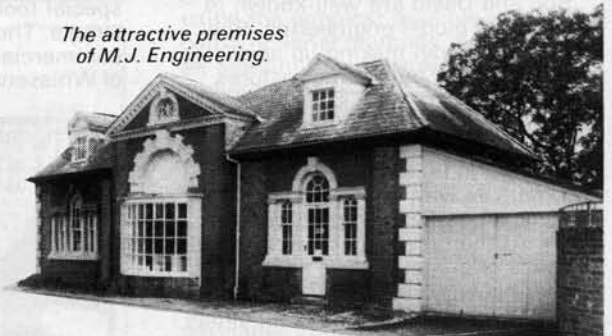
Part of one of Model Engineering Services' range of drawings; this one for the Dore-Westbury milling machine Mk11.



DORE-WESTBURY MILLING MACHINE MARK 2



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209 Wakefield Road, Drighlington, Near Bradford, West Yorkshire BD11 1EB

Tel: 0532 853652

A friendly little firm nearly always to be found at rallies, etc., with their caravan that converts into a mini showroom. So frequently do they travel about in the summer that they have been nicknamed Nomads Ltd. Always willing to offer help, the firm stocks Myford lathes and accessories, hand tools, and a wide range of castings for workshop equipment, stationary engines, traction engines and locomotives. They have recently developed a cutter grinder which can be made from their castings. They produce the locomotive "Sweet Pea" which has proved highly popular and also produce all the castings for the Durham and Yorkshire traction engine. Their range is constantly on the increase and a new locomotive is due shortly. A good stock of metal is also carried. The premises bulge at the seams with stock and squeezed in amongst this they have their own pattern shop.

BLACK & DECKER LTD.

Cannon Lane, Maidenhead, Berkshire
Tel: 062 882 2130

Well-known range of power tools and accessories including drills, saws and sanders plus the **Minicraft** range.

BONDS OF EUSTON ROAD

Arundel House, Rumbolds Hill, Midhurst, Sussex

Tel: 073 081 3441

An old-established company dealing in a wide variety of model engineers' requisites.

M. BREEZE

21 Castle Drive, Northborough, Peterborough

Tel: 0778 346565

A range of high quality locomotive drawings in 3½ and 5 inch gauges. Castings either are or will be available for the models. The range includes an L.M.S. Pacific, two L.N.E.R. Pacifics and the L.N.E.A. Green Arrow class as well as other types.

BRUCE ENGINEERING

Hollow Tree, Riverside, Walton Bridge Road, Shepperton, Middlesex. TW17 8NF.

Tel: 0932 245529

Suppliers of drawings and castings for stationary steam engines and in particular stockists of the Stuart Turner range. They also produce drawings and castings for the R&B gas engine which was serialised in Model Engineer. This model is also available part machined.

BRUNEL MODELS

3 Longlands Crescent, Heysham, Lancashire

Tel: 0524 51400

Suppliers of castings and drawings for stationary engines, locomotives and rolling stock. Illustrated catalogue; UK £1.00, overseas £2.50.

BOXFORD LTD.

Wheatley, Halifax, West Yorkshire HX3 5AF

Tel: 0422 58311

Famous manufacturer of high quality machine tools for industry whose range also includes a **lathe and associated accessories specially developed for the hobby market.**

BRIDGEPORT MACHINES

PO Box 22, Forest Road, Leicester LE5 0FJ

Tel: 0533 531122

An old-established and renowned maker of high quality industrial **milling machines** and accessories.

BUCK & RYAN LTD.

101 Tottenham Court Road, London W1

Tel: 01 636 7475

An old-established tool dealer catering for most requirements of the model engineer.

G. M. H. BUNCE & CO. LTD.

206 West Street, Fareham, Hampshire

Tel: Fareham 234136

Dealers in machine tools who also stock a wide range of materials and castings of interest to model engineers.

BURGESS POWER TOOLS LTD.

Sapcote, Leicester LE9 6JW

Tel: 045 5272292

Manufacturers of a wide range of woodwork-

ing power tools, especially a **three wheeled bandsaw.**

CAMDEN MINIATURE STEAM SERVICES

13 High Street, Rode, Near Bath, Somerset BA3 6NZ

Tel: 0373 830151

One of the leading suppliers of technical books for model engineers in the UK carrying numerous imported titles. Magazines, plus castings for very different designs are their speciality.

CAROUSEL CARPENTRY

10 Dorset Road, Ashford, Middlesex. TW15 3BY.

Fairground items are a rarity. This firm stocks many different items, including those that cause the greatest difficulty to the home constructor. They also stock drawings of fairground equipment.

CARRS MODELLING PRODUCTS

Unit 5, Centre 88, Elm Grove, Wimbledon, London, SW19 4EH

Suppliers of solders and in particular the excellent Fry's silver solder range. They also specialise in chemicals for various metal treatments and colourings. Other items stocked include military models, low melt alloys, and scenic products. A stamped addressed envelope is all that is required for a full list.

CHERRY'S OF RICHMOND

62 Sheen Road, Richmond, Surrey, TW9 1UF

Tel: 01 940 2454

Dealers in finished models of traction engines, locomotives, marine models, stationary engines etc. Catalogue is issued now twice yearly, usually January and June.

CHELSTON MODEL ENGINEERING

19 Sherwell Lane, Chelston, Torquay, S. Devon TQ2 6BG

Tel: 0803 607210

Stockists of machines, tools, metal, as well as castings for various workshop equipment and locomotives. A recent introduction has been a model poppet valve high speed stationary engine which is easy to make and yet is a true scale model.

CHRONOS LTD.

95 Victoria Street, St. Albans, Herts.

Tel: 0727 32793

Mainly specialist suppliers for the clockmaker. Their range however includes many items of considerable use to the model engineer interested in other types of modelling. In particular they make a very fine range of direct division plates. They also stock a range of machines and tools and many books of interest to the clockmaker.

J. G. S. CLARKE & CO.

The Old School, Love Lane, Denbigh, Clwyd, LL16 3LT North Wales

Tel: 074571 3118

This firm specialises in drawings and castings for locomotives basically for 5 and 7¼ in. gauges. All their designs are their own special products and include some most unusual and attractive models. They also supply completed models to order as well as a bolt together kit for a 5 in. gauge steam locomotive and tender. All their products are of the highest standard and make up into excellent models.

CLASSIC CLOCK KITS

75 Foxley Lane, Purley, Surrey CR2 3HP
Mail Order only

Suppliers of ready-machined kits of parts for a selection of clocks. The kits are self-assembled, using hand tools and polishing papers, into attractive and functional time-pieces to grace any decor.

COLLEGE ENGINEERING SUPPLIES LTD.

8 The Pines, Finchfield, Wolverhampton, West Midlands. WV3 9HD

Tel: 0902 765351

Originally started to supply technical colleges with suitable drawings and castings for workshop equipment, the range produced became an obvious target for the model engineer seeking to improve the facilities in his or her workshop. A very comprehensive range of castings for workshop equipment is available and this has just been augmented by a new design in the form of a rotary table. Many of the castings are suitable subjects for beginners to the hobby.

CLERKENWELL SCREWS LTD

109 Clerkenwell Road, London EC1R 5BY

Tel: 01 405 6504/1215

Long-time suppliers of all kinds of screws for model engineering purposes; they have many unusual varieties among their range of 230 types and sizes.

COMPASS HOUSE TOOLS

High Street, Rotherfield, E. Sussex TN6 3LH

Tel: 0892 852968

Suppliers of surplus tooling and new equipment for the model engineer.

CRAFTS FOR 4 SEASONS

1120 Melton Road, Syston, Leicester. LE1 8HJ

Tel: 0533 607242

The firm stocks very many designs for clocks in which they specialise. They have in particular a wide range of special brasses of types that are often difficult to obtain. They also stock a wide range of tools and other items of value to the clockmaker in particular and the model engineer in general.

CROWHURST ENGINEERING

2 Mill Fields Road, Hythe, Kent. CT21 4DH

Tel: 0303 64928

Manufacturers of Crowhurst Engineering brazing hearths in two sizes, purpose built for the model engineer. Strong welded steel framework with refractory able to withstand elevated temperatures. Refractory bricks available separately and special purpose hearths made to order. SAE for leaflet.

CZ SCIENTIFIC INSTRUMENTS LTD.

2 Elstree Way, Borehamwood, Hertfordshire

Tel: 01 953 1688

Makers and distributors of the East German **Hobymat** and **Pratzimat** lathes, their associated tools and accessories and a mill.

DAVALL GEAR COMPANY LTD.

Welham Green, Hatfield, Herts. AL9 7JB

Tel: 07072 65432

Manufacturers of all types of power transmission gearing, with over 2,400 standard stock gears. Toothed timing belt drives also available.

JOHN M. ELLIS

Unit 3, Fairfield Drive, Off Stone Lane,
Kinver, West Midlands. DY1 6EQ
Tel: 0384 872122

Although particularly specialising in making boilers for the smaller gauges right up to 10 1/4 in. gauge as well as for traction engines of all scales, the firm also makes an interesting range of forged coupling hooks which look highly authentic as well as having the additional strength associated with the forging process.

EMCO MAIER LTD.

10 Woodshots Meadow, Croxley Green,
Watford, Herts. WD1 8YZ.
Tel: 0923 50051

U.K. importers of the EMCO range of machine tools which are so well established in the hobby as to probably need no description. It includes the well known Unimat and the Compact 5 and Compact 8 lathes. The range has both milling attachments for the lathes and milling machines in their own right. They also stock accessories and other machines likely to be of use to the model engineer.

EURO PRECISION

259-263 London Road, Portsmouth,
Hants.
Tel: 0705 667331

The firm stocks the Unimat range of machines and, in particular, specialise in the Unimat 1.

EXCEL MACHINE TOOLS

Unit 1, Colliery Lane, Exhall, Coventry
CV79NW
Tel: 0203 365255

A wide range of good quality imported machines, in particular larger size milling machines from the far East.

EXPO (DRILLS) LTD.

Clock Tower Works, Warsash, Hampshire
SO3 6FH
Tel: 04895 83966

A wide range of very useful miniature electric powered hand tools, in particular the Saturn series of drills.

FAN AND MOTOR CENTRE

65 Sidney Street, London E1 2HH
Tel: 01 247 3710

A large stock of new and second hand electric motors suitable for all model engineering purposes.

P. FILBY

Unit 1, Half Acres, Welton Road, Brough,
North Humberside HU15 1PQ
Tel: 0482 666662

Model traction engine specialists who can supply a wide range of parts and accessories for models from 4 in. to 6 in. scale.

FLAMEFAST LTD.

Pendlebury Industrial Estate, Bridge
Street, Swinton, Manchester M27 1FJ
Tel: 061 793 9333

Manufacturers of gas equipment for the model engineer; range includes soldering torches, small furnaces, casting tools and equipment and brazing torches and materials.

FYNE FORT FITTINGS

Clarence Boatyard, East Cowes, Isle of
Wight PO32 6EZ

Tel: 0983 293633

Specialist suppliers of steam fittings of high quality for the builder who can't wait to see his model in steam.

PHIL W. GIBBONS

Six Score Road, Langtoft Common,
Market Deeping, Peterborough PE6 9QD
Tel: 0778 347515 or 0780 63458
(evenings)

A foundry specialising in castings for the model engineer. Although they have some patterns of their own, basically their work is making castings to customers' own specifications. Either from patterns or drawings. A useful service not always easy to obtain elsewhere.

G.L.R. DISTRIBUTORS LTD.

Great Northam Works, Hartham Lane,
Hertford, Hertfordshire
Tel: 0992 552962

Suppliers and stockists of tools and raw materials of all kinds.

DAVE GOODWIN

43 High Street, Rishton, Blackburn, Lan-
cashire BB1 4JS
Tel: 0254 885836

Suppliers and manufacturers of specialist parts and castings for model locomotives, in particular designs from Model Engineer Plans.

GRAHAM ENGINEERING LTD.

Roebuck Lane, West Bromwich, West
Midlands B70 6QP
Tel: 021 525 3133

Importers and suppliers of good quality foreign machine tools and associated spares and accessories, especially far East equipment.

T. S. HARRISON & SONS LTD.

Union Street, Heckmondwike, Yorkshire
WF16 0HN
Tel: 0924 403751/6 and 0924 409361/6

A 'big' industrial lathe manufacturer who has developed a model specifically for the model engineering hobby market; this is the high quality Harrison M250.

HEGNER (UK) LTD.

111 Sutton Road, Southend on Sea, Essex
SS2 5PB
Tel: 0702 617298

Saws and associated woodworking power equipment.

N. S. HEMINGWAY

30 Links View, Rochdale, Lancashire
Tel: 0706 45404

Stockist of tools, metal etc. but specialising in drawings and castings of workshop equipment of a high standard. Many of the designs by George Thomas but some by members of the firm themselves. A pair of newly designed steadies and a taper turning attachment are amongst their latest offerings. Older items include various toolposts, dividing heads, rotary table amongst the very wide range. No doubt at all that the workshop capacity can be greatly increased by using their workshop equipment.

D. HEWSON (Models)

73 Victoria Road, Barnetby, South
Humberside ON36 6HY

Specialises in odd little parts cast to a high

standard through the lost wax process. The sort of detail that makes models look good.

HEWARD & DEAN LTD.

90/94 West Green Road, Tottenham,
London N15 4SE
Tel: 01 802 1731

Suppliers of tools, materials and sundries for model engineers.

HIRSCH JACOBSON MERCHANDISING CO. LTD.

91 Marylebone High Street, London W1M
3DE

Tel: 01 935 4709

Specialist suppliers of high quality optical equipment and measuring instruments.

F. L. HUNT & CO.

48 Chapel Street, Manchester M3 7AA
Tel: 061 834 1465

A long established firm of Foundry Suppliers who specialise in the small quantities needed by the home foundryman. The range is vast and it is suggested that you phone or write for a quotation stating your exact needs — despatch is immediate to any address in the U.K.

IRON HORSE ENGINEERING LTD.

113 Stein Road, Southbourne, Emsworth,
Hants. PO10 8LS
Tel: 0243 373624

Complete suppliers for scale passenger-carrying railways from 3 1/2 to 10 1/4 in. gauge. Services include everything from planning through to running railways for the garden, estate or park.

J. A. JACKSON

"Tufagh," Ramsden Park Road, Ramsden
Bellhouse, Billericay, Essex CM11 1NG
Tel: 0258 710144

Designer and supplier of the "Manumatic" Boring and Facing Head which gained high distinction in its class at the 1987 Model Engineer Exhibition. Drawings, castings and instructions for use of the device are obtainable only from this source.

J.P.H. ENGINEERING

1 Bournemouth Park Road, Southend on
Sea, Essex SS2 5JQ

Tel: 0702 66688

The firm specialises at the moment only in the John Haining designs. These include most of the traction engines and all the other published designs such as the Dairy Engine, the living van and the water cart.

J.M.W. (CLOCKS)

12 Norton Green Close, Sheffield S8 8BP
Tel: 0742 745693

As the name implies, a specialist in clocks, parts and tools suitable for clockmaking. Their large catalogue includes all manner of general tools suitable for other types of model engineering, as well as clock items. A very large range of clock faces and hands as well as books. Plenty to interest all facets of the hobby.

L. C. JAY & SON LTD.

19-21 Oak Street, Norwich NR6 7DT

Specialist foundry willing to cast from customers' own patterns in iron bronze or alloy. Also stock castings for popular designs as well as for a couple of their own

specialities. These include a neat little lathe suitable for home construction.

A. KELLETT

2a Egerton Street, Denton, Manchester M34 3LU
Tel: 061 320 0047

Gearmakers of repute and happy to supply small quantities to customers' requirements.

KENNION BROS.

2 Railway Place, Hertford, Hertfordshire SG13 7BT
Tel: 0992 52573

The oldest model engineering supplier of them all. Founded in 1901 they moved to Hertford in 1944. Stock includes a large range of tools, and materials. Their castings include many old designs with very rare gauge "O" and 2½ in. gauge models. They also keep drawings and castings for many of the later published designs as well as some of their own specials. These include a mill engine, A Pecket Tank Locomotive, a 7¼ in. gauge GWR King, and a pannier tank in the same gauge. Two 5 in. gauge Great Western Locomotives and Butch, an O-6-0 tank locomotive that is one of the most popular designs ever. They also carry drawings and castings for two small steam pumps suitable for model locomotives or stationary plants.

A. E. KING (TOOLS) LTD.

3 Central Parade, Station Road, Sidcup, Kent DA15 7DL
Tel: 01 300 1342

Specialists in the supply of reasonably priced surplus tooling.

LEEDA LTD.

14 Cannon Street, Southampton SO9 2RB
Principally manufacturers of fishing equipment, this company's magnifying spectacles (marketed as an aid to fly-tying) are of equal value to model engineers.

LINAZE LTD.

PO Box 343, Old Marsh Lane, Maidenhead, Berks. SL6 0EJ
Tel: 0628 74344

Manufacturers of a demonstration gyroscope with balanced flywheel running on ball bearings. Useful as a teaching aid, and also as a high quality executive toy for children and adults, it is available direct from the manufacturer.

LOCO STEAM

Keswick Lodge, Keswick, Norwich, NR4 6TY
Tel: 0603 58270

A general range of supplies of metal tools, etc., for the model engineer, the firm, in particular, specialises in Gauge 1 drawings, castings and parts. They also stock drawings and castings for larger gauges and particularly attractive is the narrow gauge model "Hackfly" which is exclusive to them.

LONDON V ROPE DRIVE LTD.

Clifton Terrace, Finsbury Park, London N4 3JS
Tel: 01 272 4212

Principal source of supply for the Picador system of power tools.

L.S.M. ENGINEERING

92 Eastfield Road, Wollaston, Northamptonshire N9 7RU
Tel: 0933 665409

Builders and suppliers of parts, castings and

drawings for the larger scale traction engine model.

MACHINE MART

71-73 Manchester Road, Altrincham

Tel: 061-941 2666

Also at Birmingham, Bradford, Liverpool, Sheffield, Stoke on Trent, Hull, Preston, Wolverhampton, and Nottingham.

Suppliers of machine tools, mainly imported. In particular, they carry a large range of electric motors and starters. Also MIG welders.

MACHINE TOOL SALES

Sparks Lane, Cuckfield, Sussex RH17 5JP

Tel: 0444 413122 or 04446 42266

Suppliers of the well-known Matosa rotating centre, a British made product which MTS are able to offer at a special price direct to customers.

MAIDSTONE ENGINEERING SERVICES

Hedley Street, Maidstone, Kent ME14 5AD

Tel: 0622 62005

Suppliers of tools and materials, castings and kits of parts.

MARDYKE MINIATURE RAILWAYS LTD.

No. 3 Factory, Lambs Lane, Rainham, Essex RM13 9XL

Tel: 04027 54618

Builders and suppliers of ready-to-run locomotives and rolling stock for the large gauge enthusiast or the commercial operator.

A. MARKS (MODELOY)

3 Old Hall Close, Laughton-en-le-Morthen, Sheffield S31 7YZ

Tel: 0909 563940

Manufacturers of machine tool accessories and other related materials including centre drill holders and chuck adaptors, etc.

MARTEX NORTHERN SALES

PO Box 250, Chester CH1 4HE

A drill sharpening device is the main item of interest. They also stock a useful flexible sanding disk of above average quality as well as a range of drills etc.

MICROW ENGINEERING

5 Lindsay Street, Kettering, Northants.

Manufacturers of machine tool accessories of high quality, in particular a double-ended sliding die holder.

MODEL ENGINEERING SUPPLIES AND SERVICES

175/177 Parr Stocks Road, St. Helens, Merseyside

Tel: 0744 53634

Suppliers of a large range of new and second-hand machine tools, castings, materials, sundries and books and publications.

MODEL ENGINEER PLANS SERVICE

Model & Allied Publications, PO Box 35, Wolsey Road, Hemel Hempstead, Hertfordshire HP2 4SS

Tel: 0442 211882

A large range of plans and working drawings for model engineering subjects of all types. A fully illustrated handbook is available, price £1.50 including postage.

MODEL ENGINEERING SERVICES

6 Kennet Vale, Brockwell, Chesterfield, Derbyshire S40 4EW

Tel: Chesterfield 79153

A wide range of castings and drawings for workshop equipment. These include a

milling machine and surface grinder, dividing head, and lapping machine as well as many smaller items. Some of the larger castings are available ready machined. They produce castings for two different cutter grinders for those wishing to sharpen their own milling cutters etc.

M.J. ENGINEERING

Manor Hatch, 63b Southampton Road, Ringwood, Hants. BH24 1HE

Tel: 04254 6234

Castings for Ariel the 5 inch gauge Merchant Navy Pacific Locomotive and a 7¼ inch gauge Bagnall narrow gauge locomotive are included in the locomotives. Three 2 inch and one 3 inch scale traction engine and a 2 inch scale steam roller all to the firm's own individual designs. They also stock metal and a large range of fittings and have plans to increase their range further in the near future.

MOTORUM PHASE CONVERTERS

23 Waldengrave Road, Teddington, Middlesex

Tel: 01 977 0242

Specialist in the supply of electrical phase converters, particularly useful when purchasing secondhand machinery.

D. MACKAY

85 East Road, Cambridge CB1 1BY

Tel: 0223 63132

Not primarily model engineer suppliers, the firm stocks an exceptionally large range of tools and machinery. They also stock and will cut to size brass steel etc. but that service for callers only. Stuart Turner castings are also available.

MALDEN TRANSFORMERS

134 London Road, Kingston on Thames

Tel: 01 546 7534

A large range of new and secondhand electric motors as well as phase converters, transformers etc.

MASON & GANTLETT LTD.

29 Surray Street, Norwich NR1 3NX

Tel: 0603 628101

If difficulty in seeing is the problem then this is the firm to contact. They specialise in head mounted magnifying equipment as well as an excellent magnifying light.

MAXITRAK

"Rothiemay", Offham Road, West Malling, Kent ME19 6RG

Tel: 0732 840660

Manufacturers of large scale live steam and diesel models in both narrow and standard gauges; the locos are available in either kit or ready-to-run form.

MEDDINGS SALES LTD.

Lee Mill Industrial Estate, Ivybridge, Devonshire PL21 9LL

Tel: 07554 3277

Manufacturers of a range of high precision drilling machines among other quality machine tools.

MERIDIAN CLOCKS

Wheelwrights House, Hillgrove, Lurgashall, Petworth, Sussex

Mail Order only

Suppliers of an excellent series of specialist books by the well-known horological author John Wilding. The books deal with the making and restoration of clocks of all sorts. These books make an excellent reference source for any horologist, amateur or professional.

MICROFLAME (UK) LTD.

Vinces Road, Diss, Norfolk IP22 3HQ

Tel: 0379 4813

Importers and distributors of the **Dremel** range of precision hand-held power tools and Microflame soldering, brazing and welding tools and accessories.

MODEL WHEELWRIGHT

1 Fieldway, Fleet, Hampshire GU13 8ER

Mail order supplier of carriage, waggon and caravan plans and books for the construction of model horse-drawn vehicles.

N. MOLE & CO. (MACHINE TOOLS) LTD.

5 Tolpits Lane, Watford, Hertfordshire WD1 8LU

Tel: Watford 43135

A supplier of lathes, milling machines, etc., and the **Amolco** milling attachment.

MYFORD LTD.

Beeston, Nottingham NG9 1ER

Tel: 0602 254222

Manufacturers of model engineers' lathes and associated tools and accessories. Latest model is their 254s.

MILLHILL SUPPLIES

66 The Street, Crowmarsh, Gifford, Nr. Wallingford, Oxon OX10 8ES

Tel: 0491 38653

Specialist mail order tools suppliers; a free list is available on request.

Z. R. D. NADIRSHAW

441 West Green Road, Tottenham, London N15

Tel: 01 888 1865/4613

Suppliers of taps, dies, drills and reamers in all popular model engineers' sizes; one-off sizes are available, contact for a quote. Send a large S.A.E. for price list.

NAEROK LTD.

2 Queensway, Stem Lane Industrial Estate, New Milton, Hampshire BH25 5NN

Tel: 0425 619151

Suppliers of good quality imported machine tools, in particular **milling machines and drilling machines from the far East.**

NORMAN SPINK

52 Highfield Lane, Newbold, Chesterfield, S41 8AY

Tel: 0246 77010

A specialist in locomotive castings and drawings of which they stock a very wide range. Noted for high quality castings and prompt mail order despatch. They have several designs of their own including a 5 inch gauge Britannia, 5 inch gauge G.W.R. King and a 5 inch gauge British Railways 2-10-0, all of which are proving to be highly popular. Under the well known name of **WARCO**, the firm stocks a very wide range of machines of all sizes and types. The range goes through milling machines, lathes, drilling machines, grinders, power saws, etc. They have woodworking machinery as well. Of particular interest to modellers are their drilling machines and their 918 model engineer lathe as well as the popular range of drill mills. Also the firm stocks the Japanese **TOYO** range of machines which are proving popular with modellers.

F. O'BRIEN & CO. LTD.

Swadlincote, Burton-on-Trent DE11 0PH

Tel: 0283 217588

Manufacturers of drilling machines, including the **Star** range and, in particular, the **Startrite (Fabco)** series.

H. L. PEARSON

5 Ruskin Avenue, The Straits, Sedgley,

Dudley

Manufacturers of parts for model cannon which can be obtained as part machines or plain castings. The models are supplied with proper cast iron barrels and look most realistic when completed. The sort of odd project to fill in the shorter periods of time spent in the workshop.

PEATOL MACHINE TOOLS

19 Knightlow Road, Harborne, Birmingham B17 8PS

Tel: 021 429 1015

Manufacturers and suppliers of the **Peatol Micro Lathe** and its associated spares.

H. R. PLASTOW

The Old Rectory, All Saints, South Elmham, Nr. Halesworth, Suffolk IP19 0PB

Tel: 098 682 325

Traction engine specialists who stock a large range of drawings and castings for various types of traction engines and steam rollers. They include amongst the range some models in larger scales up to 4½ inches to the foot. They also have drawings and castings for some unusual stationary engines and stock several useful books on traction engine construction. Two of these are aimed at helping the constructor by showing a complete range of photographs relating to traction engine construction.

PRO-AM MACHINE TOOLS & MODEL ENGINEERS SUPPLY LTD.

Felmingham, North Walsham, Norfolk

Tel: 0263 732661

Excellent source of both new and used machine tools in most sizes.

PRECISION SERVICES

Princes Drive, Crackley Industrial Estate, Kenilworth, Warwickshire CV8 2FD

Tel: 0926 59142

Specialists in the supply of quality measuring instruments. The firm also stocks the **Unimat** range of machine tools.

PROOPS BROTHERS LTD.

52 Tottenham Court Road, London W1P 0BA

Tel: 01 636 4420

Suppliers and stockists of a very wide range of tools, materials and model engineering sundries, many at bargain prices.

PROOPS DISTRIBUTORS LTD.

Heybridge Estate, Castle Road, London NW10 8TD

Tel: 01 267 6911

Originally part of the Proops firm at Tottenham Court Road, this particular firm specialises in a very wide range of small items likely to be of interest to the model engineer. Many are in £1 packs with a variety of pieces of similar type incorporated in the same pack. They represent remarkable value.

QUALTERS & SMITH

Smith Wilkinson Ltd., Albion Road, Carlton, Barnsley, South Yorkshire S71 3HW

Tel: 0226 287561

Manufacturers of high quality, high precision drilling machines.

A. J. REEVES & CO. (BIRMINGHAM) LTD.

Holly Lane, Marston Green, Birmingham B37 7AW

Tel: 021 779 6831/2/3

The largest stock of all the suppliers. Probably with a leaning towards castings for loco-

motive construction for which they stock nearly all the popular types. They also have castings for traction engines, stationary engines, as well as a range of workshop equipment. They have several exclusive designs including a number of locomotives as well as workshop equipment and stationary engines. They keep the drawings and castings for the 2 inch scale **Shand Mason Fire Engine**. The large catalogue includes machines and tools as well as metal and all the other ancillary items likely to be required by the model engineer.

P. J. RICH

66 Cwm Cwddy Drive, Rhiwderin, Gwent

Tel: 0633 893156

Drawings and castings for several locomotives of exceptionally high standard. All non-published designs. The latest offering being an **LMS Patriot** in 5 inch gauge.

D. C. RICHARDS

PO Box 450, Parramatta, 2150, New South Wales, Australia

Tel: 02 633 4893

One of the leading suppliers in Australia. They stock drawings, castings, metal, screws, books, etc. Both British and Australian prototypes.

ROTAGRIP LTD.

16-20 Lodge Road, Hockley, Birmingham B37 7HT

Tel: 021 551 1566

Suppliers of a wide range of tools and equipment for the model and professional engineer. A speciality of the house is the supply of chuck spares. The catalogue, obtainable on receipt of a large s.a.e., is a useful item to have in the workshop filing system. Personal callers are welcome and mail orders are dealt with as quickly as possible.

SCOT URQUHART

371 Earlsfield Road, London SW18

Tel: 01 874 5708

Manufacturers of high quality tooling. Probably best known for their rotary and compound tables. Their products are stocked by many regular suppliers.

J. SIMBLE & SONS

The Broadway, Queens Road, Watford, Herts.

Tel: 0923 26052

One of the largest tool stockists in the home counties. Can meet most requirements of the model engineer from stock.

NATHAN SHESTOPAL LTD.

Unit 2, Sapcote Trading Centre, 374 High Road, Willesden NW10 2DH

Tel: 01 451 6188

Stockists of a wide variety of machine tools and accessories and principal source of supply for **Primus Sievert** gas equipment.

SKILLED CRAFTS LTD.

34 Bradford Road, Cleckheaton, W. Yorks.

Tel: 0274 872861

New and second-hand machine tool stockists with a large selection of equipment by quality manufacturers.

SMALL MACHINE TOOLS LTD.

Unit B3, Seadon Court, Gorse Lane Industrial Estate, Clacton-on-Sea, Essex

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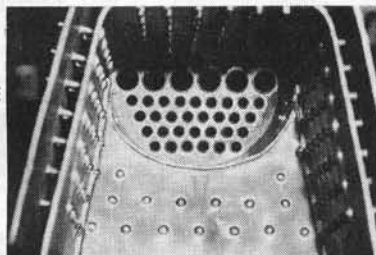
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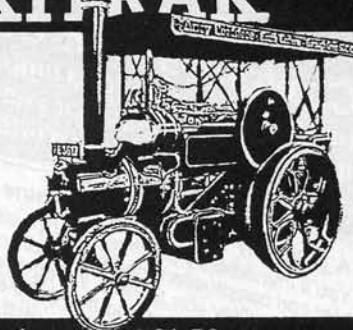
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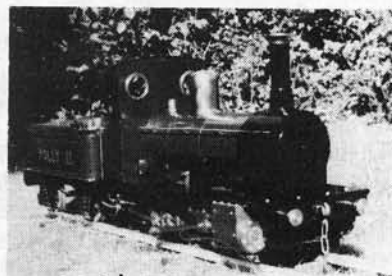
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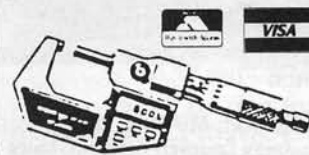
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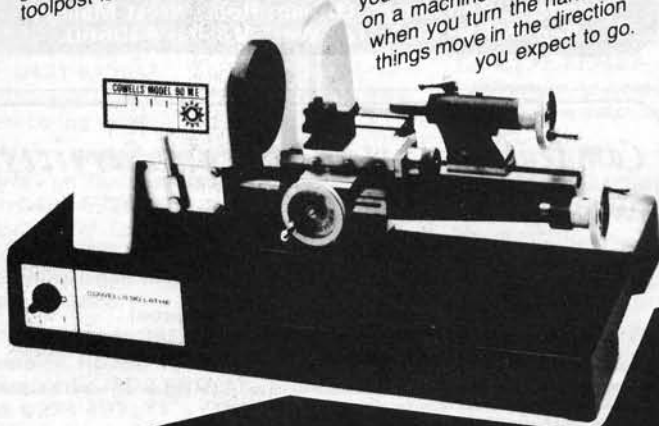
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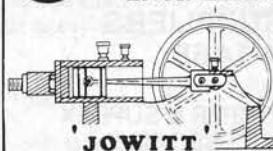
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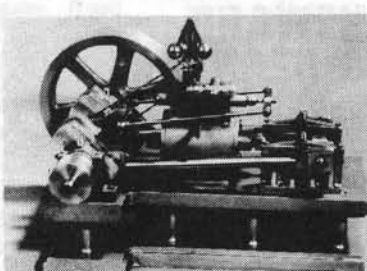
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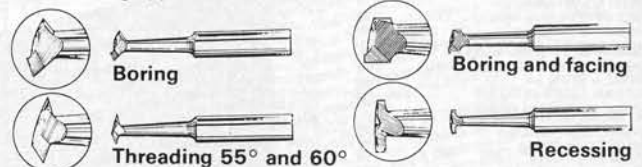
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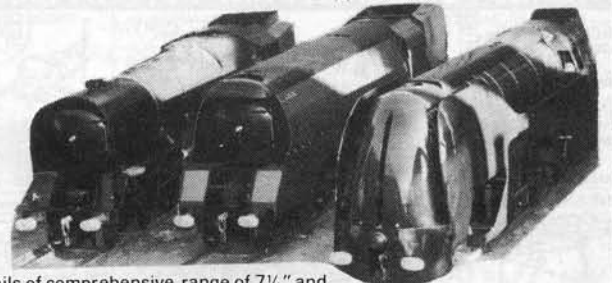


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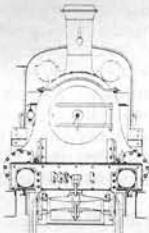
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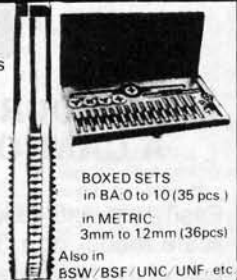


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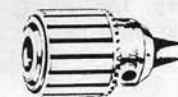
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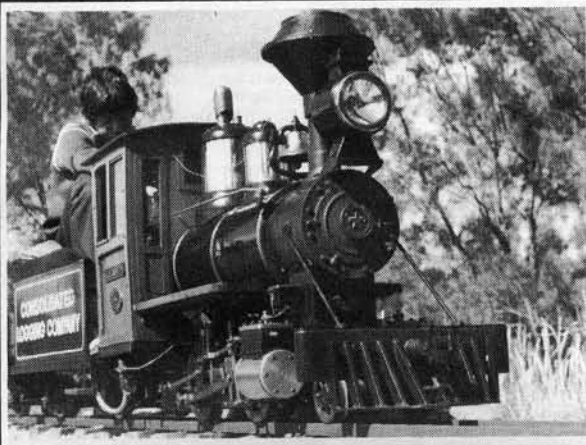


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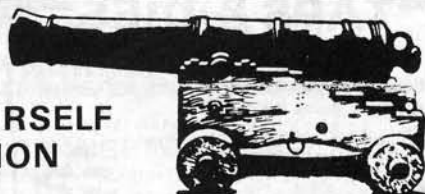
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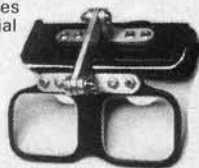
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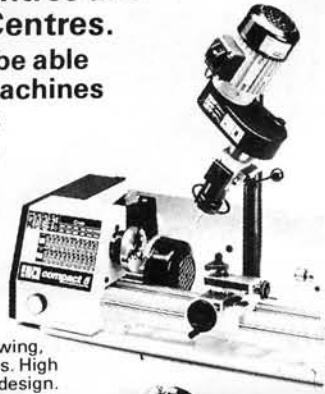


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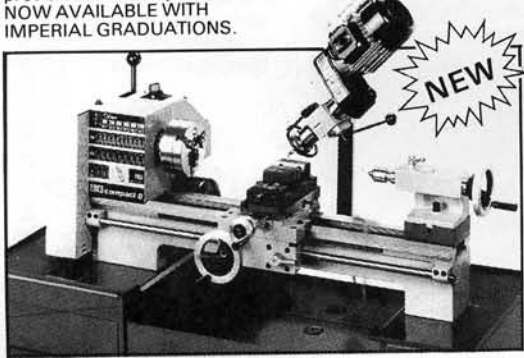
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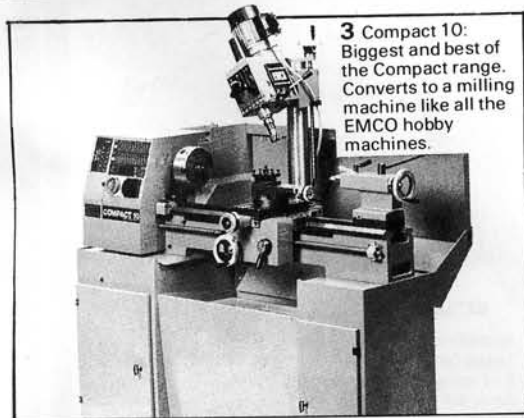
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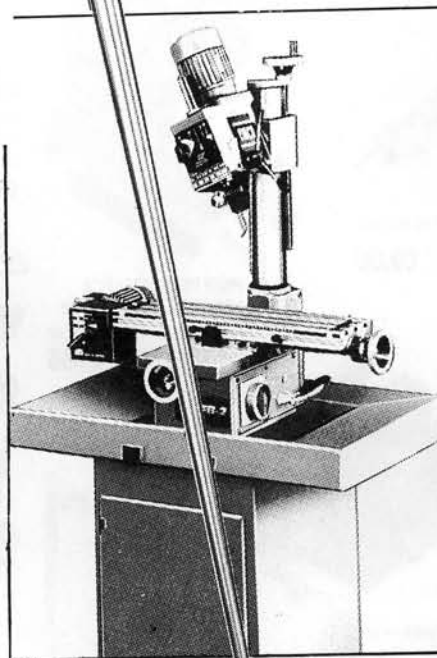
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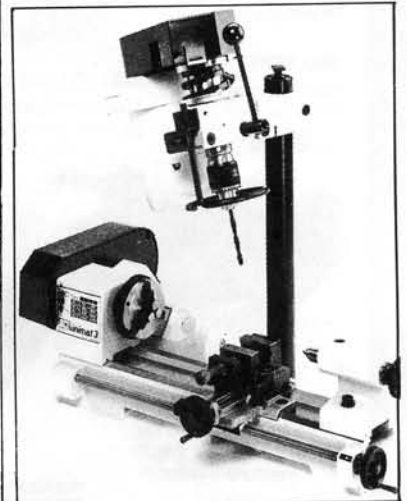
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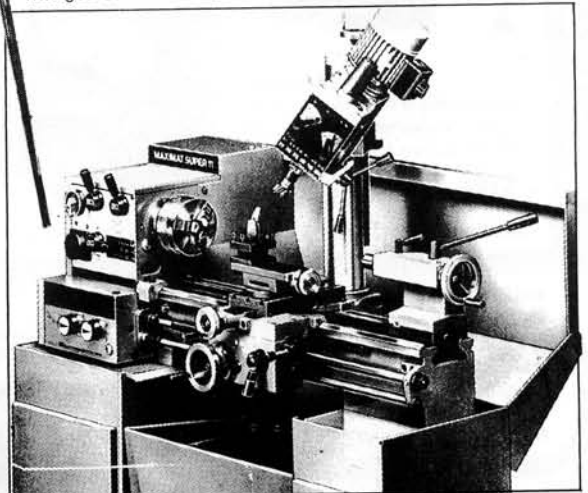
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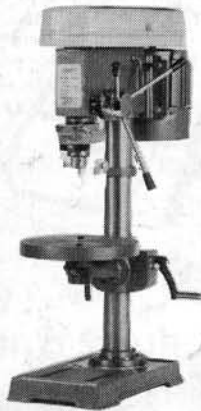
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WARCO

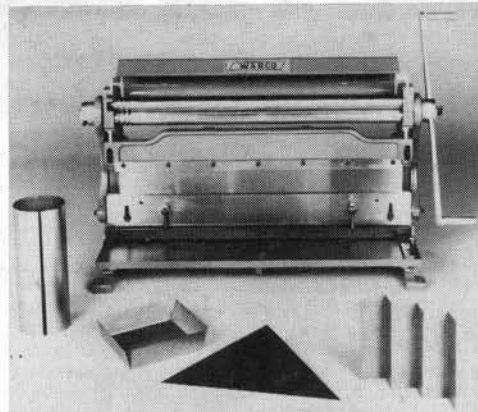
**RENOWNED FOR QUALITY, CARE AND AN UNRIVALLED AFTER SALES SERVICE.
WE STOCK THE LARGEST AND MOST COMPREHENSIVE MODEL ENGINEER MACHINE TOOL RANGE.**



BENCH GRINDERS
European made. Big horsepower.

5 1/2 h.p. **£37.50**
6 3/4 h.p. **£45.50**
8 3/4 h.p. **£72.50**

Supplied with eye shields, tool rests, one coarse and one medium stone. Wide variety of replacement stones in stock including green grit.



FORMIT

Universal sheet metal machine. 30" x 20 gauge. Rolls with top slip roll and wire grooves. Press brake with segmented knife for box and pan folding. Guillotine with back stop and squaring arm. Heavy duty construction.

£673

TOOL MATE TROLLEY £51.30

Sturdy and durable. Heavy duty 16g steel - 400lbs shelf loading. Locking wheels. Adjustable partitions. When closed doubles as comfortable seat. 840mm shelves 673mm x 355mm.

DRILLS

Huge selection from 1/2" to 1 1/2". Bench mounting or floor standing. Full specification in our brochure.



DRILL GRINDING ATTACHMENT

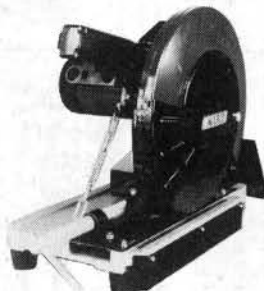
Accurate sharpening of blunt or broken drills from 1/8" to 3/4"

£9.00

DRILL VICES

Robust cast iron construction. 3", 4", 5", 6".

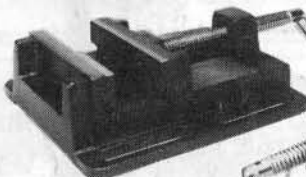
From **£9.40**



HIGH PERFORMANCE ABRASIVE CUT OFF SAW

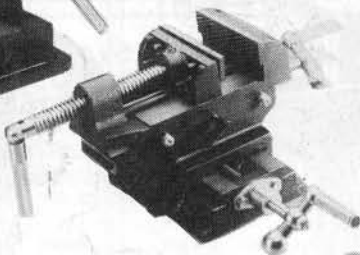
Portable. Available 240 volt or 110 volt. 1/2" capacity.

£185



CROSS VICES

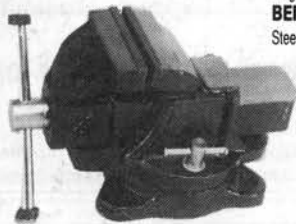
Two axis movement. Locks on top and bottom slides. Adjustable gib strips. Calibrated dials. 3", 4" and 6". Full specification in our brochure.



Huge selection of quality low cost

BENCH VICES.

Steel or cast iron from **£10.40**
Full specification in our brochure.

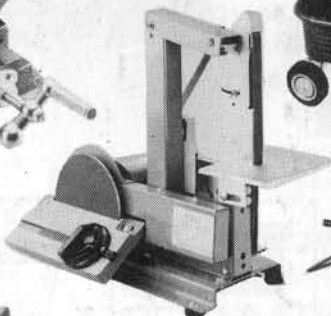


314 BANDSAW

Metal/woodcutting. 14" throat 5" depth of cut. 3 speeds. 1/2 h.p. motor. Tilting main table with mitre gauge - fence - circle cutting attachment. 6" sanding disc with tilting table and mitre gauge.

£156

Sanding belt supplied as blade option.



BDS 180 BELT DISC SANDER

1" wide sanding belt for intricate complex shapes. 8" dia sanding disc with tilting table and mitre gauge.

£153

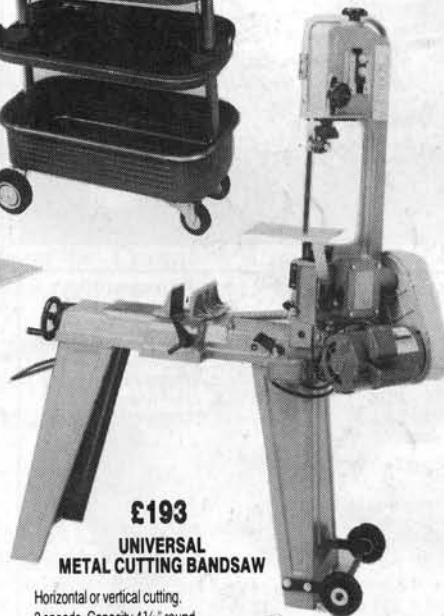
BDS 460 BELT DISC SANDER

£87

BDS 690 BELT DISC SANDER

£184

Full range of replacement belts and discs in stock.



£193

UNIVERSAL METAL CUTTING BANDSAW

Horizontal or vertical cutting. 3 speeds. Capacity 4 1/2" round. 6" x 4" rectangular section mitre vice. Auto cut off at end of stroke.

Large selection of used part exchange Myford's and other small/medium size lathes. Stock rapidly changing - please phone for details on 048 641 3434.

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