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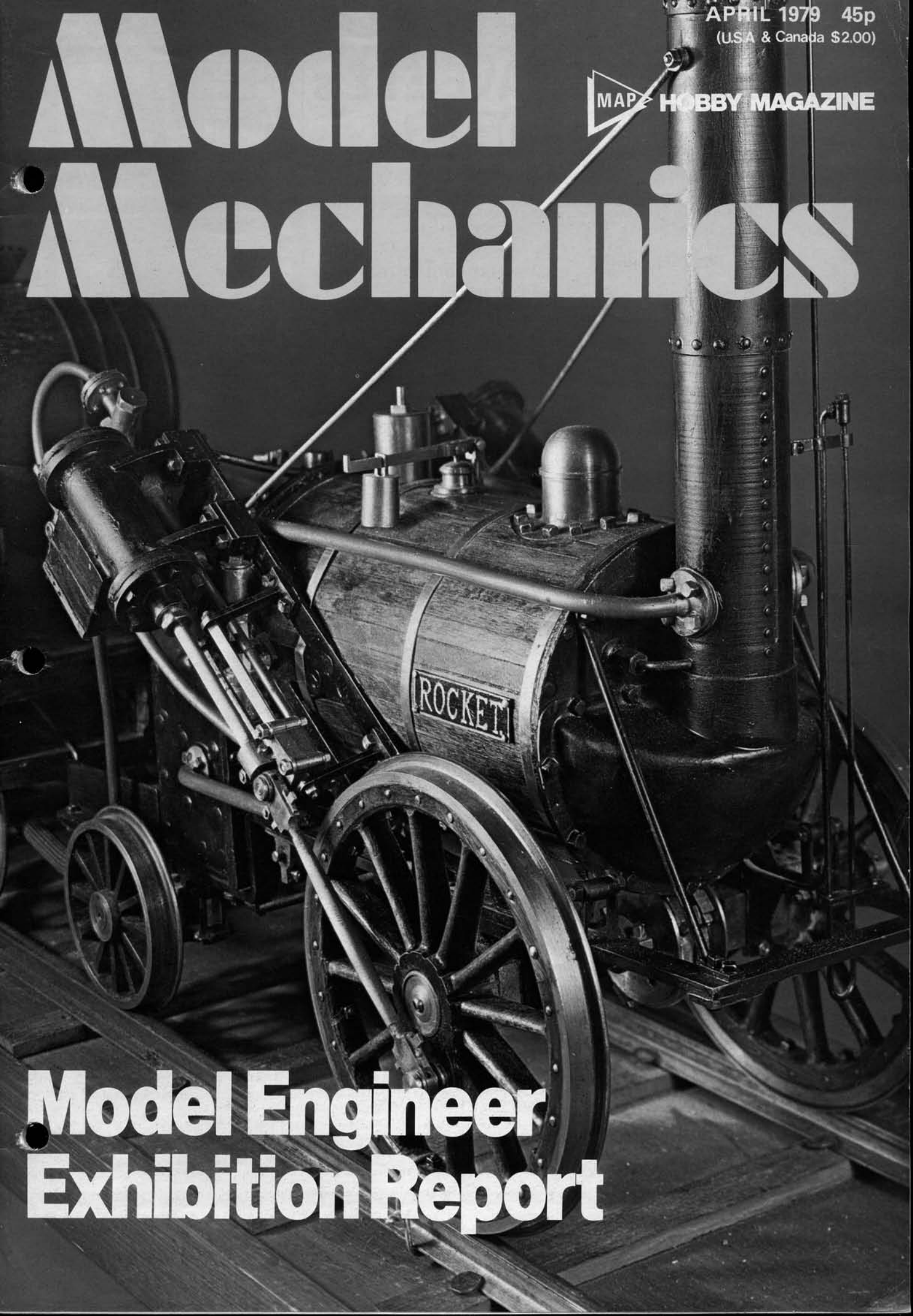
Model Mechanics

MAP HOBBY MAGAZINE



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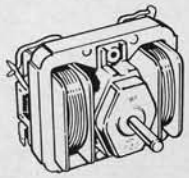


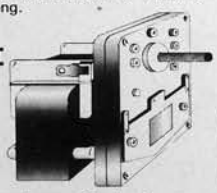
INDUCTION MOTOR

60p carr. & pkg. 25p

Mains operated, 2,800 r.p.m. Approx. size 59 × 65 × 49 mm., 18 mm. long.

•220/240 Volt A.C. Motor & Gearbox

£5 p&p 90p



Shaded pole type motor, gear box with steel gears. Approx. size 93 × 75 × 18 mm. deep. Shaft length approx. 26 mm., diam. 8 mm. Available with final drive shaft speed of 20 r.p.m., 60 r.p.m. or 100 r.p.m. State requirements.

•ROBUST 12 Volt 2.5A. D.C. Motor

£2.50 p&p 60p

Approx. dimensions 74 × 60 mm. diam. Shaft length approx. 6 mm. × 2 mm. diam.

Manufactured by Crouzet. 3600 r.p.m.

• MODEL MOTOR 12v.

Johnson Type 333.

Approx. 1¼ in. long x 1in. diam. Spindle ½ in. long x 1/16in. diam.

75p carr. & pkg. 15p

• AC/DC POWER UNIT

£1.50

carr. & pkg. 35p

Compact versatile unit in plastic case, suitable for a wide variety of modelling applications; power for small motor, miniature lighting circuits, etc. Input 220/240v A.C. 50 Hz. Output 12v 0.3a D.C.; 15v 0.5a A.C. Double insulated and fitted with Thermal Overload Cut-out. Size approx. 3 x 2 x 2 in. Approx. 8 ft. twin core mains lead.

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£1 p.&p. 15p

• ELECTRIC CLOCK TIMER

£1.75 Carr. & pkg. 55p

Mains operated electric clock powered by 3w. synchronous motor and engineered to the highest standards of reliability. Makes a useful timepiece but originally intended as a cooker time switch. Can be used in dozens of control situations, such as converting radios to clock radios, switching on lighting, process timing, etc. Switches up to 25A 230/240v. AC 50 Hz and can be pre-set to allow once on / once off switching in a 5-hour period.

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• SYNCHRONOUS MOTOR

£1.00 carr. & pkg. 20p

12 volts A.C. 50 cy. 600 rpm. Size: 47mm dia. x 18mm wide. Spindle 6.8mm long, 1.9mm dia.

• GEAR SET

£1.75 carr. & pkg. 25p

40dp white nylon matching gears, with two interlocking racks and 3v. motor with drive shaft to suit. Set comprises 5 gears (number of teeth shown in brackets), 40mm dia. (60); 33mm (50); 27mm (40); 20mm (30); 14mm (20); one pinion 7mm (10); two racks 103mm long (50); 3 x 115mm lengths shafting plus 3v. motor 35mm overall length x 24mm dia. with 7mm long drive shaft. All dimensions approx.

• PULLEY SET

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All modeller needs to make up fascinating step-up, step-down, reverse motion pulley mechanisms. Set of 8 white nylon pulley wheels, consisting of two 30mm dia. two 20mm dia. and four 11mm dia., i.e. in a ratio of approx. 1:2:3. 16 interchangeable bosses also supplied for making up fixed or loose, single or double, pulleys, together with suitable shafting and driving bands. PLUS a 3v. D.C. motor complete with mounting brackets and screws to power your model. Full instructions and illustrated examples included.

•MULTITESTER

£4.95 p&p 25p

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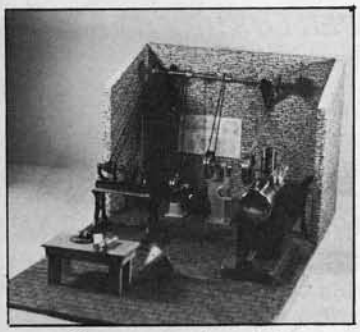
Model Mechanics

VOLUME 1 Number 3 APRIL 1979

Model of George Stephenson's locomotive the "ROCKET" in 3½ in. gauge. Made by Mr. Rowland H. Procter of Twyford, Reading, Berks. The construction follows that of the original locomotive.



Steam powered workshop.

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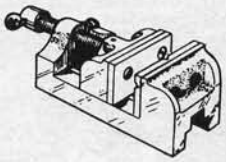

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Editor's Chat

Now that we have reached the third issue of *'Model Mechanics'*, we are beginning to receive letters from readers — which is exactly what we had hoped. For the most part you have all been very kind and it is obvious from your letters that the magazine should prove popular. Some of you have made suggestions for future issues and all of these will be considered and hopefully incorporated. We have, for example, been asked to include articles on slot car racing and approaches have been made to certain experts in this field. Meccano, too, should be included shortly. What is important is the fact that you have responded to the first issue and given us a basis for development. True there have also been one or two voices raised in disapproval. One reader complained that the first issue contained too much in the way of steam and was, therefore just an extension of *'Model Engineer'*. For my part I cannot agree and I know many others would query whether one can ever have enough steam!

Nevertheless, the opinion is welcome because it would not do for all of us to be tarred with the same brush and if, by respecting an individual request we also please others who have not expressed their views, some benefit must result. On the other hand, we must not overlook the fact that suggestions and criticisms have been made on the strength of one issue in which space was limited and available articles obtained at very short notice. It was only natural that many of the contributors are well-known to us at Model Engineer. In time we will receive — indeed we are already receiving — articles from readers which will, we hope, be as varied as it is possible to be.

It has been suggested that *'Model Mechanics'* overlaps with other magazines in M.A.P.'s range, and I for one would not disagree. But if we are to publish a magazine for the model maker, rather than for the specialist in model engineering, boats, aircraft etc., then all of these subjects should at some stage be included. I well remember *'Model Maker'* magazine of the 1950s, I read it regularly and although I made only a few of the projects included it was always a source of pleasure to read.

If, when you have been reading *'Model Mechanics'* for some time, then you decide to concentrate on one branch of model making activity, then of course you will turn to the magazine offering most information on the subject. If, on the other hand, you decide to retain the freedom of a variation in modelling activities then we hope you will stay with *'Model Mechanics'* and help us to make it the magazine to meet your needs.

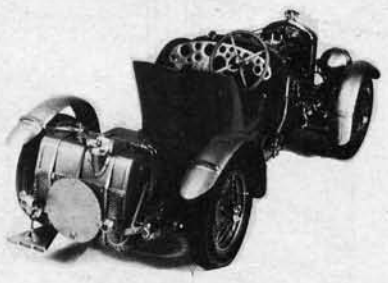
This, the third issue, welcomes the start of a steam locomotive design by Martin Evans, who is already very well-known in the field. At our request he has restricted the size to 2½in. gauge so that all components may be machined on one of the table-top lathes currently available. There is a flourishing National 2½in. Gauge Association, whose rallies will be reported in *'Model Mechanics'* from time to time and the secretary will be pleased to welcome new members and advise you of those clubs which own a track of this gauge. One size smaller is the Gauge 1 Association, which favours the 1¾in. gauge and this is also a very useful size of model for those with limited machine shop equipment. Here are your contacts:

National 2½in. Gauge Association
Secretary: Paul Wiese, 6 Halliwell Road,
Redcliffe Bay, Portishead, Bristol.
Telephone: 0272 848147.

Gauge 1 Association
Secretary: S. J. Roberts, Esq.,
12 Clarendon Road, Broadstone, Dorset, BH18 9HY.
Telephone: 0202 694213.

Some of you who have been following the simple steam engines of John Wheeler may have seen these at the Model Engineer Exhibition at Wembley in January. In this issue, John discusses a reversing arrangement for the engines, which make them ideal for radio control in boats. John also starts talking about simple lathe-work, which I am sure is what many of you wish to learn and this theme will be kept up in future issues. Chairman of the Sheppey Miniature Engineering and Model Society, John Wheeler also teaches metal work at his local school and his natural ability for teaching is reflected in his articles.

On the car scene, Geoff Sheppard's slightly more ambitious project is taking shape and I hope there are many like it throughout the model making scene. Those of you who favour the car as a model will be interested in a competition known as the Elliott/Wingrove award. Judging takes place in December and there are very handsome prizes for cars built from plastic or white-metal kits and scratch built. I hope the latter class will appeal to *'Model Mechanics'* readers, but it must be a model of an actual car. Do not worry if your standard cannot reach that of Gerald Wingrove, whose magnificent Hispano-Suiza appeared on the cover of issue 2. Mr. Wingrove is a professional and is involved with the organisation of the competition. But his model epitomises the atmosphere of all model building. We see something we like and decide to make a model of it. How we go about it and what the end result is like is very much up to the individual.



Gerald Wingrove's 4-½ litre Bentley

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Baseboard basics

By Cyril Freezer

Some years ago my wife and I, as is our wont, were looking over a large house. In one of the two attic rooms we found, already erected, a Greenly style baseboard. Apart from the fact that this house was large, and conveniently situated close to shops and sea, this was the only other point of merit, so we declined the offer.

The important point is that I instantly recognised the origin, yet, when a few months ago I at last acquired a copy of Greenly's *Model Railways*, published in 1924 (a very good year) I discovered that in a mass of useful, practical information, a deal of which still has relevance over half a century later, he included one short paragraph and two diagrams on the subject of substructures. For the benefit of those who have never seen this minor classic, I've redrawn the sketches and included the paragraph 'for it reveals so clearly a way of life is gone forever'. To be fair, later in the book there are details of baseboard variation but the important point is that Greenly was still thinking of the pre-war (1914-18, of course) enthusiast who usually called in a local craftsman to build the baseboard. In the few cases where this wasn't done, the reason was that there was a sound handyman on the staff. Not that this denoted laziness, the old-time modeller was faced with a lot of tasks most of us avoid like the plague.

In the brave new world of a land fit for heroes, the hobby was moving down the social scale, and the prophet was the Rev. Edward Beal, who not only popularised OO gauge but in the early 1930s practically wrote *Model Railway News*. As befits a Scots preacher, he had a shrewd idea of the value of money and was full of ingenious ways of converting domestic items into model railway fittings. Unfortunately, his knowledge of structural mechanics was about on a par with my acquaintance with theology.

In his first textbook, the classic *Railway Modelling in Miniature*, he deals with baseboards in roughly two pages. I have redrawn his principal diagrams; he shows how, more or less, to make gradients; his cross-section of an embankment is sound.

However, he omits the longitudinal stringers on the baseboard which, in the Greenly design, add a vital strength. His inclusion of angle brackets is in some way a substitute, but I suspect the carpenter building a Greenly style baseboard would have used a few strategically located skew nails to hold the feet in position, unless the floor was stone or concrete.

However, Beal points out correctly that if you construct the baseboard between the walls the final result, if you are using planks for the top surface, is a fairly rigid structure.

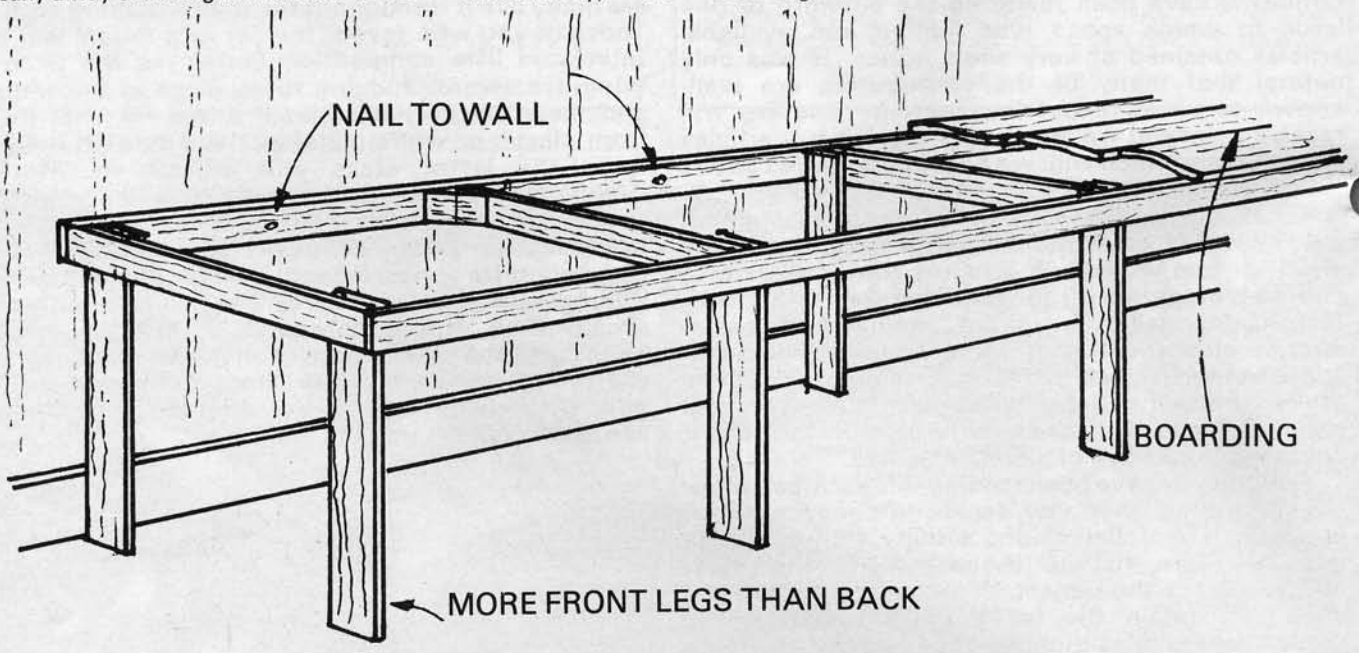
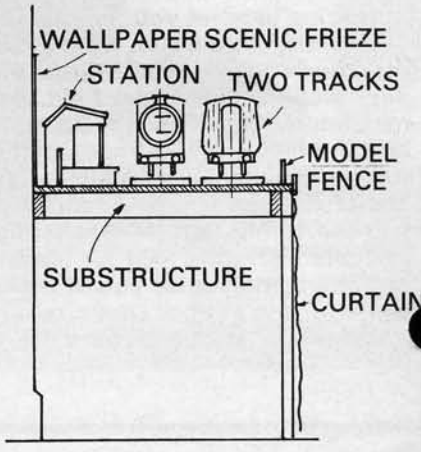


Fig. 1 Substructures

As a general rule, the convenient height above the floor level for an indoor model railway is 3ft. 2in. to rail level. The line is laid on frames supported from the wall and posts to the floor. The frames are boarded. While the height of the trestling may be varied it is, perhaps, convenient to arrange it at one level, except at dips in the surface, which may require to be bridged by embankments or viaducts. Cuttings, tunnels, etc., are then built up from this level. Fig. 42 shows a suitable arrangement of framing. Fig. 43 is a cross-section indicating a scenic frieze or painting on the wall at the back and a curtain to mask the legs of the sub framing in the front.

Extract from 'Model Railways' by Henry Greenly. 1924.



Now I must digress. Although we tend to think at present that the price of timber is such that one might be excused for believing the stuff doesn't grow on trees after all, in the 1930s it only appeared cheap. At least, it was when you bought it from a timber merchant, but in those days the ubiquitous card carton was in the minority. Almost everything came in wooden crates and if you were prepared to carry them home your local grocer would sell you empty crates for a penny, or in the case of the larger egg crates a penny ha'penny. Old-fashioned big pennies, of course. There was just one snag: most of the wood was fairly thin and, in general, unsuitable for this type of baseboard construction. In point of fact, if this source of supply still obtained I would explain how, with a lot of boxes and a little ingenuity, it is possible to build a combination baseboard-bookcase. (Incidentally, I have seen accounts of how to make a baseboard from heavy-duty card cases, but I've not tried it.)

The snag is that, in the absence of sizes for the baseboard scantlings there was a temptation to use the long planks from egg crates: the result was just tolerable. When Edward Beal discovered Treetex he failed to realise it needed battening. Hence, in his forth book, *Scale Railway Modelling Today*, he begins a chapter on baseboards (up to then it was a section of another chapter) with the ominous sentence:

'The most expeditious method of building up a baseboard for a railway model layout is only learned through years of experiment.' What a pity Henry Greenly, who knew the right answer (he was a highly competent engineer), failed to give a full specification, let alone point out the importance of the solid timber top. At least by then Beal realised you needed 75 × 25 (3in. × 1in.) timber for this type of baseboard.

John Ahern had come up in the 1940s with a design for a permanent baseboard which used 50 × 25 or 40 × 20 timber, and could cope with rough sawn material. For a permanent layout it is sound, if obsolescent. Furthermore, in *Miniature Landscape Construction* (still in print!) he shows how this type of construction can be built for straightforward, though far from easy, dismantling.

The Ahern method of framing has a serious defect, the supports run along the track; for convenience, and to minimise trouble in the event of sag or misalignment, they should be run across.

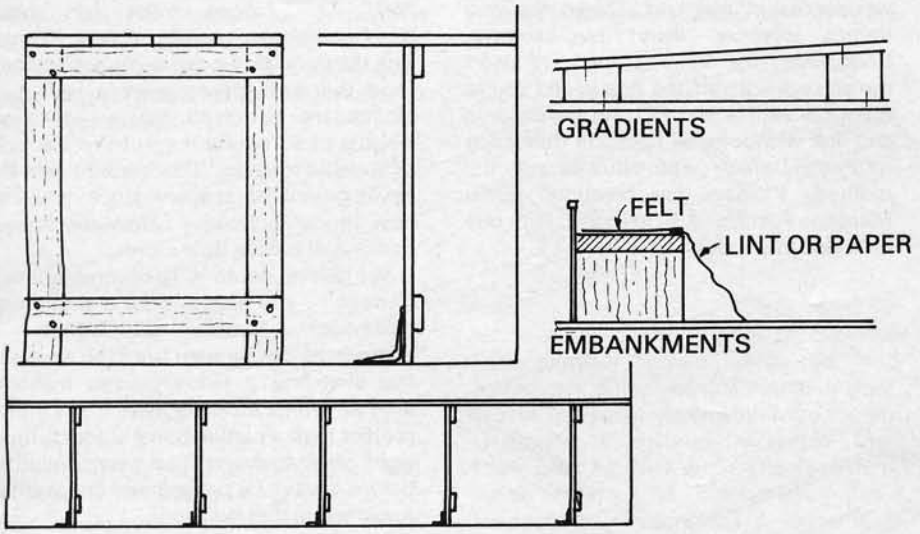


Fig. 2. Baseboard framing from Edward Beal's Railway Modelling in Miniature. No sizes are given, and the longitudinal member is omitted. Sketches showing the arrangement of gradients and embankments were added.

In the inset I show a very simple, effective framing which works well if you have a source of relatively small section timber of uniform thickness, or a lot of second-hand floorboards and a power saw, which comes to the same thing. It has one great virtue, you just nail cross bearers to the two longitudinals: if the longitudinals spring so much under the hammer that it is hard to drive in the nails, shove in an extra pair of legs! Crude, but effective.

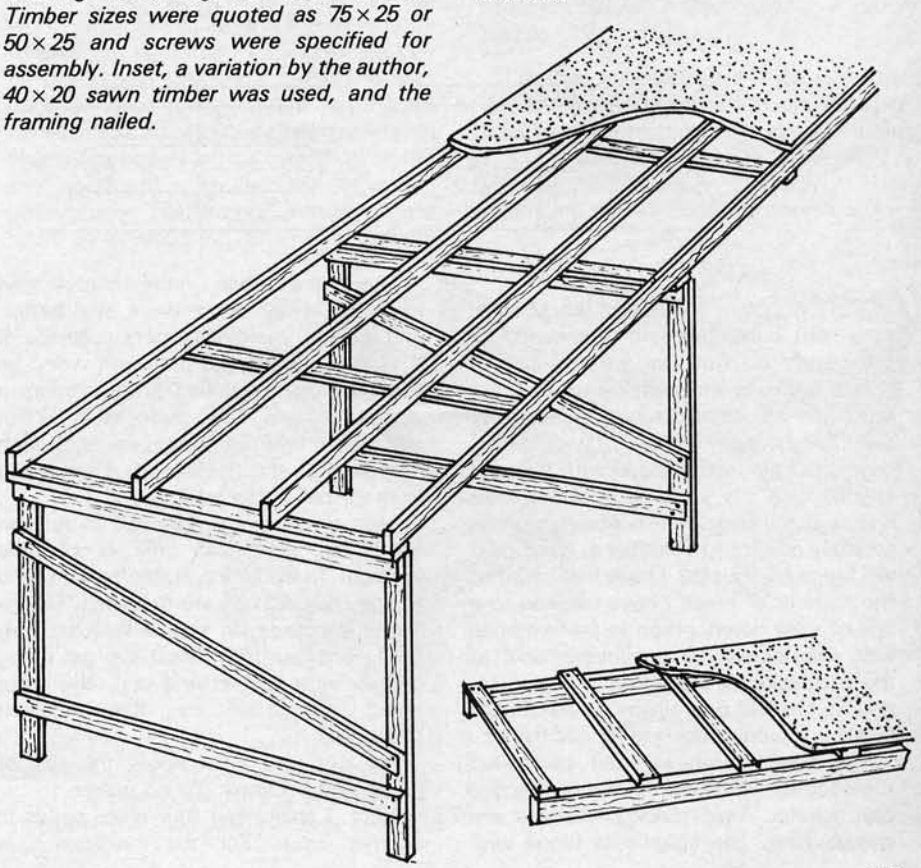
However, by then the need for portable layouts was growing. More than that, even those with a permanent site were told to build the model in sections so it could be readily removed and re-erected quickly in the event of moving house.

Let me put it bluntly: you have a much better chance of winning a portable television in a national competition than moving house and finding that the layout will fit. My wife did the first; despite five moves since our marriage, we've failed to find a site even approximately similar to the one I had before. Now, with a sixth move in the offing, I am certain that the new layout, built to fit a garden shed, will prove incorrect when re-erected. Even if I take the shed, it will be a fractionally different size on the re-erection.

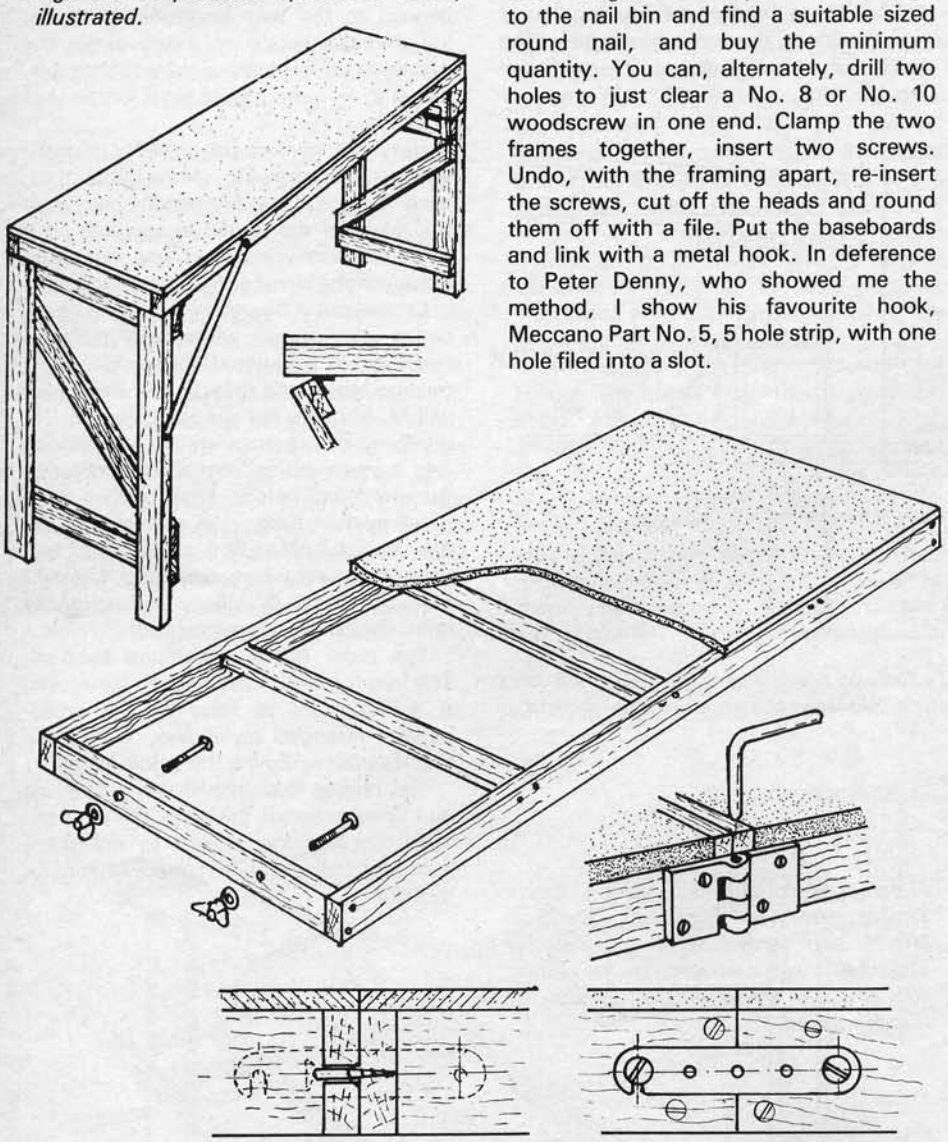
The basic British baseboard evolved. The framing is 50 × 25 prepared softwood. It is important to have all the cross-bearers arranged as shown, within the side members running the whole length.

The reason is simple: if you screw the end bearers across the sides the strength resides in just four screws in end-grain: not very clever and a certain recipe for disaster.

Framing according to John Ahern. Timber sizes were quoted as 75 × 25 or 50 × 25 and screws were specified for assembly. Inset, a variation by the author, 40 × 20 sawn timber was used, and the framing nailed.



Below, Fig. 4, we have the standard British baseboard frame, made generally from 50×25 timber, covered with ply, blockboard, chipboard or semi-hard wall panel. Sections are joined by coach bolts, split hinges or dowel and hook (see text). Alongside the arrangement for hinging legs for a portable system is briefly illustrated.



The top surface can be ply, blockboard, semi-hard building board (Sundeala) or chipboard. Do not use soft wallboard, unless backed with something else. *Do not under any circumstances whatsoever use hardboard.* Many DIY 'experts' describe 'train tables' faced with this, yet anyone with any knowledge of materials knows that unless put in position under carefully controlled conditions, hardboard will bulge and buckle. I have lost count of the number of times I have listened to a tale of slow deterioration in performance with ever-increasing derailments and, at the end, told the unfortunate enthusiast that he has laid the railway on hardboard and that the only cure is to rebuild the lot.

The basic baseboard can be bolted together with coachbolts. This is effective but tedious. Two quicker systems are shown inset. The ubiquitous hinge with the pin removed and replaced by a close fitting wire insert is very quick. The only problem is making the pin. The answer is to buy your hinges from one of the few surviving ironmongers rather than a DIY shop. The hinges will come from a cardboard box at half the price of the same thing in a bubble pack. You then go to the nail bin and find a suitable sized round nail, and buy the minimum quantity. You can, alternately, drill two holes to just clear a No. 8 or No. 10 woodscrew in one end. Clamp the two frames together, insert two screws. Undo, with the framing apart, re-insert the screws, cut off the heads and round them off with a file. Put the baseboards and link with a metal hook. In deference to Peter Denny, who showed me the method, I show his favourite hook, Meccano Part No. 5, 5 hole strip, with one hole filed into a slot.

There are other, more complicated methods. They don't work any better, and are only marginally more accurate. It is worth pointing out that with wood an accuracy greater than 0.5mm is more a matter of luck than judgement. With relatively crude methods there is enough play to align the tracks with a smart tap from the ball of the palm.

Legs on a semi-permanent layout can be bolted in place: time is of little moment. In the true portable layout speed is vital, hinged legs are favoured. Only a few baseboards (in simple layouts, only one) need four legs. Most can get along happily with two at one end, the other being supported by the adjacent baseboard.

I've not said a lot about the size of baseboard sections. To do justice to the subject, I shall need four more pages in another issue. For the moment it is enough to say that, although club layouts can use large modules, since we can assume two or more willing workers, this is not possible on private layouts. Agreed, one's wife is technically available, but I said willing. Apart from that in most houses there is a tight pinch along the corridor. The only answer is to up-end the baseboard and carry it in front of you. Anything much over 1.5m × .75m is too big, and too heavy.

One way of reducing length is to fold in half. The hinges must be above baseboard level, usually at least 50mm. The diagram shows the open top system. Here the track bases are cut from ply, blockboard or chipboard — or short lengths of softwood if you have a supply of suitable material. This method aids the development of scenery since you can now model landscape below the line of track. Just below, little more.

For greater depth — to accommodate a viaduct — you simply drop a section of baseboard. Usually 200-500mm is enough, as can be seen from the diagram. I've sketched a medium-sized masonry arch in Brunel style because it's not only prettier than a conventional viaduct, but a sight easier to draw: I had twenty minutes before a good TV programme and wanted to complete that drawing!

Now two hints. To fit screws, you need to drill two holes, a clearance in the top piece and a 'tapping' in the bottom. There are tables; I prefer a little trial and error and commonsense. In theory you should countersink, I find that with most softwood and good screwdrivers most screws countersink themselves. OK, I know it's wrong, but it works for me. Incidentally, there are sets of D-bits which will put all the holes in place in one go.

If your carpentry is at all suspect, the simple way of strengthening the curves is a 5mm ply gusset plate fixed underneath the framing. Metal corner brackets cost money and are difficult to screw in place.

I,ve included a sketch of the L girder system. This is about the best thing to have come out of the USA, a stroke of genius on the part of Linn Westcott.

It is at once simple and highly sophisticated, and calls for another full-dress article to explain. It is ideally suited for a permanent layout, and has the great virtue that the whole system can be broken down into individual timbers for removal. It also uses the absolute minimum of legs. For elaborate multi-level scenic systems there is nothing better.

It is, however, over-elaborate for a small portable layout. Perhaps the most important development here is the growth of car-ownership. It is not too far-fetched to say that a portable layout should fit into the family car and leave room for luggage. Yes, I know about roof-racks, I also know that even without rain, an unprotected layout is not going to enjoy a spin at 70 m.p.h. along a motorway. Nor is an estate car or hatchback necessarily a good idea, and even then you often need to seat three or four.

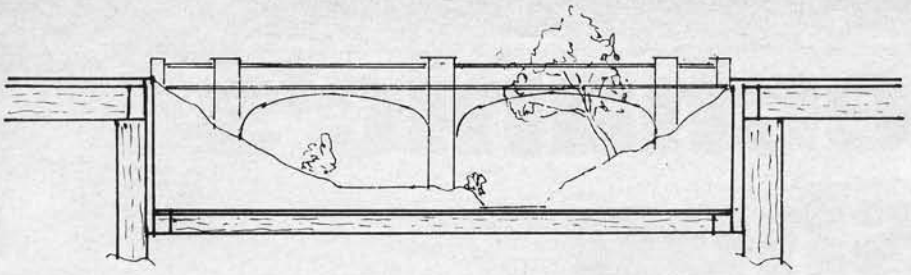
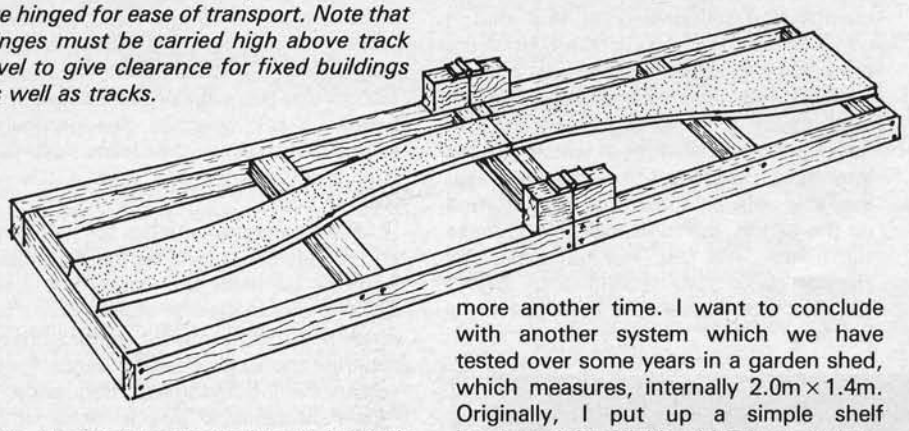


Fig. 5. At the top we show how by dropping one section any required distance, a valley can be introduced to provide a viaduct section. Below a pair of sections are hinged for ease of transport. Note that hinges must be carried high above track level to give clearance for fixed buildings as well as tracks.



So the ideal maximum length for each module is 1m. With so small a layout 50 × 25 timber is unnecessarily heavy, 25 × 25 is ample. After a little experimenting, my eldest son Nick and I developed a coffee-table system, using ready-made screw-in legs to support and their sockets as corner brackets. Surfaced with 5mm ply the resulting baseboard is roughly half the weight. The splayed legs increase the base, a useful feature on small layouts.

Agreed the height, 500-700mm depending on the legs, sounds low compared with Henry Greenly's chosen 1m, but in practice these small layouts can be operated whilst sitting in an easy chair. They do not obstruct the view of the TV, and can be easily stepped over. Ducking under portable layouts is a dangerous business.

We have developed this concept further in Nick's Dugsdale Road, of which more another time. I want to conclude with another system which we have tested over some years in a garden shed, which measures, internally 2.0m × 1.4m. Originally, I put up a simple shelf baseboard for Nick's old Triang system, made from 12m blockboard. As I suspected, with brackets at every shed frame, it didn't sag, so when I took over the shed as a workshop, and realised that a simple test-track could double as a small layout, I adopted a slightly modified version of this simple scheme. The final diagram shows how it is built. 12mm blockboard or chipboard is supported by 12m blockboard brackets screwed to each frame. 25 × 25mm end pieces have coach-bolt fixings, small pieces of 25 × 25mm wood are screwed around the front edge to take the hardboard edging which can be cut to a profile for a cutting. It also adds a little stiffness. The hardboard backscene is fixed to the shed framing. In practice it covers all the space up to the next shelf and is backed with expanded polystyrene insulation. Actually, you could be excused for thinking it is empty egg boxes, but I've always believed in recycling waste.

Although I haven't tried it, I have a feeling that with a hardboard edging on each side, glued and pinned to the baseboard surface, baseboards of up to 1m would be quite strong. The beauty of this system is that, with a jig saw you can build the most intricate shape, an important factor when building a minimum sized layout with a central operating well.

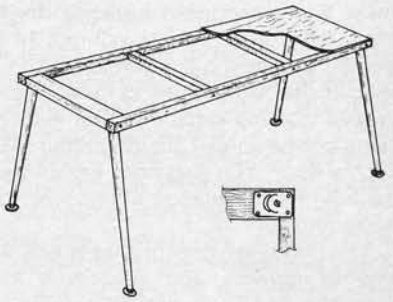


Fig. 6. Lightweight coffee table type baseboard, utilising ready-made screw-in legs. Longitudinal timbers 25 × 25, end members 50 × 25. Note how the fixing bracket also serves to strengthen the corner joint and that the legs splay outward to widen the base.

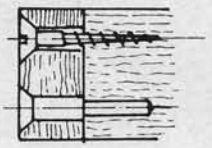


Fig. 7. Above, pre-drilling holes for screws. Below, a simple gusset, cut from ply can be screwed underneath to strengthen the frame. Useful if your carpentry is doubtful.

I'd like to emphasise that with the exception of the early Greenly style baseboard, which is well known to be solid and reliable, I have tried all the schemes mentioned in this article. They work, and are reasonably economical.

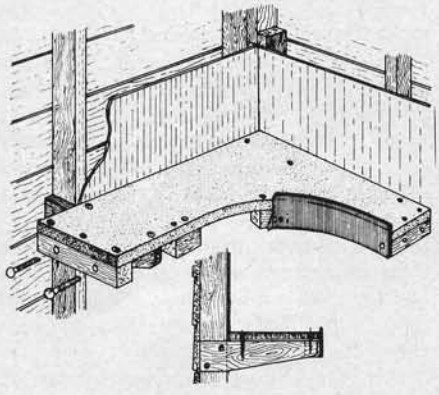


Fig. 8. Lightweight baseboard for use in garden shed or other situation where bracket supports can be arranged at not more than 500mm centres. The main strength lies in the surface, 12mm chipboard or blockboard, a little stiffening is provided by the hardboard fascia.

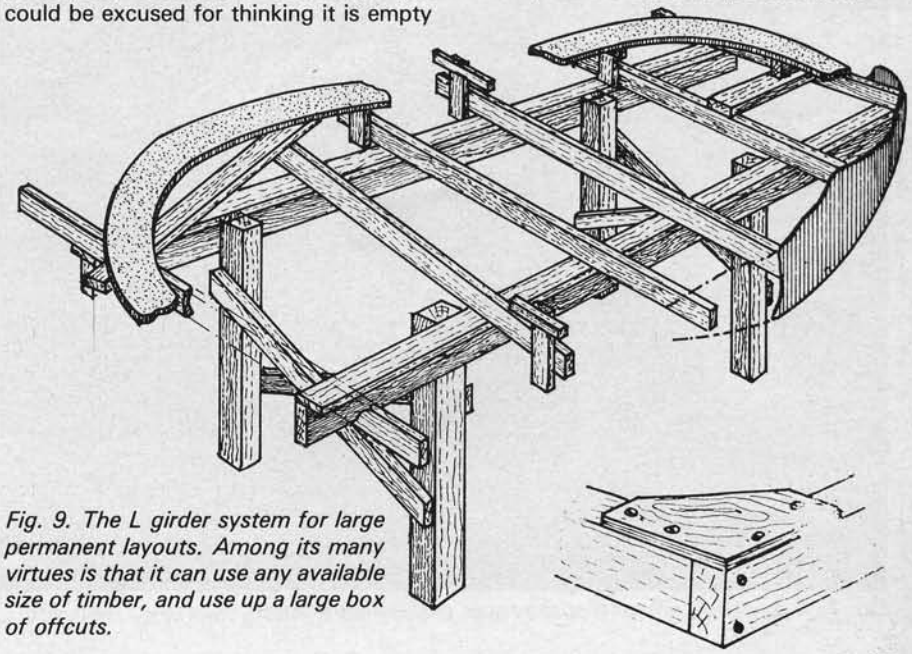


Fig. 9. The L girder system for large permanent layouts. Among its many virtues is that it can use any available size of timber, and use up a large box of offcuts.

The Mechanic's Workshop

By Andrew Smith

A PAIR OF HANDS AND SOME TOOLS make a workshop, but probably the first thing that the enthusiast will require is a bench. Something substantial and fit for its purpose, without being fussy. A large area of working surface so that tools and parts can be spread about without falling on the floor. You also need lots of space beneath for the storage of material, tools and equipment.

The "filled-in" bench, that is one with lots of drawers and cupboards looks excellent, but proceed with caution. My experience has been that it is better to get the plain structure of the bench built and in use first and add various drawers, etc., later. It is amazing how one's ideas change and maddening to find that a cupboard is just not big enough or of the right shape for one's final requirements.

There is no such thing as the perfect or ideal bench. The type which will suit you will depend on the work in which you are interested, the space (and shape of space) available, the equipment to be mounted on the bench, the tools available to make the bench, and last, but not least, the material you have managed to gather together from which the bench is to be made.

Fig. 1. A pair of hands and some tools make a workshop

Do not rush into bench making without a great deal of thought. Study carefully those you see in friends' workshops, at work, school or college, and in catalogues. Consider each detail as it affects you and your proposed use of the bench. Many benches are particularly specialized, but we can learn something from every one we see, even if it is only what to avoid.

Ideally separate benches for woodwork and metalwork should be the aim, mainly because oil from the latter may cause discoloured patches on woodwork. If this is not possible, it may be useful to have a separate top to go over the bench for the activity we indulge in less frequently. As *Model Mechanics* this is likely to be woodworking, so a sheet of plywood or chipboard clamped over our "mechanics" bench will protect our planed and scraped oak panels from being scratched by swarf and filings embedded in the main bench top.

As everyone's requirement will be different it would be a waste of space to attempt to suggest the bench you should build, however, Fig 2 and Fig 3 should help your ideas along, while a letter via the Editor will help with any specific problems.

The value and adaptability of a bench is enhanced by the accessories and fittings which are, and can be mounted thereon.

The obvious, and probably most expensive, are vices. As a worker in metal you will need a mechanic's or engineer's vice. If humanly possible, get a large one, you will never regret it. You can always make some device to hold small work in a large vice, but never vice versa. It is a law of home workshops — until now, unwritten — that one is invariably trying to do a job that is too big for the available equipment! So buy a big vice, by that I mean at least of 3 in. jaws, even if it is a second-hand one.

For woodwork the correct type of vice is recommended although a lot of work can be done in a mechanic's vice if wood clamps are fitted to protect the work from the hardened and serrated jaws.

If the pocket won't run to buying two vices, it is not particularly difficult to make the woodwork version and one made to the sketches in Fig 4 is a worthwhile project until you can afford the real thing.

In fact, vices with up to 9 in. wide jaws have been built following this scheme and given excellent service for many years.

Facilities to assist when planing wood are always necessary and a bench stop like the commercial one in Fig 5 or the

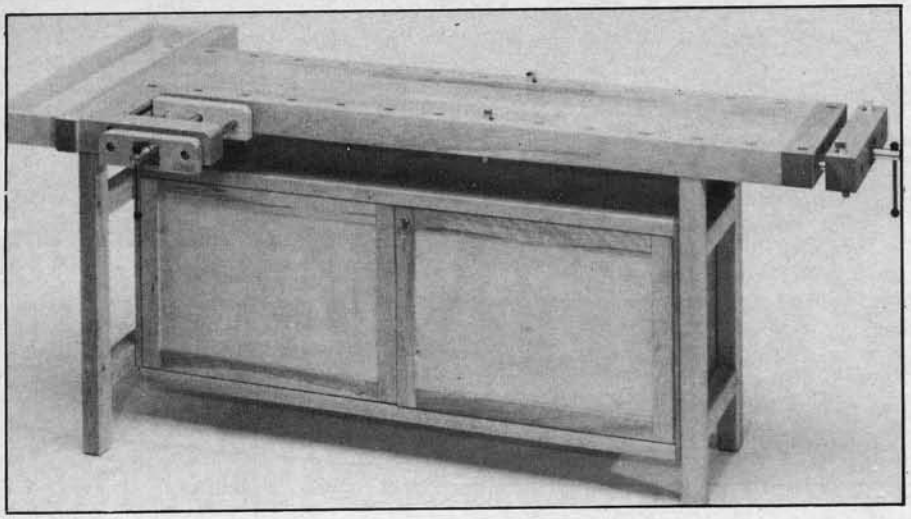


Fig. 2 An excellent commercial woodwork bench by 'Lervad' that may give newcomers some ideas

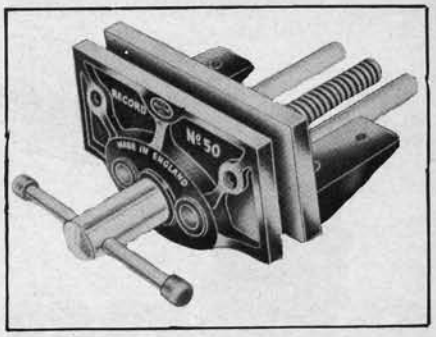


Fig. 4 Woodwork vice

home-made version in Fig 6 are very useful. Likewise, the bench holdfast is invaluable not only for woodworking, but also when sawing sheet metal, Fig 7.

The angle-iron vice or clamp for bending sheet metal shown in Fig 8 is well worth rigging up. Depending on the size of your bench and the work you expect to do, it can be made from steel angle of any size and of any reasonable length.

It is also useful for holding wide boards of wood for working the ends such as cutting dovetail joints.

Timber engineering

The fact that we have been considering bench-making rather presupposes that the structural material will be timber. And although we may look upon ourselves as primarily workers in metal, let us not despise common wood.

In fact, in the mechanic's workshop, wood can be an extremely useful material in an engineering context. Some thirty years ago I was, for a brief period interested in the stress grading of timber. This is a technique of considering wood, not from its type or attractive appearance, but from the point of view of its usefulness as a load-bearing structural material.

About that same period, a French firm exhibited, at the Model Engineering

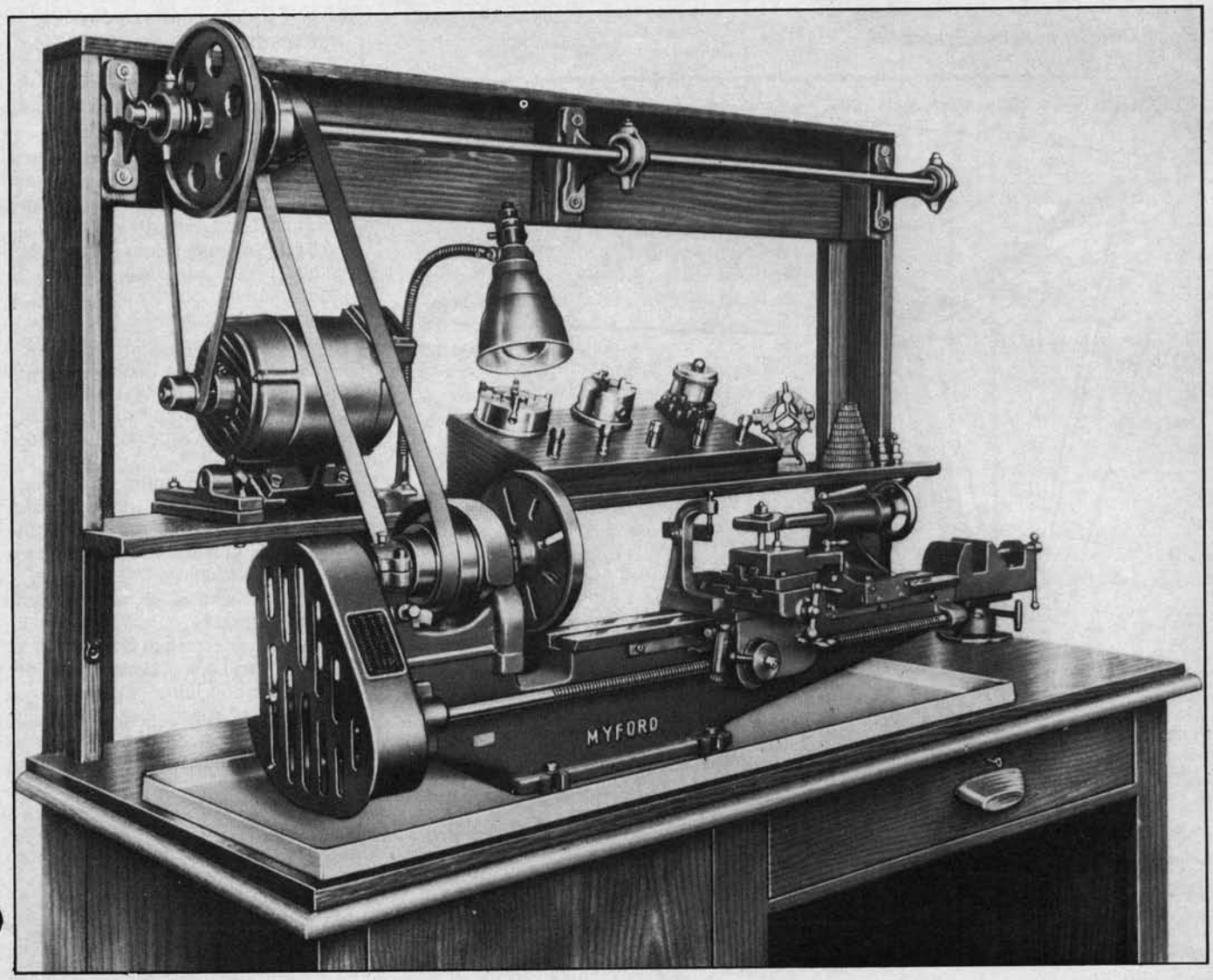


Fig. 3 A stout wooden bench fitted up as a machine shop with an engineer's lathe and vice

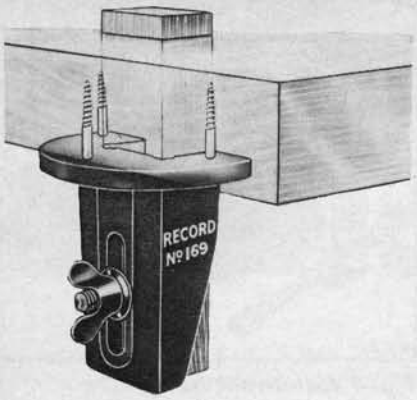


Fig. 5 Commercial bench stop

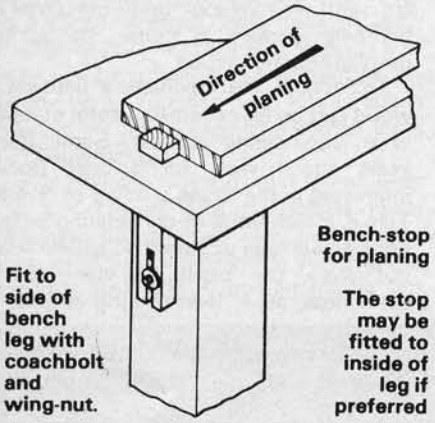


Fig. 6 Home-made bench stop

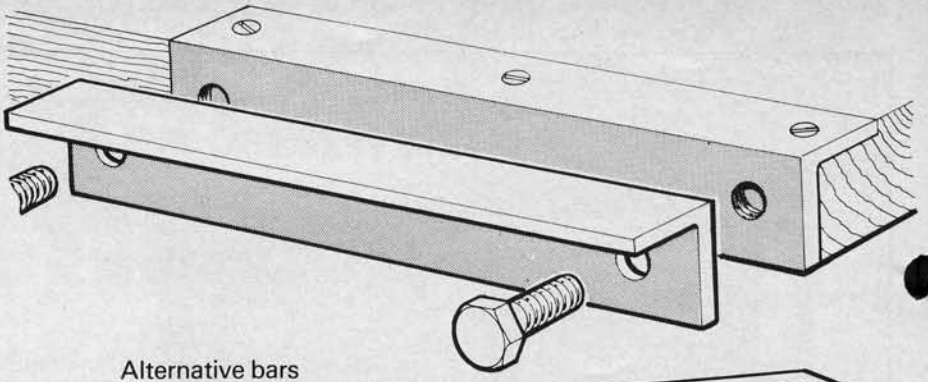


Fig. 8 Vice for bending sheet metal, make to any convenient length

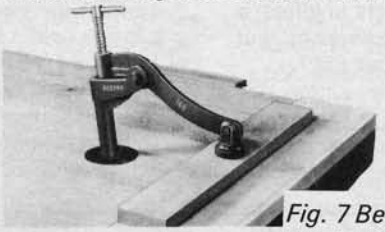


Fig. 7 Bench holdfast, useful for sheet metal, as well as wood

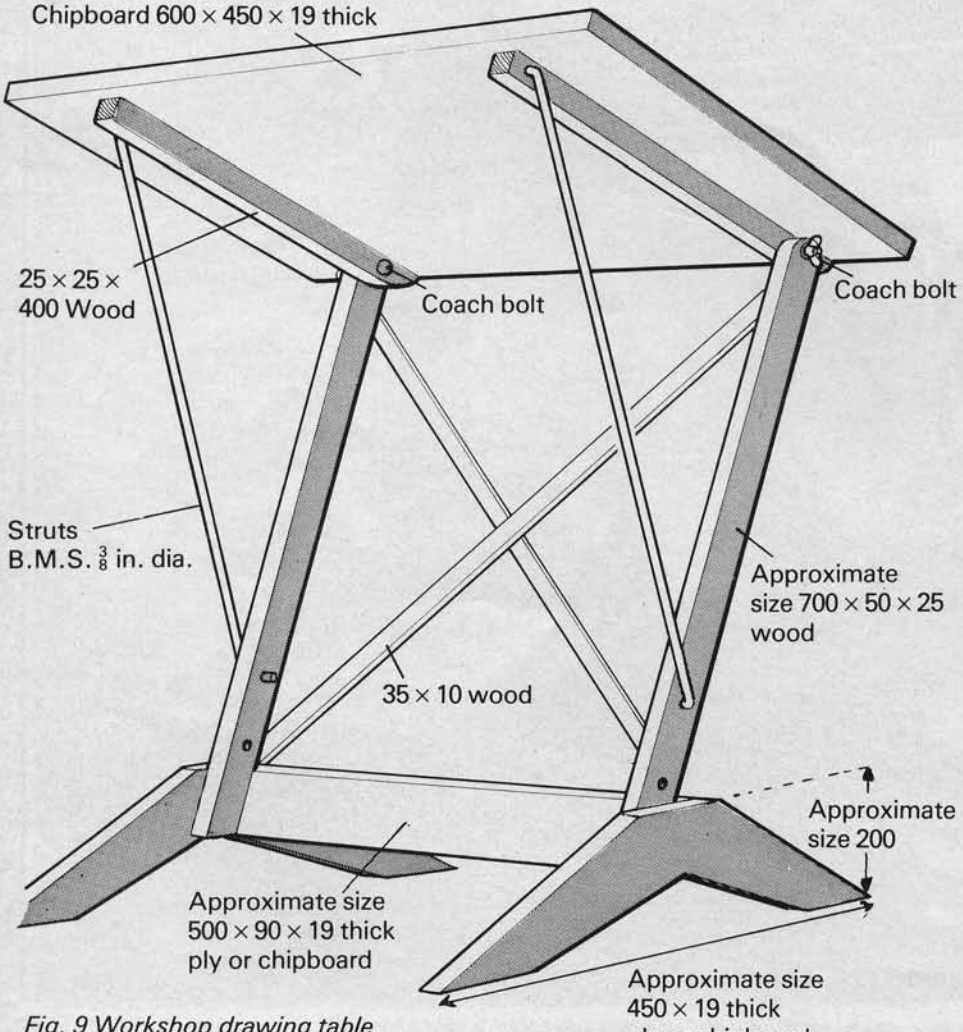


Fig. 9 Workshop drawing table

Exhibition, a range of excellent "home-workshop" size woodworking machines with all the structural parts made of wood. They showed, as I remember, circular saws, planing machines, and spindle moulders; and very effective they seemed to be.

The beams of early steam engines were enormous baulks of timber, whilst the first locomotives had mainframes of timber sandwiched between two wrought iron plates.

So, model mechanic, if you are looking for some method of making a bed for a simple lathe or the structure for a circular saw, don't despise a piece of common wood.

Workshop Drawing Table

Still on the subject of working in wood, the table illustrated in Fig 9 has in the past proved invaluable in my own mechanics workshop.

That odd drawing which is often found necessary, generally ends up by being done without, or sketched on the back of an old envelope. Lack of drawing facilities in the workshop or home is generally put down to lack of space, while the bench top, from the viewpoint of cleanliness, is not the ideal place to use a drawing board.

The roughly dimensioned drawing in Fig 9, should enable readers to make up a simple and convenient "design department" where you can really say — "back to the drawing board"!

Well having, I hope, got you setting up a workshop of sorts, next month we'll see what can be done about getting a simple lathe organised.

Reversing the simple oscillating engine

by John Wheeler

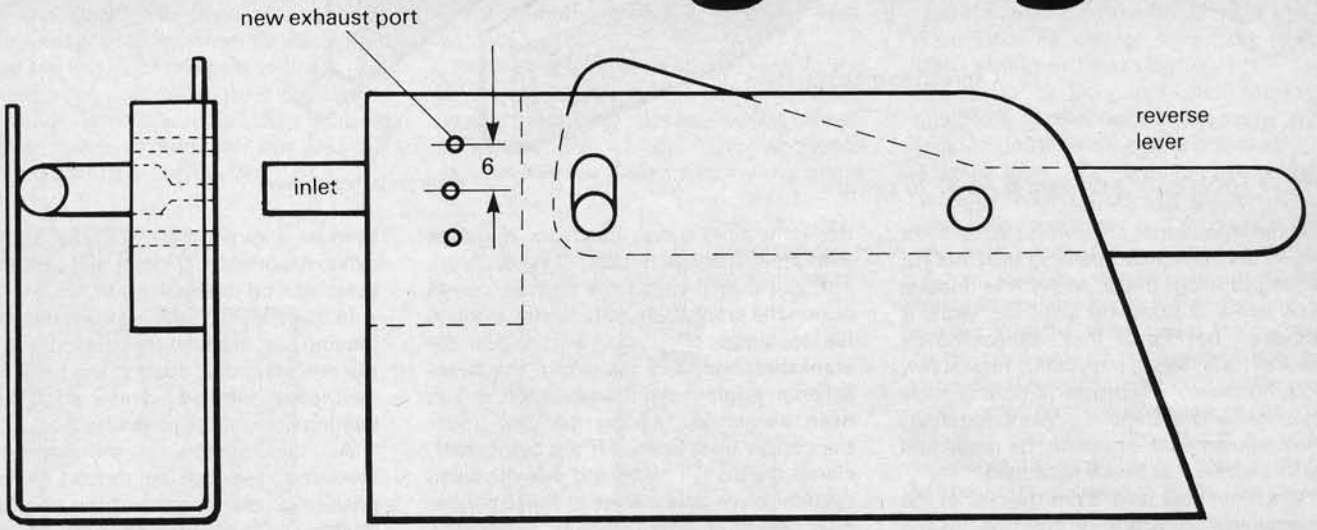


Fig. 1 Engine mainframe and reverse lever showing new exhaust port and inlet pipe

IN ISSUE 1, I mentioned that the simple oscillating engine could be reversed by interchanging the inlet and exhaust pipe connections, that is feeding live steam into what was the exhaust pipe and using the original inlet pipe to exhaust the used steam. The changeover is accomplished by using a form of D valve.

However, it does require both the inlet and exhaust ports to have pipes leading to a reversing block. With our multiple cylinder engine this means adding extra pipes for the exhaust, which will make the back of the engine look like a plumbers' nightmare! Fortunately there is a simpler way involving no extra pipework, so it is easy to modify an existing engine, using a mechanism to move the cylinder pivot position.

A movement of the cylinder pivot position is chosen which allows the inlet port to remain the same and requires an extra exhaust port on the other side to the original exhaust. Fig. 1 shows the reversing lever engine frame and ports. In the case of my original single cylinder engine, I had to cut off the original copper inlet pipe, block up the hole with ARALDITE, re-drill the inlet port to fit the copper inlet pipe into the rear of the port block, and drill out the extra exhaust port.

The reversing lever shape is shown in Fig. 2, cut off 100mm length of 25 × 1.5mm mild steel, coat with marking-out dye and mark out to shape using a sharp scriber and dividers. I find it pays to get the final sharp points on scribers or dividers using a small oilstone slip with oil, until the points will scratch a line on your fingernail! If they can do that, then they are sharp enough to scribe clean precise lines on mild steel. Make sure your divider points are of equal lengths when the legs are nearly closed, then with the lightest of dot punch marks for the centre of the curve you can scribe arcs or circles of small radius. Otherwise with blunt divider points or unequal lengths they will continually slip around on your work.

Drill the 5mm dia. hole for the crankshaft in the new lever, strip your engine down, place the lever behind the mainframe, with the crankshaft in place and position so that the centre punch mark for the new cylinder pivot is visible through the existing hole. If you have marked out and drilled accurately in both pieces this mark will be "on centre". Slight errors will not matter, larger errors — examine critically your marking out technique!

Clamp in place using a small toolmaker's clamp and drill 5.00mm dia. through the existing cylinder pivot hole into the lever.

Toolmaker's clamp

I have several of these small toolmaker's clamps which I made up as a batch using 10mm square mild steel and 50mm Round Head machine screws; they are so useful, I have made a sketch (Fig. 3) to show their construction. An hour's work making at least four will save many

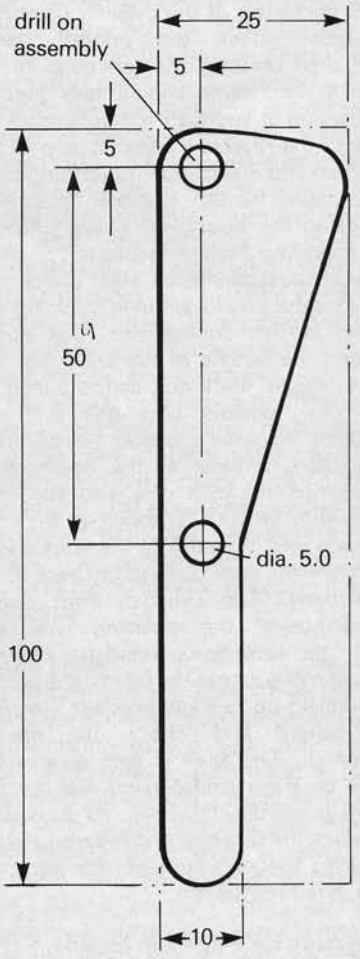


Fig. 2 Reverse lever B.M.S. 1.5 thick

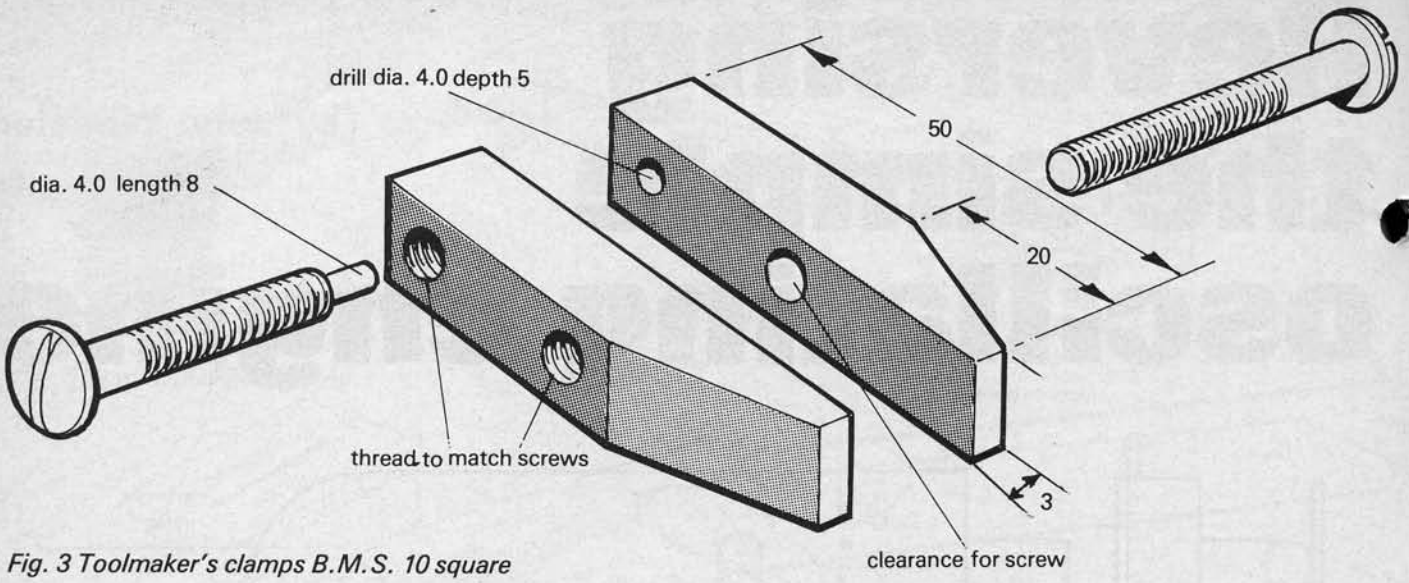


Fig. 3 Toolmaker's clamps B.M.S. 10 square

wasted moments and workpieces later on, when items need holding together for drilling or filing. In use screw A is undone and screw B done up until the work is gripped between the approximately parallel jaws, this is important, now screw A is tightened which exerts considerable leverage and clamps the work together. Fine adjustments can easily be made just before screw A is finally tightened.

Unclamp your lever from the rear of the engine and reposition on the front of the frame, still using the crankshaft as a locating pivot, adjust the lever position until the centre of the cylinder pivot hole is 5mm above the original, easily measured because the top edge of the hole in the frame should only just be visible and in line with the bottom of the hole in the reversing lever. Clamp in this position and drill dia. 5.0mm through into the main frame. Remove the lever exposing the hour-glass shaped hole in the main frame which is filed out to give a curved sausage-shaped slot. Check that the cylinder pivot will move freely up and down in this curved slot. Dot punch around the outline of the lever, cut and file to shape. Mark out, centre punch for the new exhaust port and drill dia. 2.00mm. Remove the burr on the front face using a twist of the countersink. Reposition the inlet pipe and secure in place with ARALDITE, touch up any paint damage and re-assemble the engine with the reversing lever close to the back of the mainframe. The cylinder pivot spring bears against the reversing lever and when the lever is operated the cylinder should move across the face of the ports.

Connect up to a low pressure steam or air supply and check for reverse operation. The lever is held against the ends of the cylinder pivot slot by the rotation of the flywheel, so a washer between the flywheel and reversing lever, allowing the minimum of side play will help to reduce friction.

Reversing for 3-cylinder Engine

In order to move the three cylinders at the same time a disc cut from 16-gauge mild steel sheet is needed (Fig. 4). Mark out, dot punch round the outline, centre punch the crankshaft hole deeply, cut and file to shape. Drill dia. 5.0mm for the crankshaft and fit to the rear of the three-cylinder engine mainframe when it has been dismantled, sliding the disc under the copper inlet pipes. Fit the crankshaft, clamp the disc in place and drill the three cylinder pivot holes. Note the disc cannot now be turned into any other position as the hole positions may not coincide. I marked the top of the rear face of the disc with a centre punch mark. Often you will find such location marks on matching parts that require taking apart, to ensure that they are reassembled correctly.

Reposition the disc on the front of the mainframe, turn 5mm clockwise, looking from the front. Clamp and drill out the mainframe at the three cylinder pivot positions. Remove the disc and file out the pivot slots as described for the single-cylinder engine. Mark out, drill the extra exhaust ports dia. 2.0mm and remove the burrs around the holes.

In this case the inlet pipe will not require moving, so reassemble the engine with the reversing disc against the back of the mainframe and the cylinder pivot springs bearing against the reversing disc.

As this engine is self-starting the reversing disc can be moved from one position to the other and the engine will reverse and commence running again. One of the model ship builders in my local club suggested this movement could easily be operated using a radio control servo which along with a servo-controlled steam or air valve would allow the engine to be used in a model ship. He even suggested a compressed air supply, although I am doubtful if it would give a long enough running time.

I have not described or drawn out a reversing lever or sector for the two-cylinder engine as I am sure now you could work that out for yourself.

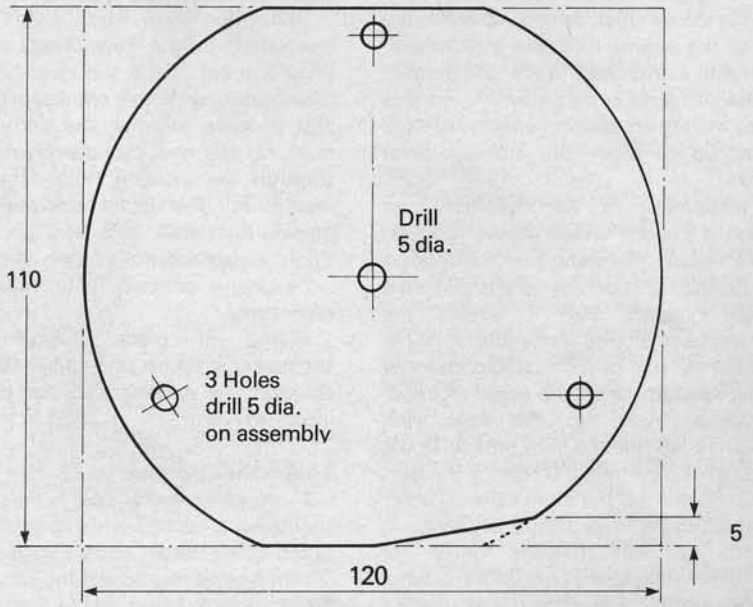


Fig. 4 Reversing disc for 3-cylinder engine B.M.S. sheet

Turning a Flywheel

I have been asked by the editor to describe some lathe operations, so using the flywheel as an example, I will try.

Cut off a 20mm length from a mild steel bar approximately 60mm diameter. You may be lucky to obtain a short length cut off for you, if not it is hard muscle and a way of improving your hacksawing. One tip — mark off a line all round the bar, hold horizontally in the vice, cut down the depth of the blade, add a little cutting fluid to help, turn the bar about it's own axis *away* from you whilst held in the vice, now cut down the dept of the blade again, repeat until you have travelled right round the line. Continue the process until you have cut right through, it appears to be much less laborious than cutting straight down through the bar and will give you a squarer end surface.

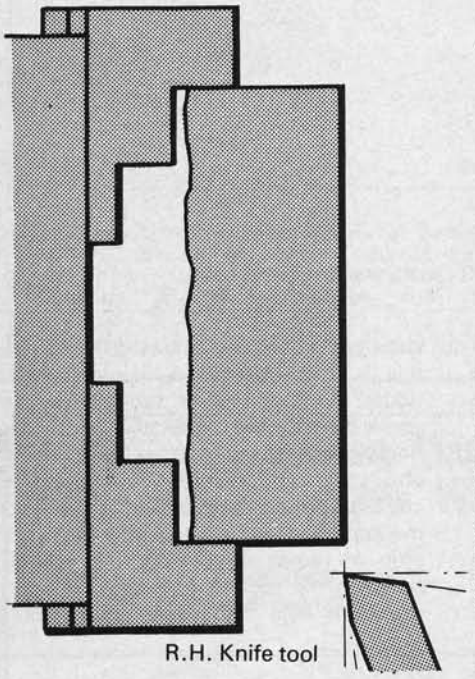


Fig. 5 Plan view of chuck workpiece and R-H Knife tool

Grip lightly in the 3-jaw chuck with reversal jaws, the ones with the lower steps near the centre. Aim to have the work on the highest step possible consistent with the minimum opening of the jaws (Fig. 5). Tap the rough sawn face of the blank until all three jaws grip the round outer surface of the blank with no gaps. Do not try to bed the blank back against the jaws yet, as the rough rear face is probably not true. A slight gap is even better as then you know the jaws are not strained out of square. Tighten the jaws firmly and take several cuts across the face until you have a smooth surface. Use the cross-slide to feed the tool across the work, the top-slide or saddle wheel to add on successive cuts, cutting fluid carefully applied by pump, spray or brush and a RIGHT-HAND KNIFE TOOL positioned as shown by the plan view Fig. 5.

I prefer to have my lathe tools in a holder that gives an immediate TOP RAKE ANGLE, then I have only the side and front clearances on knife and vee tools to worry about when grinding. I also prefer the use of a cup wheel for grinding the side and front clearance as the lathe tool can be held in a more natural position, similar in fact to its position in the lathe. It is dangerous practice to grind on the side of a normal wheel, because as the wheel wears, you undercut the outer periphery and form a groove on the side face which can give rise to an internal crack, allowing the wheel to burst at normal running speed! You have been warned.

Now reverse the flywheel blank in the jaws and bed the freshly-trued face back against the jaw steps, whilst firmly tightening the chuck. This sequence ensures that the blank cannot move under

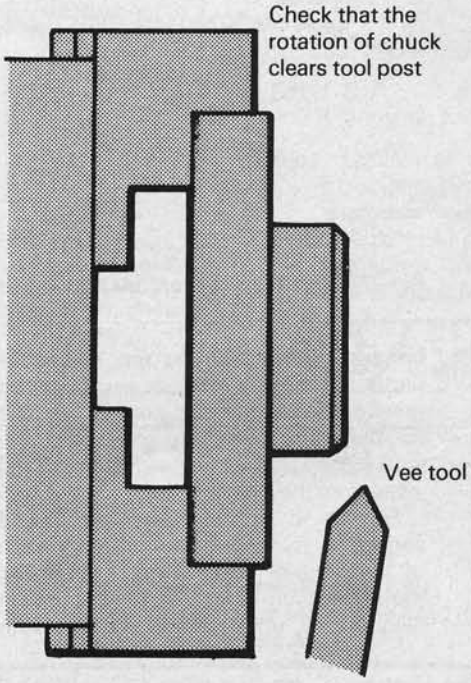


Fig. 6 Plan view forming chamfers, using a vee tool

subsequent cutting loads. Tap into position with a brass drift, suitably made from a 150mm length of 20 or 25mm dia. brass bar. A very useful implement! Keep it close by the lathe for all such trueing occasions. Face off the exposed rough surface to a smooth finish as before and then turn down to 30mm dia. for a length of 10mm.

I hurry things along here and take cuts down close to the diameter, checked with outside calipers when the work is stationary, using the cross-slide screw, adding each successive cut by moving the saddle to the left or locking the saddle to the lathe bed, setting the top slide parallel to the axis of the lathe and using the top slide screw to control the depth of cut. Each cut can be near 1mm in width coming from the front edge of the Knifetool.

After honeing the cutting edges, taking care to keep the ground angles, I take progressively finer cuts until I reach the drawing size. Take off the sharp corners by setting a Vee tool round in the tool-post so that one edge makes an approximately 45° angle to the lathe axis, and using the cross-slide screw form the chamfer to size (Fig. 6). Not too wide, otherwise the tool will dip or break under the load.

Return the chuck jaws to their normal position for gripping round material and grip on the 30mm dia., bedding the embryo flywheel back against the jaws with light taps from that brass drift! Now is the time to turn the outer edge true to 60mm dia. as well as facing off to give true running surfaces (Fig. 7).

Set up a Vee tool and form the chamfers at the rim, make them equal (Fig. 7). Centre drill and drill through dia. 4.5mm then dia. 5.0mm for a fairly accurate round hole. Of course if you have a 5mm reamer, drill through 4.7mm and then holding the reamer in the drill chuck, pull the three jaw chuck over towards you by hand whilst feeding the reamer into the work using the tailstock feed. Use plenty of cutting fluid here and work the reamer in and out of the work whilst continually pulling the chuck over towards you. You should not reverse a reamer in the work, always keep it turning in the cutting direction then the cutting edges will not become dulled.

As a flywheel needs its weight at the rim the next operation involves a boring tool. To help the boring tool start, use as large a drill as possible in the tailstock drill chuck to a depth of about 8mm. Set up the boring tool (Fig. 7, operation 7) and feeding the tool towards you from the centre of the work use the cross-slide screw and take successive cuts leaving a rim of 10mm width. Once more lock the saddle to the lathe bed, use the top slide to add on successive cuts of approximately ¼mm, and bring the boring tool out to the same cross-slide reading each time. Do not forget to hone the cutting edges before taking the final skims over the bored surface.

You should now have a flywheel with a true running face, rim and crankshaft hole as these have all been machined at the same setting in the chuck, hence it should run smooth and true when secured to the crankshaft. Remove the flywheel from the chuck, mark out drill and tap for a grub screw in the 30mm dia. to secure it to the crankshaft.

Lathe Tools

I recommend you start lathework with the five main lathe tools shown in Fig. 8. Commencing with a new ¼in. square high speed steel tool-bit grind it to the plan shape of the Right Hand Knife Tool, then with further grinding undercut the new cutting faces back by about 5-8 degrees, leaving a sharp edge at the top face. These are the front and side clearance angles and are very important in that the tool will not now run on the revolving work in the chuck. Each shape

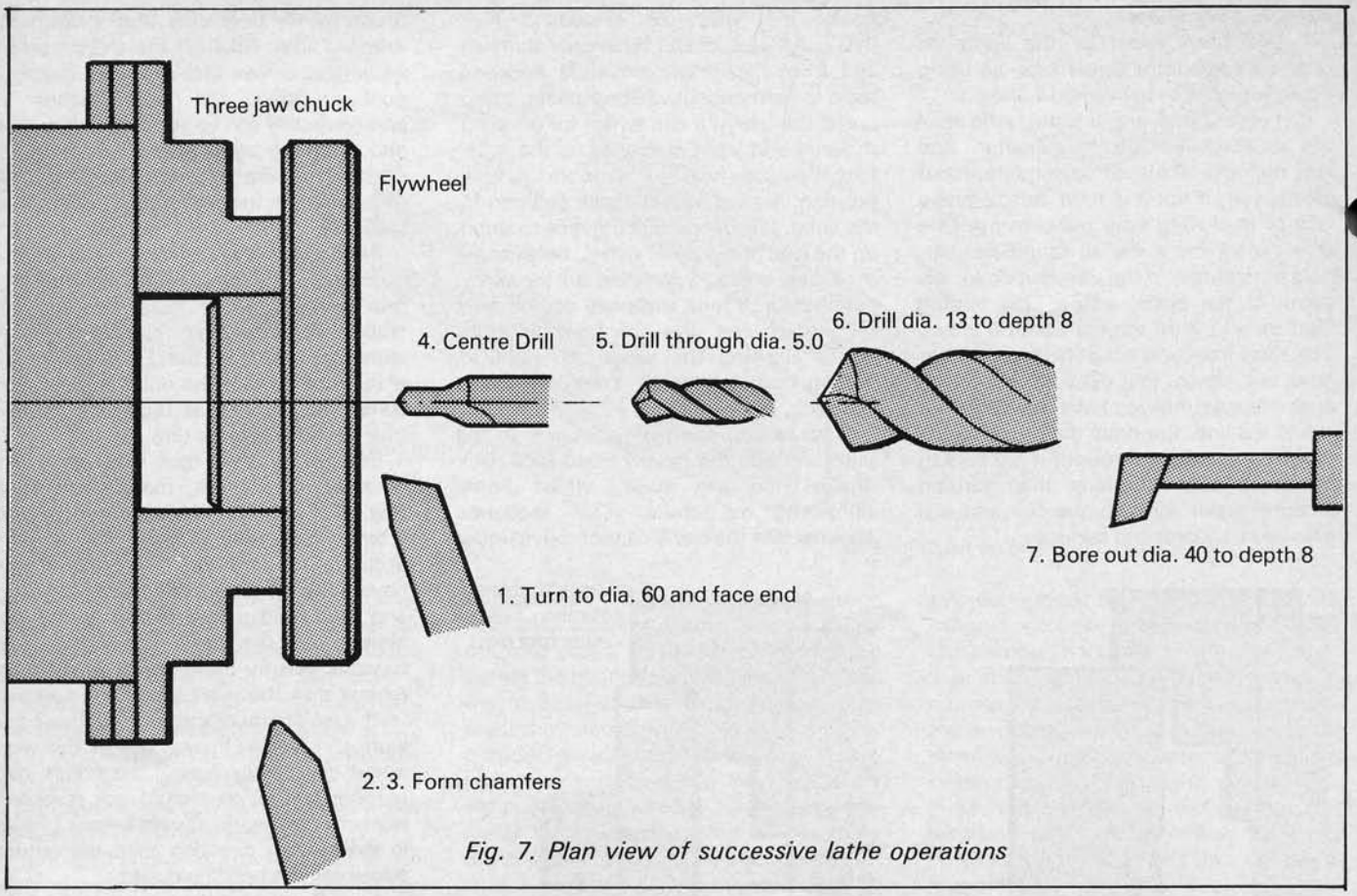


Fig. 7. Plan view of successive lathe operations

should be ground in a similar way. They will now need some Top Rake, so tilt the Right Hand Knife tool up at about 10-25 degrees. some lathe tool holders are designed to do just this; and immediately you should see that the front or side clearance will need increasing by a further 10-25 degrees. With such a tool holder you can leave the top surface of the tool bit flat which makes it easier to oilstone or hone.

brass very well with no top rake; it is better for cutting steel or aluminium to grind a 10-15 degree slope on the top face so that the swarf cut off from the workpiece in the chuck slides down and away from the cutting edge.

Finally, to get that smooth turned surface on your work, carefully hone each of the ground faces, whilst maintaining the angles, on a fine oilstone slip with plenty of oil, until you can see a smooth

lathe centre height. Lathes differ in how this is done, some use packing strips under the tool bits or tool holder and some others have adjustable height tool holders, but most important is the need to check that the toolsetting does bring the cutting edge to "centre height". A quick method I find useful is to lightly trap a thin strip of metal; a six-inch rule will do; between the tool bit cutting edge and a round bar held in the three-jaw chuck or

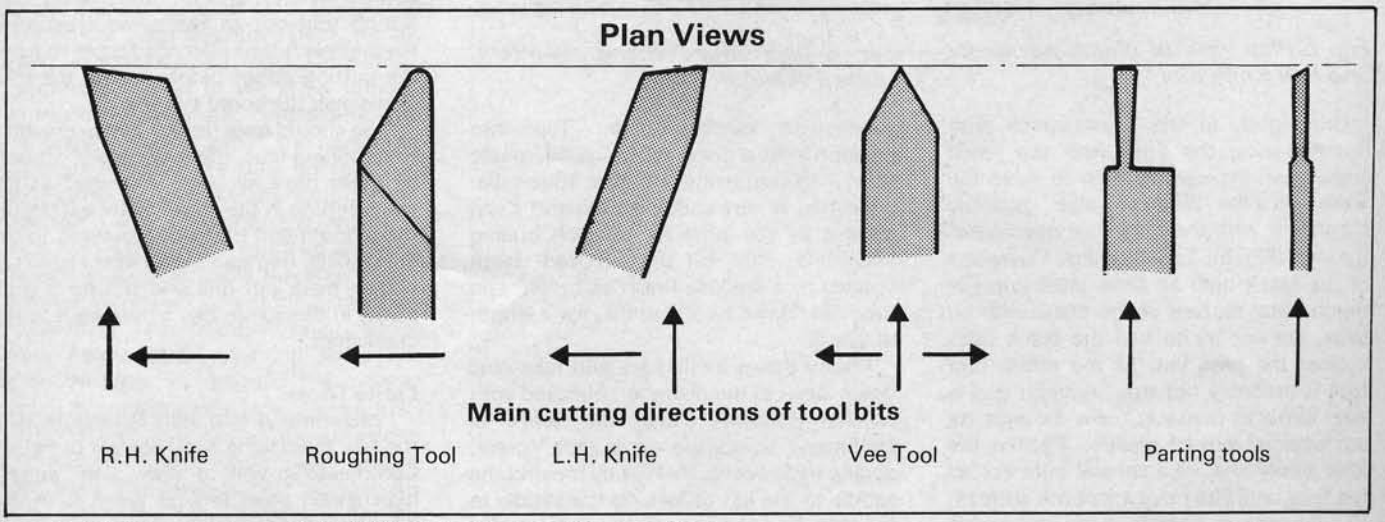


Fig. 8. Cutting portions of tool bits in normal working positions

If, however, your lathe tool is held horizontally in the toolpost, you will have no need to increase the front or side clearances; and although you can cut

shining light reflecting surface visible at the cutting edges.

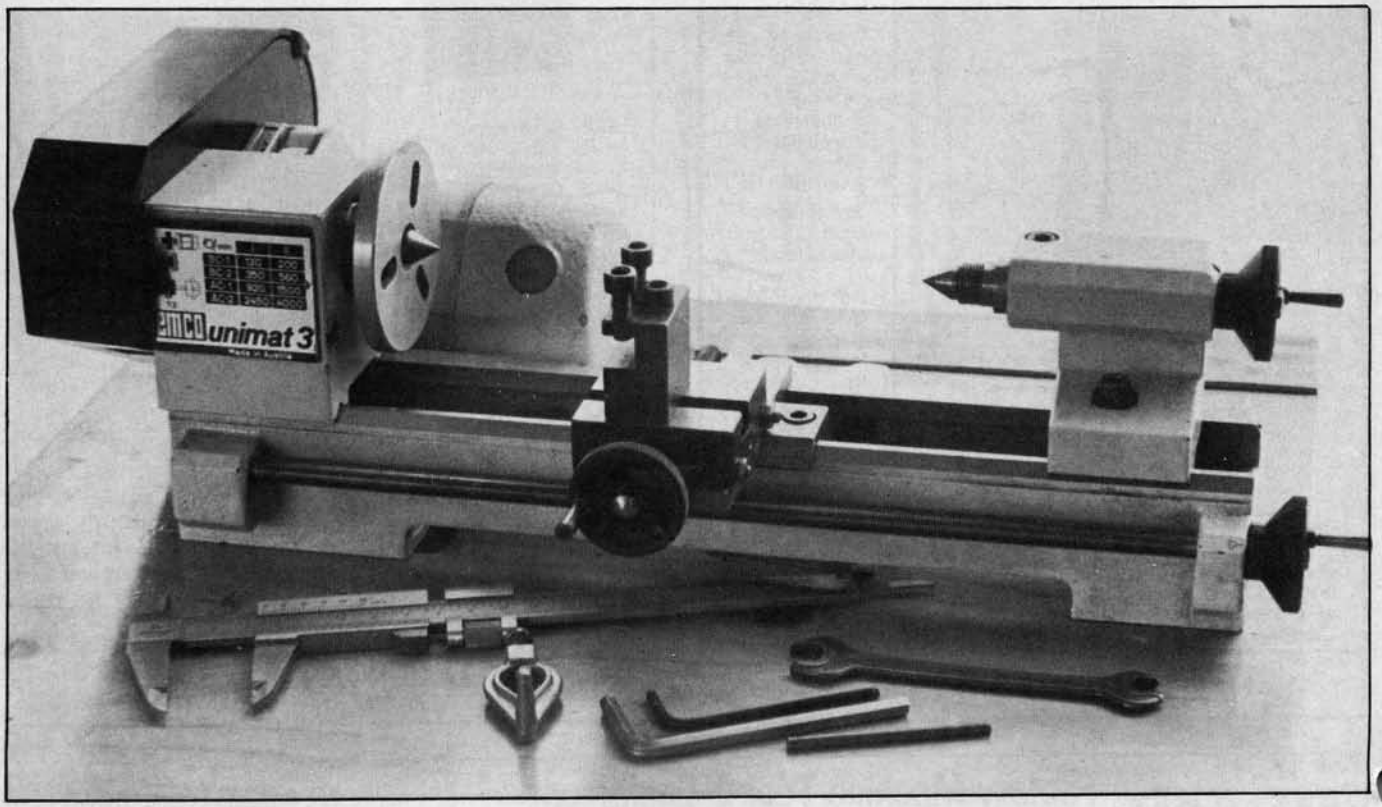
Every lathe tool needs to be set up so that the cutting edge is accurately at the

the tailstock barrel. If the strip i held truly vertical then the cutting edge is at centre height. A tilted strip will indicate if the tool bit too high or low.

To be continued

Tools of the trade

The Unimat 3, a review by Rex Tingey



The Unimat 3 basic lathe outfit. The vernier caliper is not part of the kit, but shows size, the jaws are open 1 in

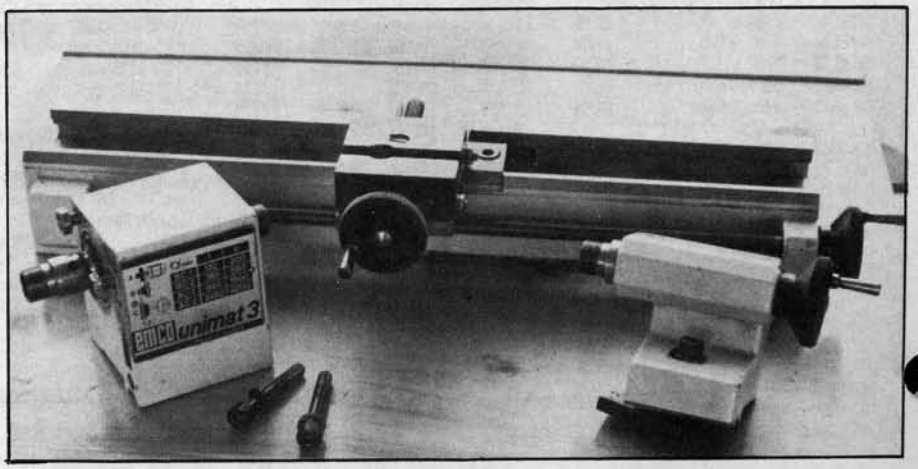
THE UNIMAT 3 is the latest in the line of Unimat models and is a breakaway from the rather unconventional design of the model SL and is more in line with modern lathe construction. However, it still retains all the versatility of the universal small machine tool, and in most respects is as good as, or better, than the old model. Despite being a little more expensive than the old, the basic Unimat 3 represents excellent value for the beginner or the expert who has little room for a full-size workshop, or the cheque-book for the equipment to fill it.

The Unimat 3 can be bought either as a basic lathe or as a drilling and milling machine, and then readily adapted by means of a good range of accessories to perform most of the engineering machining jobs as well as a good range of woodworking tasks. But the SL is capable of wood-turning much longer jobs, by means of extension bars, which the 3 cannot. Components and accessories for the 3 are in good supply at most times, and are readily obtainable from the local toolshop, who will order accessories they do not stock.

The Bed

The basis for the Unimat 3 is a cast-iron bed, machined with two rails to hold the major components of the lathe and various accessories. The bed is machined at the back to hold a vertical column rigidly in position. The front rail is a right-angle pyramid in section, and the rear rail is flat, level with a small flat where the apex of the pyramid has been removed, on the front rail. Beneath the rails is a parallel slot, right across, to allow components to be held. The rails and slot run the full length of the bed so that this full length can be used for working in various modes. This means that the swing is limited by the rails when turning larger diameter work in the lathe.

Other lathes may be provided with a gap in the bed, where the chuck turns and forwards, to allow bigger diameter work to be swung in the gap. The Unimats do not offer this facility, and it could *not* be recommended that a spare bed be purchased and cut with a gap to provide a better swing, since the bed casting would be considerably weakened and would



The headstock and tailstock removed from the bed

certainly warp. The bed, as it stands, is a quite light open casting, extremely strong and, being cast-iron, an excellent bearing material for a long life.

Lathe Fittings

The main components of the basic lathe, as purchased, are the bed with the headstock, a tailstock, and a bed slide with a cross-slide complete with the required lead-screws and handwheels. The motor is fitted to a motor plate, all part of the basic set, and has a set of pulleys and rubber drive belts. Other components included are a face-plate and driving dog, two dead centres, a toolpost and some adjusting tools. The main components are basically alloy castings with steel fittings and the cross-slide is of cast-iron.

The headstock is an open alloy casting containing two ballraces to hold the main spindle concentric. The main spindle is threaded at both ends and has a good pass-through of 10.2mm, enabling material below this diameter to be fed through for repetition work and for longer jobs to be worked on the lathe. The accurate location of the headstock is by means of the triangular front rail into the underside of the casting, assisted by the flat back rail, as are the other bed components. The headstock is screwed to the bed from beneath.

The headstock, left-hand side, carries two screws to hold and secure the drive plate in a type of 'bayonet' fitting, which is quick and positive. The motor then lies behind the bed, with its switch pointing upwards. The drive plate is fitted with a hinged cover to be clipped over the pulleys once the belts have been correctly adjusted, as a guard. It does seem to me rather silly to guard the innocuous rubber drive and then require the operator to stretch over a dangerous, sharp-edged, unguarded chuck to switch on and off. (Fit a foot-switch!).

The drive plate intermediate drive pulley, together with the main spindle and motor pulleys, provide various speeds with varying ratios, and these are shown on a well-printed plate on the headstock. Further, the motor has possible internal half-way rectification of the AC supply providing half-speed drive, approximately, by means of a second 'on' position of the main switch. The drive is by two rubber belts providing a reasonably powerful drive from the 95-watt rated motor, which is of modern design, intended to be driven hard and to get hot in use, without damage, but an idle time of 25% of its driven time, between runs, is recommended.

The tailstock slides along the rails and is clamped by means of a flat under-plate in the slot of the bed. The tailstock barrel is driven towards and away from the headstock by a calibrated handwheel. The tailstock is threaded the same as the main spindle (M14 × 1mm) and has the same hole of 10.2mm to take the dead centres. Screws for all the main everyday operations are M6 and are tightened with one Allen key.

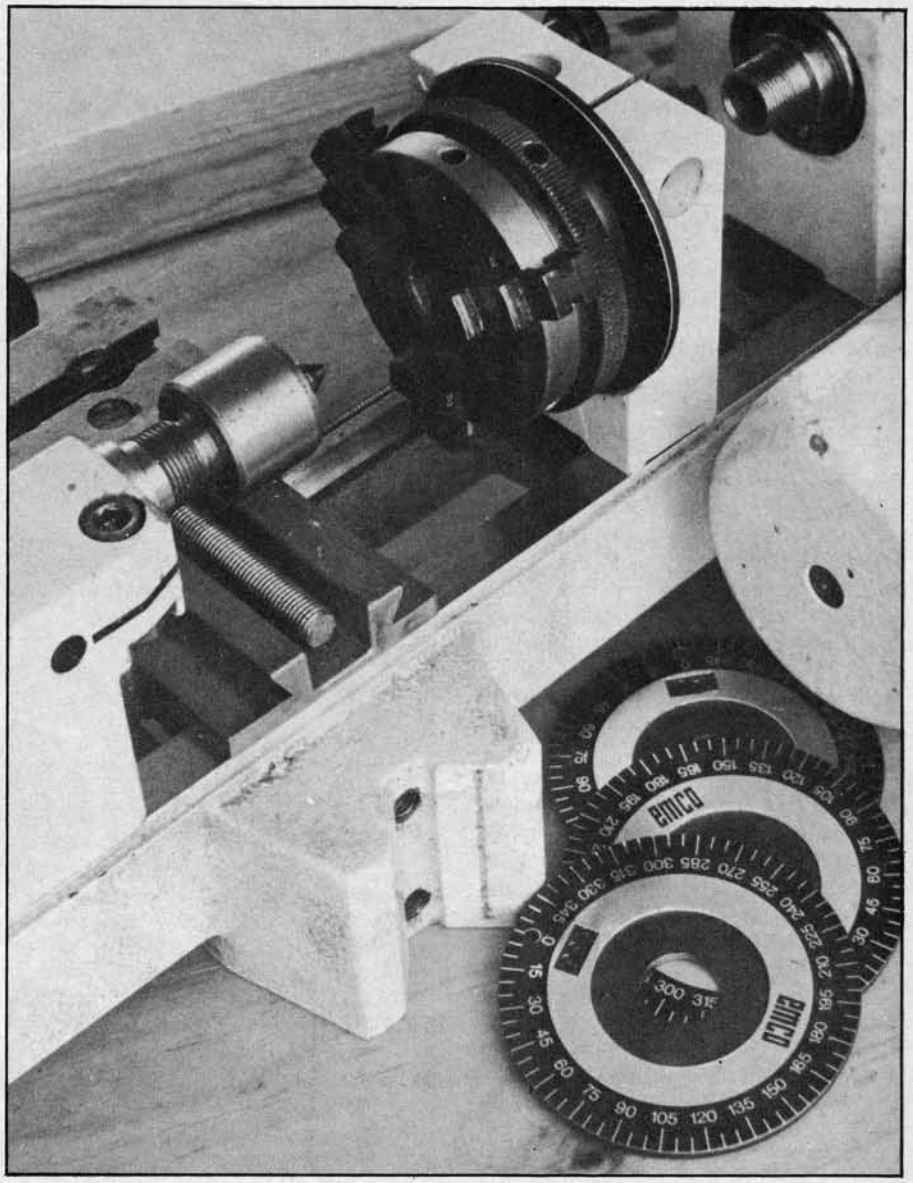
The longitudinal slide has its lead-screw down in front of the bed, operated by a handwheel on the right of the machine. At the left of the machine the lead-screw terminates with a flat, inside a box cast integral with the bed, which can be dog-coupled with a fine feed device (an extra) driven from the main shaft. The bed-slide is secured in the slot, to run on the rails above, by means of plastic keep-plates and a single square steel nut, called a jaw in the handbook. The slide is driven by a threaded arm, down on the leadscrew, which is part of the slide casting. It is thought that this threaded arm is the most vulnerable part of the lathe, as far as wear and damage are concerned. The lead-screw is unprotected from swarf which always falls in this area, and which has to be constantly brushed away before it feeds into the mating threads. Wear between the lead-screw and threaded arm will cause play which cannot be compensated for except by replacing the bed-slide and lead-screw. Covering plates and rubbing strips are not to be recommended; the first hides the swarf, and the second caused more wear than without strips. The answer would be for the manufacturer to fit a split bush, secured by a tightening screw, and replaceable, the split, pointing down, acting as a swarf trap and thread cleaner.

The cast-iron cross-slide travels across on prismatic guides, fitted with a gib-strip, adjustable for tension and wear. The slide is operated by a central lead-screw and calibrated hand-wheel, and the nut on the lead-screw is replaceable, should any wear occur.

Extras

As far as lathe accessories are concerned the most essential items to buy with the basic outfit are a three-jaw chuck and a drill chuck. In order of priority follow these with the live, ball-bearing centre and the four-jaw chuck, enabling eccentric or odd-shaped work to be turned.

The most useful conversion accessory, to make the Unimat a universal machine tool, is the vertical column and head



The indexing and dividing attachment positioned on the bed. The vertical column has been removed to show its mounting position

which can be bought with or without an additional drive unit. The first items to obtain for the vertical Unimat are the milling table and the machine vice, both essential for milling and drilling operations. The drive plate from the lathe adapts very easily to the vertical mode.

In second order of priority for the improving machine tool are the indexing attachment with the complete set of plates, the vertical fine-feed, and the three-point steady. A third order of priority must start with the threading attachment, particularly required if extra accessories are to be made on the lathe for the lathe; in this case get the 1mm leader and follower. The top-slide is useful for taper turning, and the collet holder with a set of collets for precision work, plus the self-act device to get an excellent finish on work.

The purchase of other accessories will be a matter of need, but do buy a good quality double-ended grinding wheel as a separate machine to avoid using the Unimat for grinding except when necessity demands, then follow up the grinding operation with a thorough dismantling, and a good clean-up, or rapid wear will result.

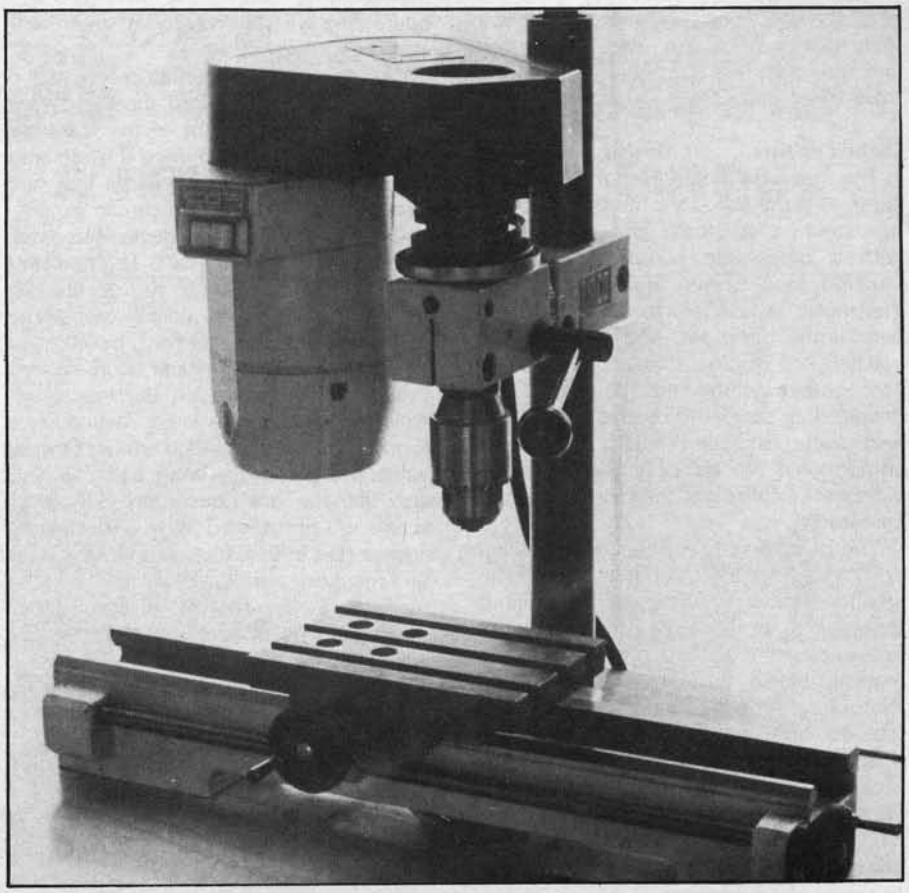
All the accessories I have tried are very well made, work correctly, and fit the machine well, giving the minimum restriction on the working area; so important on a small lathe. The most difficult accessory to fit is the threading attachment, which is quite complicated and requires the left-hand leg be fitted well up to the headstock; for which operation the chuck must be first removed. There are no instructions for fitting the threading attachment apart from the summary in the Instruction Book which comes with the basic set, this is true of all the accessories so a certain amount of acumen is required.

The only drawback I can find with the accessories is that the drill chuck, unlike that supplied with the Unimat SL, has no bore through so that long material cannot be fed through from the main spindle, which can be very useful when tapping and threading in the lathe. Also, considering its size the three-point steady has too small a pass-through (40mm).

Criticism of the Unimat 3

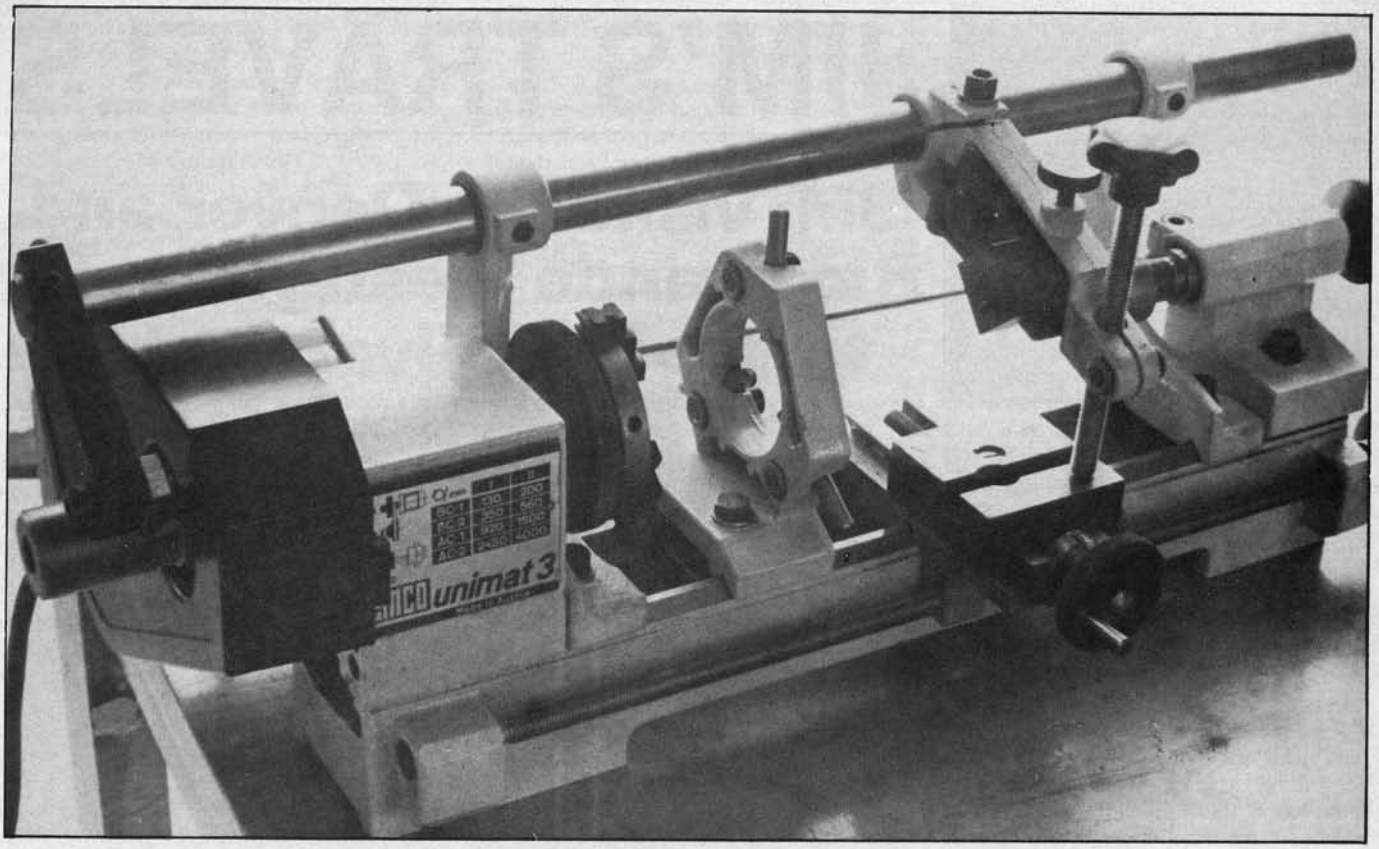
Before criticising, it must first be observed that the Unimat 3 is a superb machine tool, more versatile in its original, modern design and accessory range than any other machine on the market. For its size it has a good swing and between-centres distance. But compared with the Unimat SL it is more difficult to adapt for home-made improvements and accessories.

Although the drive system is more robust than that of the SL the drive is still by means of rubber belts, which tend to stretch and slip under load, and also to break. Swarf is much harder to clear from the intricacies of the cast bed than it is from the simple bed of the SL. The handwheels are of black plastic and the

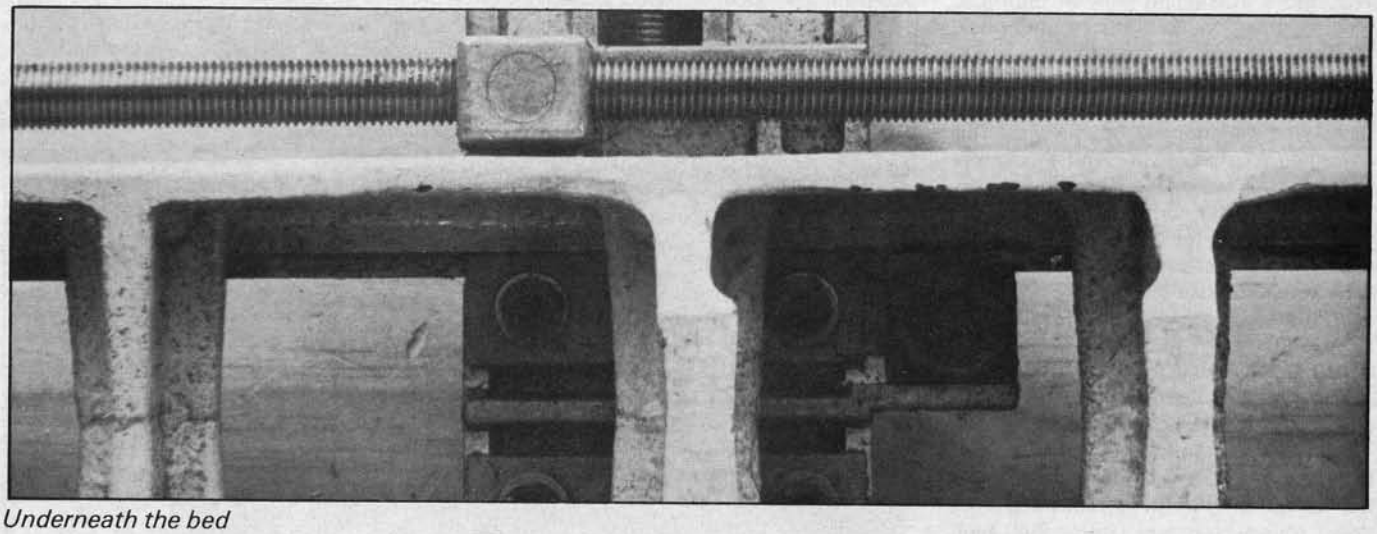


The milling and drilling version. The table and drill-chuck are extra

Vertical fine-feed attachment. An Allen key is used to advance the calibrated mechanism



The threading accessory, and the three-point steady. Notice how the leader and follower are outside the machine so that the maximum between centres length can be utilised



Underneath the bed

threads are easily damaged, and the handle can be knocked out, after which they are loose, but metal wheels are readily made on the lathe and the handles fitted to these, proving much stronger. The cross-slide does not travel back (towards the operator) very far so that the outsides of larger diameter cannot be easily turned down.

Those who have converted from the SL will miss the mobility of the headstock for turning larger workpieces and for taper turning, and the top-slide accessory does not provide the same taper length. But there can be no doubt that the solid bed of the 3 provides superior turning in finish and accuracy. The vertical column is stouter and better mounted to be less prone to milling chatter.

Home-made Accessories

I have designed a range of accessories and improvements for the Unimat SL and I am progressively designing for the 3. Most of the work is described in my book 'Making the Most of the Unimat', which gives both SL and 3 designs, and other work will be appearing in his magazine and *'Model Engineer'*. All the accessories I describe are capable of being made on the appropriate Unimat model. My latest project, for example, was to make a kit of parts to increase the swing of the Unimat 3.

Value for Money

The basic Unimat 3 can be purchased, at present, for around £140, and a more complete outfit with a vertical column and chucks for around £200, both including the motor. This is very good value in the small lathe market since you will have bought a milling and drilling machine as well, within the price of other makes of small lathes which can do little else but turn, and perhaps require a motor as an extra.

MAIN SPECIFICATIONS

	mm
LATHE	
Centre Height	46
Distance between Centres	200
Swing over Bed	92
Cross-slide travel	52
Tailstock Spindle travel	23
MILLING AND DRILLING	
Maximum Working Height	140
Stroke of Vertical Spindle	25
Motor	95 watts

JIM'S TRAVELS

Jim visits the Denver and Rio Grande Western Depot to see the 'Silverton Ltd'

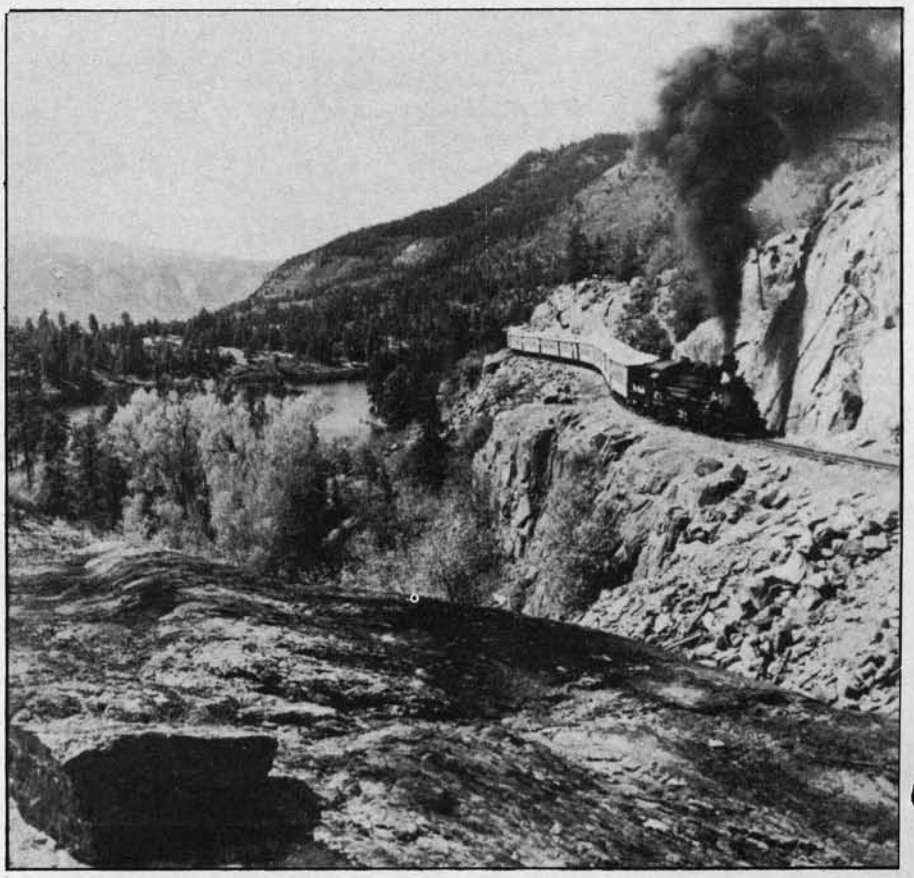
IT FIRST HAPPENED several years ago on an eventful trip just before Christmas, on the way from Denver, Colorado, to Arizona to have a look at that natural wonder the Grand Canyon. Eventful indeed as we had hit a 200lb deer on a mountain pass at about 6.30 one crisp December morning, en route for breakfast at Durango 65 miles away. Having checked the damage to the VW Beetle, we made Durango for breakfast and a date with the Forest Ranger. We had some time to spare, so we took a short walk round this tourist trap of a town, ending up at the Denver & Rio Grande Western Depot.

The deserted depot was soon looked over. More interesting was an unofficial tour of the yards and roundhouse, watching the crew on maintenance work. When we left I resolved that if the opportunity arose, I would make a return visit when the line was operational. This arose just four years later, but the former party of four was now increased by the presence of the writer's three-year-old grand daughter, for whom the sight and sound of live steam would be a new experience. So we drove into Durango one September noon this time without incident, unless you call waiting on the Interstate Highway for a cattle drive to clear, yes the drovers were typical cowhands, loved by the movie maker.

Early booking into the hotel allowed time to get into position to photograph the "Silverton Ltd" on its return from the daily round trip up into the high mountains. In full cry the narrow gauge steam locomotive appeared looking incredibly big to my eyes for a three-foot gauge. The 2-8-2 hauled its load of 13 coaches down Narrow Gauge Avenue round the loop line into the depot, after having announced its approach whilst a mile out of town with an almost continuous blast on the whistle as the many grade crossings were met. Progress through town being similarly marked with the added continual ringing of the bell. Indeed from being a place that had been forgotten the depot became alive with humanity from almost the first whistle blast. This continued until all the passengers had alighted and the locomotive had been uncoupled, and departed to the roundhouse. Within minutes the depot was deserted and had gone to sleep again.

So much for first impression and on the morrow an early rise saw two of us at 8.00 am waiting for the conductor's "All aboard" at 8.30, which was followed by a prompt departure. The 2½-hour and 45-mile journey along the course of the Animas River (also known as the River of Lost Souls) to Silverton commenced. This last remaining section of the vast narrow gauge empire of the Rio Grande Western was originally the Silverton Branch built to haul silver from the mines at Silverton. The depot at Silverton was also the meeting point of four narrow-gauge lines. Now the only railroad in the USA still operated by steam power, the Silverton Branch like the only other part of the narrow-gauge network, The Cumbres & Toltec on the other end of the state of Colorado, is strictly for the tourist, a large number of whom grab a seat on the handrail at the end of the coach and remain there for the whole journey. Yours truly did just this while the younger members of the party drove to a vantage point to film the train. The following day's effort of getting shots from the moving car accounted for upwards of 20 rolls of film stock, so be warned if you contemplate a ride.

Back to the train, which soon worked up to a respectable speed by the time it cleared the town and headed across flatlands to Hermosa. This ran parallel to Interstate Highway 550 all the way, to the obvious pleasure of the auto passengers. At Hermosa, the road crosses the track on a grade crossing and the railway starts climbing, a fact emphasised by the increase in intensity of the engine's exhaust. Over to the right was the Animas River and both river and railway follow the



Entrance to the Animas Canyon on the high line

course of the canyon. Speed drops as the engine tackles the grade and the continual blast of the exhaust plus the screeching of the coaches wheels as the flanges grind their way around the sharp bends, is a cacophony all of its own and is real music to the ears of the enthusiast.

The competing highway winds its way up the mountain on a separate route, finally crossing the track on the level at Shalona Lake to the added sound of bell and whistles and is not seen again until Silverton is reached. From this point on the railroad is the only way through the San Juan National Forest and the Animas Canyon, real railroading for this was at one time the only way up to Silverton.

Steadily climbing we now enter the high line and the timid give up their perches on the hard rails, while the hardy make sure their footholds on the railing ornamentation is secure. We now climb high above the river, which at times is 400 feet below and the track is on a ledge blasted out of the mountain side with so little clearance that on curves the passenger riding the platform contrary to the prohibition notice, looks down the cliff face. All the time the loco has been working flat out and the train has only stopped to pick up water, or set down the "back trekkers" who intend spending time in the wilderness area.

On and up through Rockwood Cut, temporarily covered over for a tunnel in the film "Round the World in Eighty Days". The river is not always far below the track for at times it runs just 5-10 feet below the rails, but whereas the railroad tends to a constant grade the river has several places of steep descent. In order to get through the canyon the builders have to take the line higher than the terminus and there is a descent of several hundred feet into Silverton, which is awakened by the train's whistles and makes ready for the daily train. The tourist has a stay of several hours before departure. The return trip looks round the relics of this mining town and all the time the train of 13 cars remains parked down the middle of Blair Street. Just right for the enthusiasts to use yet more film up, talk with the crew of the train or of the works cars. Two petrol driven work caps are used, each with a two-man crew, one in front of the train to check for debris on the line and the other at the rear to put out any fires. At the end of the scheduled stop the train is turned on a triangle track for its run back to Durango.

The train takes the same time on the return journey in spite of the fact that the line descends 2,897 feet in the 45.6 miles. Perhaps it is just as well that brakes keep the speed well under control and the re-railers carried on the locomotives and cars are unnecessary accessories. Back in Durango the train runs round the yards on a loop line, so that at all times the fixed seats in the cars (ex-Denver Tramway Buses) face forward.

Although the connection to Denver has long ceased to exist the mile-posts still show the distance back to Colorado's Capital City.

The first D. & R.G.W. passenger train steamed into Durango on 1st August, 1881 on completion of the main line to Alamosa. Completion of the Silverton Branch was on 3rd July, 1882. Until that time access had been over a stage coach

The Silverton after pulling the daily train from Durango. Built for the Denver and Rio Grande Western Railway by Locomotive 'C', New York in 1923. Class 282S 156 RO No.

Technical data

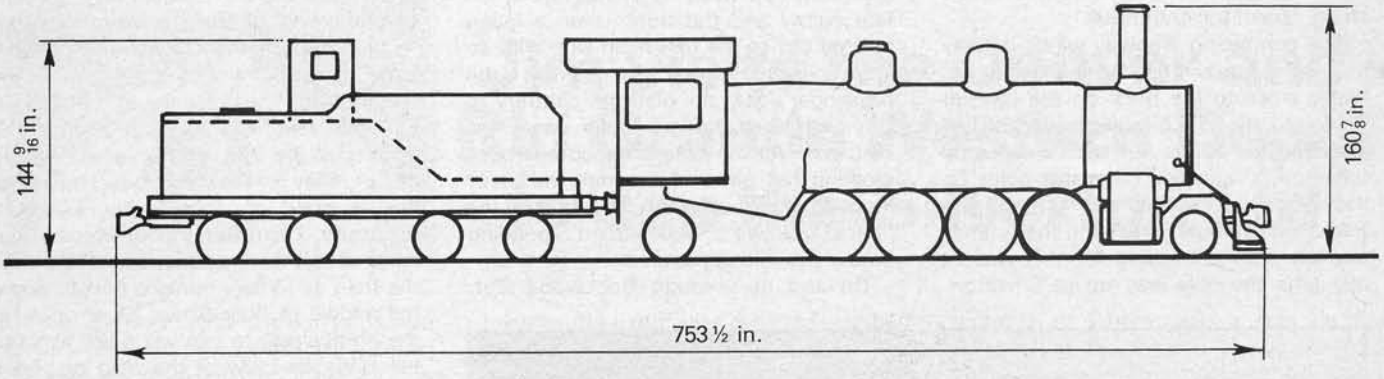
GAUGE OF TRACK	CYLINDERS		DRIVING WHEEL	BOILER		FIREBOX		TUBES		
	DIA.	Stroke		Inside Dia.	Pressure	Length	Width	Number	Diameter	Length
36"	18"	22"	44"	63 ½"	200 lbs.	72⅛"	60 ¼"	106 22	2 ¼" 5 ½"	16'-0"

WHEEL BASE			WEIGHT IN WORKING ORDER—POUNDS				
Driving	Engine	Engine & Tender	Leading	Driving	Trailing	Engine	Tender
12'-3"	28'-10"	53'-6"	29599	113500	22000	156000	98500

FUEL		HEATING SURFACES, SQUARE FT.				GRATE AREA SQ. FT.	MAXIMUM TRACTIVE POWER	FACTOR OF ADHESION
Kind	Tubes	Flues	Fire Box	Total	Superheater			
Soft Coal	993	993	504	97	1594	422	30.1	27500 lbs.
		504	97	1594	422	30.1	27500 lbs.	4.12

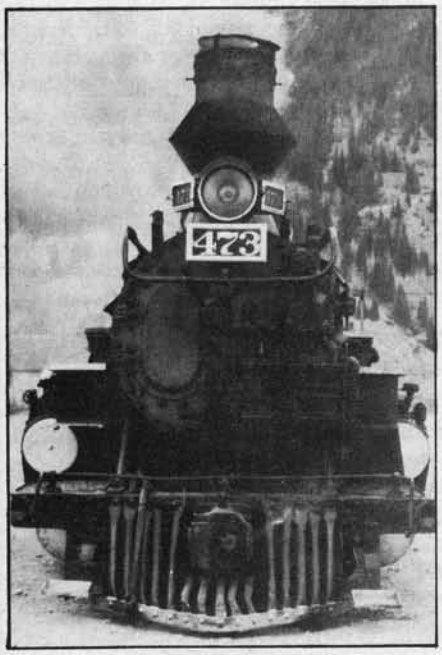
Tender, Type 8-wheeled Capacity, Water, 5,000 Gals Fuel, 8 Tons.

Denver & Rio Grande Western R.R.
Type-2-8-2 Class-K-28 Series-473, 476, 478 Narrow Gauge

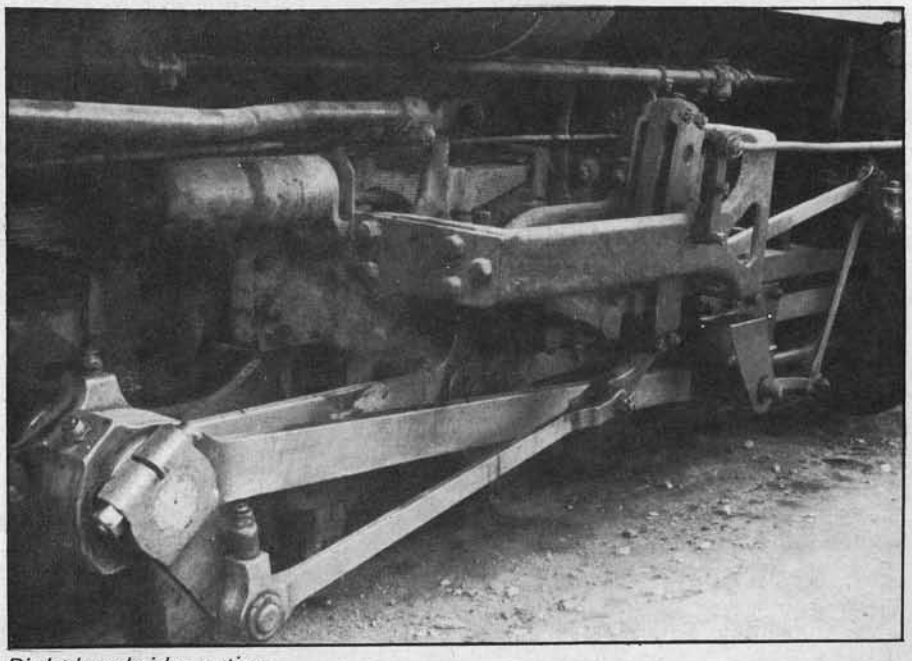


Description

Gauge . . . . . 3'-0"
Valve Gear . . . . . Walschaert
Wheels . . . . . Spoke
Grate . . . . . Rosebud
Superheater . . . . . Schmidt Type A
Firebox Size, Inside . . . . $72\frac{1}{8}" \times 60\frac{1}{4}"$
Tubes, 2¼" Dia., No. 106
Flues, 5½" Dia. No. 22
Flues, Length over Tube plates . . . . . 16'-0"
Grate area, Sq. Ft. 30.17
Width Over Running Boards . . . . 9'-5"
Width Over Cylinders . . . . . 10'-5½"
Width Over Frames . . . . . 4'-9"
Heating Surface:
Firebox . . . . . Sq. Ft. 102
Tubes . . . . . Sq. Ft. 994
Flues . . . . . Sq. Ft. 504
Total . . . . . Sq. Ft. 1,600
Superheater area . . . . . Sq. Ft. 396
Tractive Power . . . . . Lbs. 27,540
Wt. on Engine Truck . . . . Lbs. 20,500
Wt. on First Drivers . . . . . Lbs. 29,200
Wt. on Second Drivers . . Lbs. 29,200
Wt. on Third Drivers—Main . . . . . Lbs. 27,600
Wt. on Fourth Drivers . . Lbs. 27,500
Wt. on Trailer Axle . . . . . Lbs. 22,000
Wt. on Drivers—Total . . Lbs. 113,500
Wt. of Engine . . . . . Lbs. 156,000
Wt. of Tender—Loaded . . . . . Lbs. 98,500
Wt. of Engine & Tender—Loaded . . . . . Lbs. 354,000



Front end of the K28 2-8-2



Right hand side motion

road, parts of which are still visible. The locomotives that steam on the Silverton are very much different from those early ones and are three in number, 2-8-2s of class K28, ten of which were built by the American Locomotive Co. in 1923. The appearance has changed over the years and most noticeable is the dummy spark arrester. Two of them were fitted with spark arresters for their part in the film "Butch Cassidy and the Sundance Kid". The outside framed arrangement with the massive cranks is not usual in U.S. Loco practice, but these are big engines and indeed in 1928 and 1930 D. & R.G.W. rebuilt some of their standard 4ft. 8in. gauge 2-8-0s into putside framed 2-8-2- on the narrow gauge, side by side the two classes are very similar in size.

The dimensions of these locomotives will interest many, perhaps even tempting someone to build a small edition or even go for a trip on the 'Silverton Limited' itself, I believe it still runs and is an unforgettable experience. For myself I am scheming on how to get to W. Virginia and the Cass Railroad. A logging line preserved by the state and using Shays, Heisler and Climax geared locos for power. But more of that some other time.

The 'Eagle' designed by Martin Evans

A simple 2½ in gauge 4-4-0 locomotive

IN RECENT YEARS there has been a distinct revival of interest in model steam locomotives for the 2½ in. gauge. I think this has come about due to the very high cost of both castings and materials, rather than any special preference for the smaller coal-fired type of model. This movement towards the smaller gauge has also been assisted by the formation recently of the 2½ in. gauge Society, which holds rallies at those model engineering societies, that have tracks laid for this gauge.

Another point that has favoured the 2½ in. gauge, rather than the bigger 3½ in. and 5 in. models, is that the equipment required to build the smaller types of locomotive does not need to be so heavy or expensive. However, a word about this later.

The design which I am offering to *Model Mechanics* readers is a very simple one, suitable for the complete beginner (of whatever age!) and for those with rather limited equipment. Many readers, however, may look askance at the type of locomotive I have chosen — a 4-4-0 express passenger. Surely, they will say, a small 0-4-0 tank, such as used for branch line shunting or in industrial works, should have been chosen. But I had very good reasons for choosing a 4-4-0, so let us have a look at some of them.

Firstly, many beginners want a locomotive powerful enough to haul both the driver plus a passenger or two. This requirement puts the small 0-4-0 tank out of court at the outset! Secondly, a 4-4-0 is actually no more difficult to build than even the smallest 0-4-0 tank! Consider a moment. A simple 4-wheel bogie is extremely easy to make. If the builder is capable of turning up driving wheels and axles, he will certainly find no difficulty in turning up four bogie wheels and their two axles. Thirdly, however simple a 0-4-0 tank is made, it must still be fitted with some kind of automatic feed pump to supply the boiler with water continuously; it also needs a good reliable lubricator to ensure that the cylinders are kept in good condition. A hand pump is also highly desirable, not only to feed the boiler when the engine is stationary, but to act as a test pump, when testing the boiler during construction. and it is often difficult to find space in a 0-4-0 tank engine for the hand pump.

There is yet another reason why a 4-4-0 tender locomotive may be preferred to a small tank engine. The tender can be made to carry a useful quantity of fuel and water, impossible on a small tanker, for which the builder ends up by having to make some kind of fuel and water carrier to be fitted at the front end of his passenger car! Finally, the extra space available in 4-4-0 type locomotive, makes it an easier job assembling the working parts, and particularly the pipework inside the smokebox which is often quite a "teaser" in small tank engines.

My 2½ in. gauge 4-4-0 is based on a lesser-known type of locomotive that used to work on the Great Northern Railway of Ireland. The prototype design was actually a three-cylinder compound, though of course our model only has the two outside cylinders. The design was by Mr. G. T. Glover, the Chief Mechanical Engineer at the time, and was quite a big and powerful engine for a 4-4-0. The single inside cylinder was the high-pressure cylinder and was 17¼ in. bore by 26 in. stroke; the two outside low-pressure cylinders were 19 in. by 26 in., and the working pressure was 250 p.s.i. — quite a high figure for the period. The coupled wheels were 6 ft. 7 in. dia. on a long wheelbase of 10 ft. 8 in. The total heating surface of the boiler was 1527.5 sq. ft., and the grate area 25.2 sq. ft. The weight of the engine in working order was 65 tons, or with the tender 103 tons. The tractive effort calculated at 85% of the working pressure amounted to 23,762 lbs.

Unfortunately, I have no information as to the performance of these very handsome engines, though I understand that they were considered reliable and very economical.

Returning now to our 2½ in. gauge model, the outside cylinders will be ¾ in. bore by $1\frac{1}{8}$ in. stroke, with valves inside the frames operated by slip eccentric valve gear, this being about the easiest valve gear of all to construct. The boiler will be of the regulation locomotive, but made as simple and easy to build as possible; it will be suitable for either coal or gas firing and the working pressure will be 80 p.s.i.

Before starting construction, a few words of the kind of workshop equipment that will be required may be useful. A lathe of some kind is of course essential. The ideal machine would be one of the very popular 3½ in. centre lathes now on the market, such as the Myford ML.7 or ML.10, or the new "Speed 10", or possibly the Perfecto. Many of the pre-war machines of the 3 in. to 3½ in. centre height would also be perfectly suitable, such as the Randa, the Zyto, the Willimot, the Winfield, and the Drummond, to mention only a few. But those readers who only have a Unimat SL or the new Unimat Mark III can take heart, as many of the smaller components can be machined on these baby lathes; this also applies to that excellent little lathe, the Cowell 90. At this point, perhaps I should say that anyone building the locomotive on one of these baby lathes and is unable to cope with the driving and coupled wheels should write to me c/o the Editor, when I hope to be able to make arrangements to supply them with finished wheels.

Apart from the usual 3-jaw self-centring chuck and 4-jaw independent chuck, the most useful lathe accessory is probably the vertical slide, and those builders who have one of these slides, preferably with a suitable machine vice that can be conveniently clamped or bolted to it, will be well prepared to deal with such things as cylinders, valves, crossheads, etc., etc.

A final word before we start on construction. I am calling this locomotive *Eagle*. This may seem a strange name for a steam locomotive, but in fact one of the class of G.N.R. (Ireland) 4-4-0 compounds carried this name. Originally I was going to name the model *Kestrel*, which was the actual name carried by the first engine of this class, but I came to the conclusion that there might be confusion with a well-known model petrol engine designed by the late Edgar T. Westbury, which carried this name; so *Eagle* it is.

The main frame

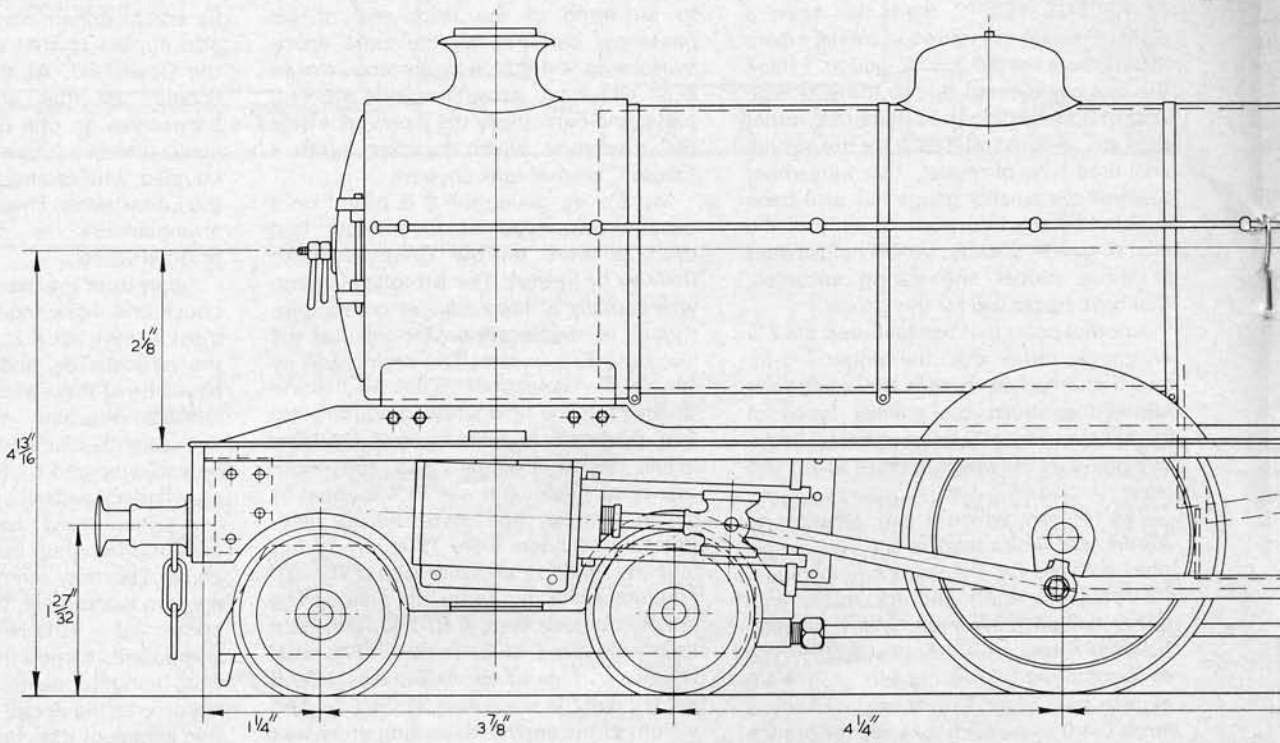
Let us now make a start on the main frames. For these we will require two pieces of bright mild steel 2¼ in. wide by $\frac{3}{32}$ in. thick and 18 in. long 2¼ in. wide steel may, however, be rather difficult to locate, so 2½ in. wide will be the answer. Actually it may be wise to purchase the 2½ in. wide steel, as much of the mild steel plate on the market today is produced by shearing off large sheets, and this leaves distorted edges, and the wider material will enable us to saw away the distorted parts.

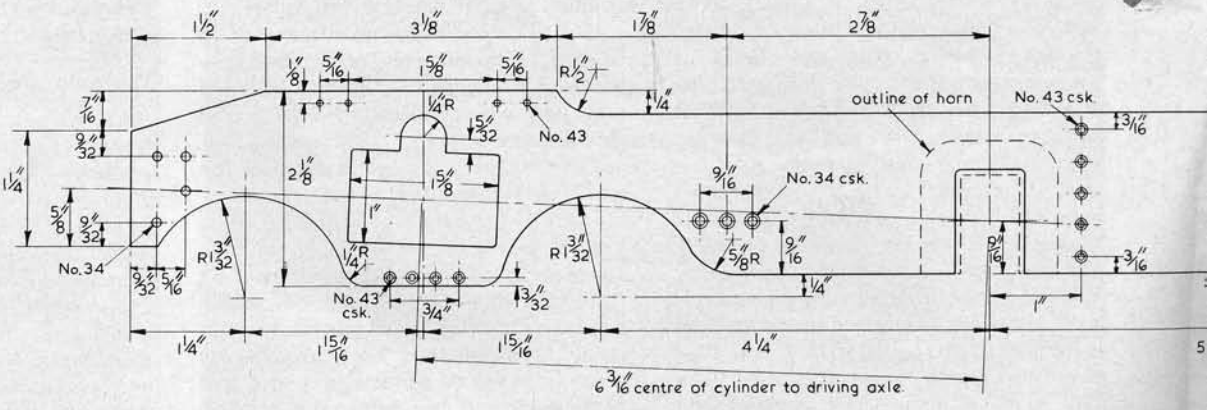
True up on edge of one piece of the steel, the top edge is the more convenient, then give it a coating of any brand of marking out fluid, which will enable our scribed lines to show up much better. As the frames are reduced in height from a point a little to the rear of the cylinders, start by scribing this top edge, which will be ¼ in. below the top edge of the plate. From this, using dividers set off the bottom edge, which is 1¾ in. below, noting that the part of the frame below the cylinder is $\frac{1}{8}$ in. lower, or $2\frac{1}{8}$ in. deep overall. The next thing to do is to saw along the top edge and true this up by careful filing, checking with the try-square. Now using the square again,

EAGLE

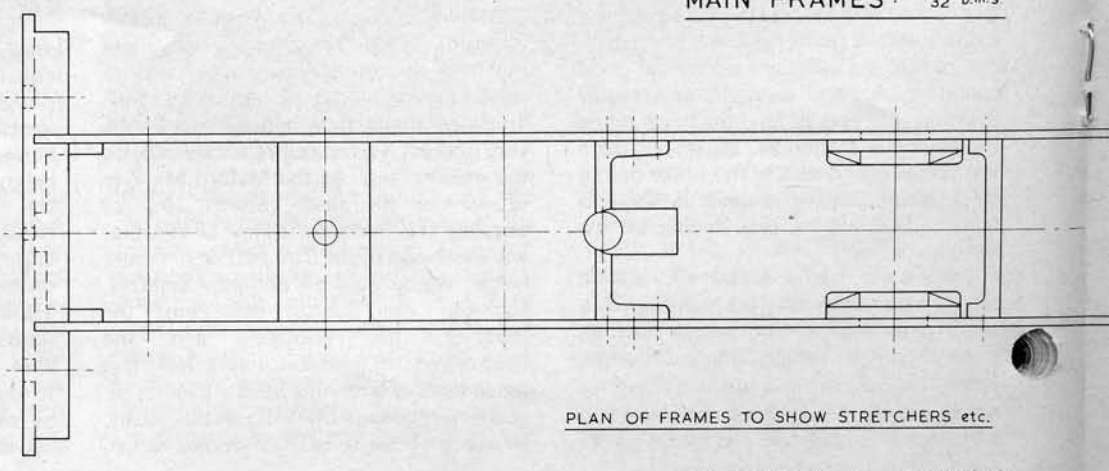
A $2\frac{1}{2}$" gauge 4-4-0 locomotive based on a G.N.R.(I) design.

by MARTIN EVANS





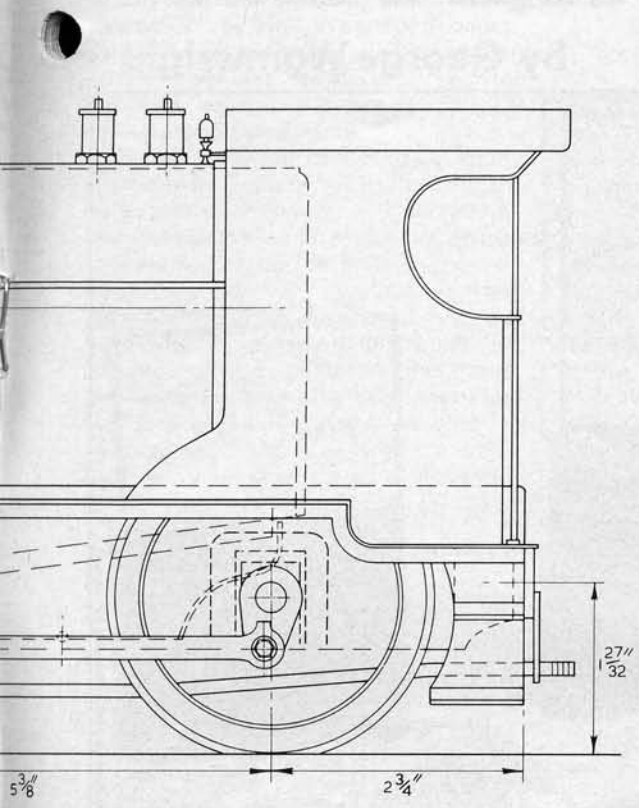
MAIN FRAMES : 3/32" b.m.s.



PLAN OF FRAMES TO SHOW STRETCHERS etc.

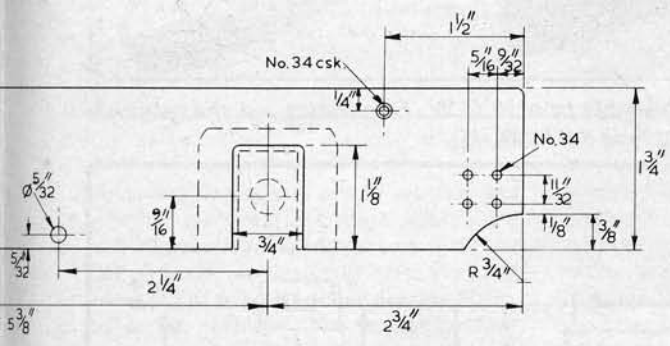
scribe the vertical lines representing the front and rear ends of the frame, the centres of the bogie, and the centres of the driving and coupled wheels.

Next, set out the horn slots, these being ¾ in. wide and 1⅛ in. deep, and carefully mark the centres of the driving and coupled axles, centre popping these lightly. They are at $\frac{9}{16}$ in. from the bottom edge or $\frac{13}{16}$ in. from the top edge, whichever you prefer. The front end of the frames, to which the buffer beams are to be attached, are unusually deep in this design, at 1¼ in., the top corner being $\frac{7}{16}$ in. from the extreme top edge of the frame, so mark off the face to which the buffer beams will be attached, and from the bottom corner of this, mark another point exactly $\frac{5}{8}$ in. up. Now scribe a line (lightly) from this point to the centre of the driving axle, this line will then represent the inclined centre-line of the motion. From this line is marked out the rectangular slot for the cylinders, the steam chest of which projects right through the frame. In addition to this rectangular slot, we need a further slot marked out at a radius of ¼ in. from a point $\frac{5}{32}$ in. above the upper side of the rectangle.

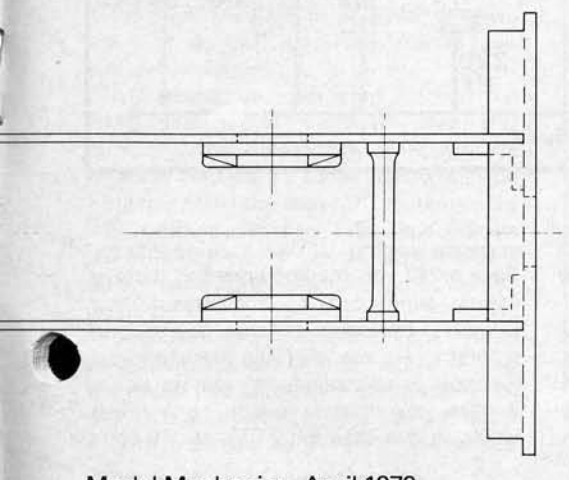


The radiused "arches" to clear the bogie wheels are scribed at a radius of $\frac{13}{32}$ in. from points ¼ in. below the bottom edge of the frames in the area of the main horns, or if preferred from points ⅛ in. below the bottom edge of the frames below the cylinders.

The next thing to do is to mark out the positions of the various holes and to centre-pop them ready for drilling. There is a group of four No. 34 holes on the extreme left, for the attachment of the front buffer beam. Then moving to the right, we have two groups of two No. 43 holes near the top edge of the frames above the cylinder slot. These holes are for the attachment of the smokebox saddle. Just below the cylinder slot, there is a group of four No. 43 holes (which will have to be countersunk later on) for the attachment of the boiler feed pump. Immediately to the right of the driving axle horn slot, we have a vertical row of five No. 43 holes (to be countersunk) for the main frame stretcher. The $\frac{5}{32}$ in. dia.. hole to the rear of the last group, close to the bottom edge, is for a pin to keep the ashpan in position for the coal-fired version of the locomotive. A single countersunk hole No. 34 to the right of and above the trailing coupled axle horn slot is to take a simple round frame stretcher, and finally there is a group of No. 34 holes on the extreme right, for the attachment of the drag beam.



We now want to rivet the two frame plates together, so that we can complete the sawing, filing and drilling in one "go", but before doing this, drill some holes inside the cylinder slot, not too near the scribed line, opening these out carefully so that the unwanted piece of metal can be removed. Clean this slot up to finished size, then drill two or three of the holes $\frac{3}{32}$ in. dia. so that the two frame plates can be riveted together, using copper rivets filed flush. The pair of frames can now be finally finished and all holes drilled barring those used for the rivets. Knock out the rivets, open out the rivet holes to the correct size No. 34, carry out the countersinking, remove all burrs and clean up with emery cloth, when we will be ready for the next operation, which is fitting the main horns.



To be continued.

A basic test instrument
The 'MULTIMETER'

by George Wainwright

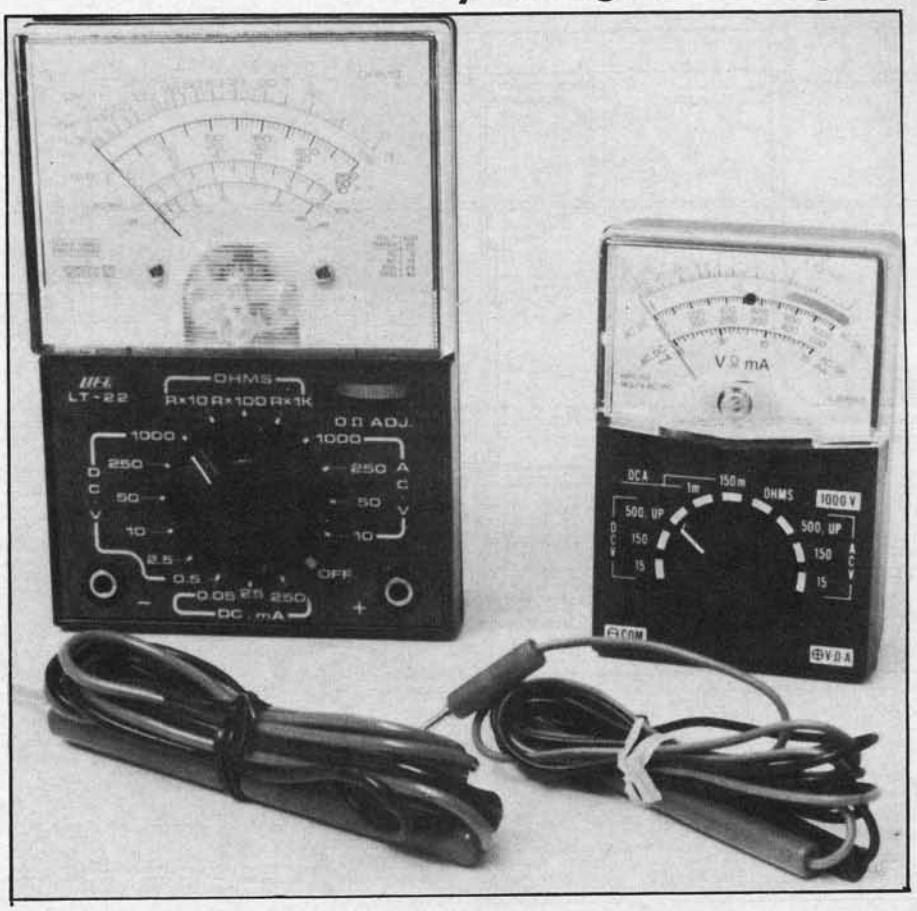
IN THE FIRST article, I tried to cover a pretty wide range of subjects as a basic introduction. It is probably now a good point at which to stop and dwell a little more deeply into some aspects. So let us take a look at the measuring of various parameters to be found in an electrical circuit and at the types of equipment that would be used to carry out these measurements.

Even the simplest arrangement of components require measurements to be made if we are to understand a little of the working of a circuit.

The basic measurements we might wish to make can be divided into various groups. Let us begin with voltage and current, and we will use the power unit described in the first article as our vehicle for this little exercise. The circuit is repeated in Fig. 1. We will assume we have a test meter of the type shown in one of the photographs. We will also assume that our power unit is complete and that we shall use the meter to carry out some functional tests. We know that the power unit is to operate from the household mains supply, so we will check this supply first.

Using the properly insulated connecting leads supplied with the instrument, we must always select the correct range before making a connection to the points to be measured. Now the type of instrument we are referring to is known as a multirange meter (multimeter for short). As its name implies, we are able to vary switches on the instrument to convert the meter to check various parameters, so it is really a variety of voltmeters, ammeters etc., in one unit. The usual ranges of the simpler instruments allow AC and DC voltages from say 2.5V full scale (FSD) to 500 or 1,000 volts. DC current measurements are normally confined to the more expensive types due to the need to build in fairly costly current transformers. In addition to these ranges it is usual to provide 1, 2, or 3 resistance measuring ranges. Resistance measurement made this way is really the display of a current which will flow through the resistance under test provided by a small internal battery. The meter is calibrated to read directly in Ohms, the unit of resistance. For the record; Ohms law states that the current flowing through a resistance is proportional to the voltage across it and that 1 volt will cause a current of 1 ampere to flow through a resistance of 1 ohm.

$$\text{So: } V = IR \text{ or } I = \frac{V}{I}$$



Two low cost multimeters available from A.G.W. Electronics, on the left type LT22-20kΩ/V and on the right type KRT100-1kΩ/V

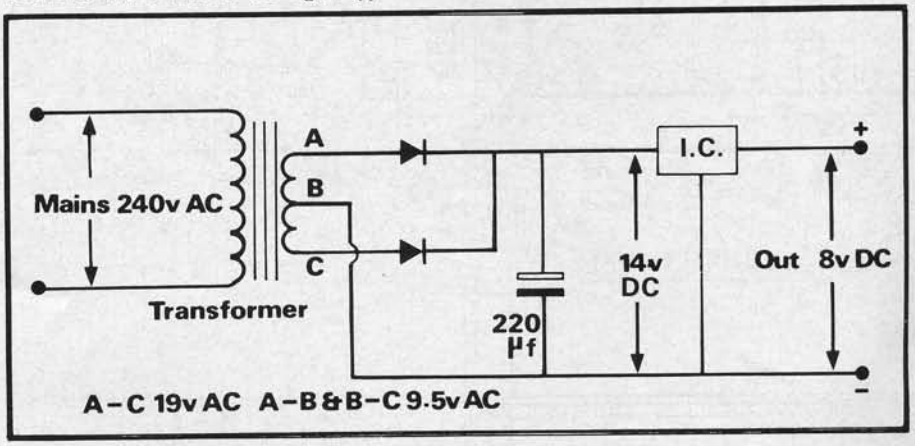


Fig. 1. Voltage checks

Making a measurement

Back to our power supply and that first measurement.

We know that the mains supply is 240v AC, so we would set our meter range to the highest safe setting, say 500 volts and having taken a reading we may well be able to select a lower range for a more accurate reading. We will assume that we have a 240 volt reading showing there is mains connected to the transformer primary. Referring to the power unit diagram, we see that the transformers' function is to 'transform', as its name implies, this mains voltage to a lower value, in this case 9.5-0-9.5v (or 19 volts