Model Mechanics

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MAP HOBBY MAGAZINE

SIMPLE STEAM • TOOLS OF THE TRADE
TETHER RACING CAR • CASS RAILROAD

JIM'S TRAVELS

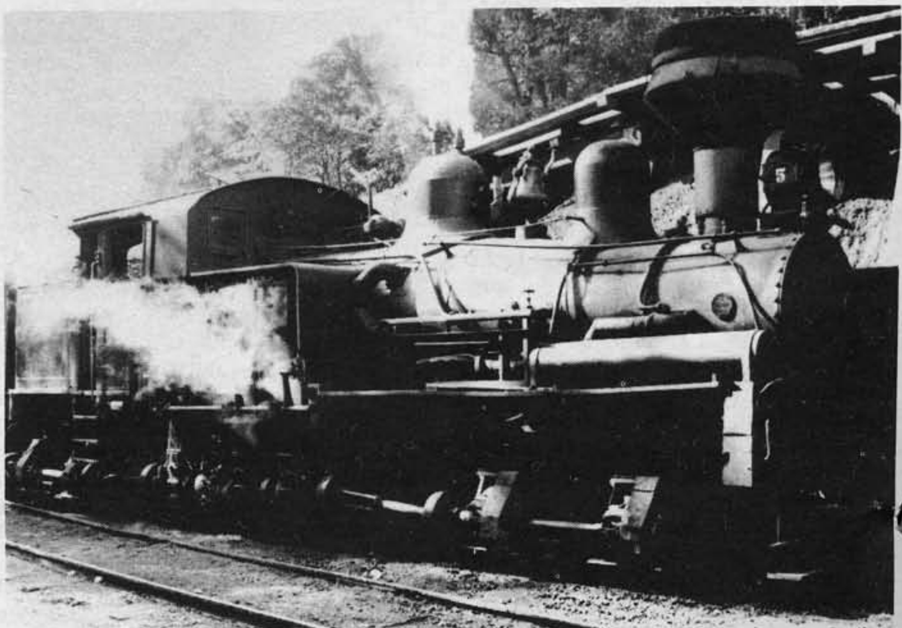
Jim King's search for places where steam still reigns supreme takes him to Cass, West Virginia, North America

ON A PREVIOUS visit to Virginia I resolved that if the opportunity arose I would take a trip out to Cass in West Virginia to see the railroad that runs up the mountains to Bald Knob and which is noted as one of the last places where logging locomotives can be seen at work. Cass, once the centre of a massive logging operation, became a dead town when the lumber company ceased operations on 1st July 1960 and the logging road along with the big lumber mill that at its peak handled a quarter of a million feet of timber each day was abandoned and it was expected that Cass, like so many lumber towns before, would decay and finally disappear from the map. There was still lumber to be cut but the company were using trucks for transport and all machining was done in some other place.

This railroad, which at one time operated over 200 miles of track with its articulated locomotives, Shays-Heislers and Climaxes, seemed to be consigned to the scrap-heap but the story now is a familiar one. An enthusiast from Pennsylvania named Russell Baum, remembering the Shays operating on the road, went to the State Capital to ask the legislature to buy the remaining track and rolling stock and turn it into a tourist operation. As soon as the plan became known hundreds of Virginians came forward to support the idea and again a familiar pattern of volunteer labour and support was available in the following months to clear the line and get it back into a working condition.

In 1963 on 15th June the Cass Scenic Railroad opened for business in its new guise of a State-owned tourist and preservation project. For the first season trains only ran as far as Whittaker Station, 4.2 miles from Cass, and 23,000 people paid to ride the train. Since then the line has been opened to the top of Cheat Mountain, Bald Knob, 11 miles up a grade that is mostly a 1 in 20 incline but which at times gets as steep as 1 in 10. The trains are scheduled to run to Whittaker and varying on the season once or twice a day to Bald Knob. All the passenger cars are built on the underframes of the trucks previously used for the logging operation and needless to say are built to give the rider the most opportunity to see and photograph the scenery. The seats are arranged back to back down the centre of the cars which vary from completely open observation platforms to partly closed ones and in some it is possible to shut the windows to keep out the cold air at the top of Bald Knob, nearly 5,000 feet above sea level.

Pacific Coast Shay No 5



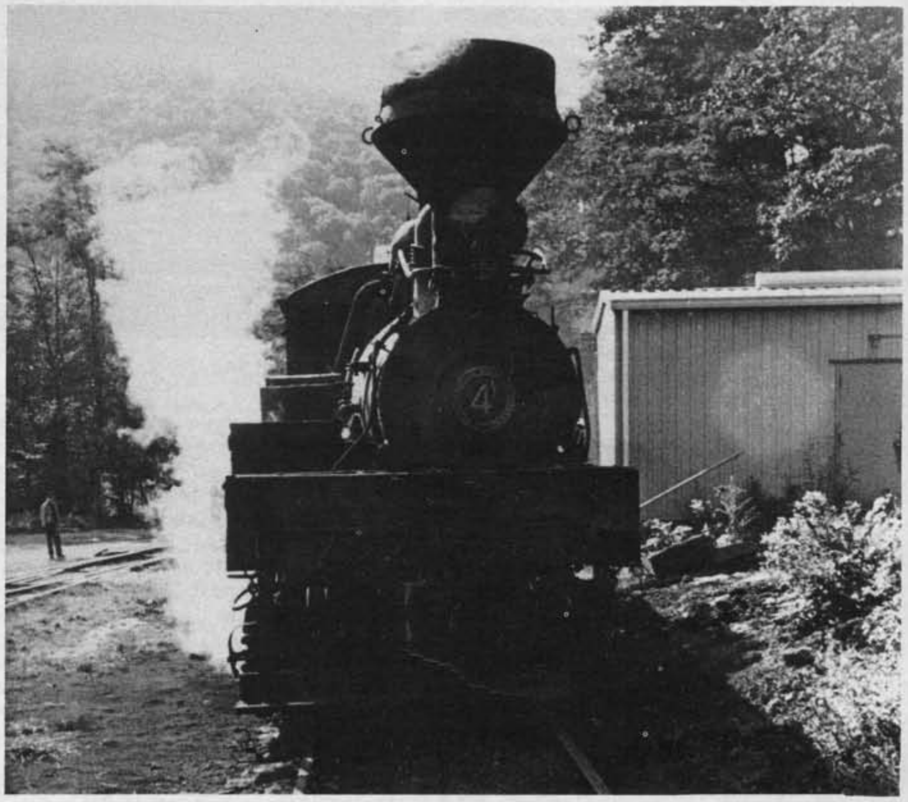
THE CASS RAILROAD

So after a drive of 250 miles from the Washington D.C. area, made 36 hours late by the airline changing the flight from Gatwick and thus reducing the available time in W. Virginia, I arrived in Cass. It is a very modest town in the mountains, reached after crossing the Allegheny Mountains and driving through the valley of the Shenandoah River. I was too late to see the trains on the evening of my arrival but was early enough to be able to book in the one hotel in town, the Cass Inn, like the town small but very good and at $14 (£8) for a double bedroom, very reasonable. Cass in the evening seems dead and so with not much to do, early to bed and early to rise was the best idea.

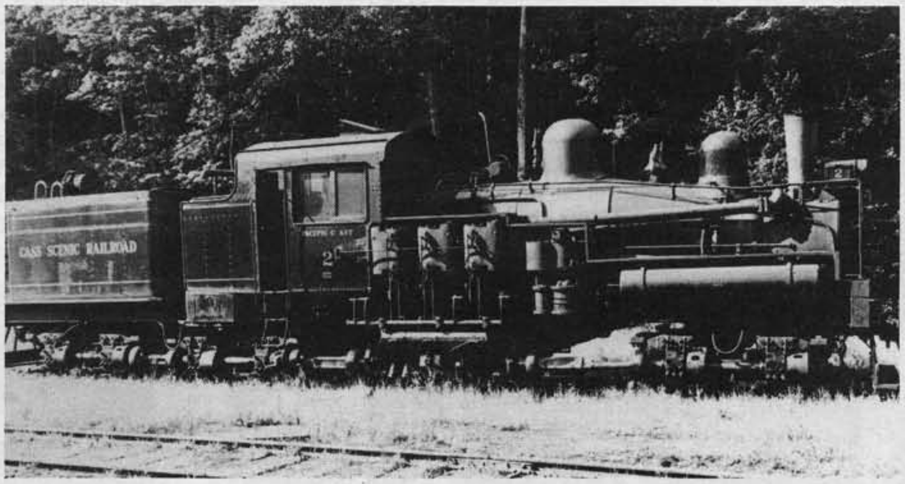
In the early morning there was plenty of movement and the prospective travellers on the train and the crews began arriving soon after sun-up for the first train scheduled to run to Whittaker at 11.00 a.m. I was soon on my way to book my seat on the 12.00 noon to Bald Knob. The Cass RR uses the depot of the Cheasapeake & Ohio Greenbrier branch and until it was burned down recently this was a typical American country station. Now the facility is operated from a series of trailer offices until such time as they have funds to rebuild. Having guaranteed my seat, a check in the office and I had arranged a visit to the engine terminal about half a mile up the line. Although it seemed that several other people also had the same idea and had taken leave to look around I think it is always a good idea to check first. It is surprising how nice people can be if you just are polite and ask first.

There were three locomotives being prepared, all coal burning — at least they said it was coal but the smoke that the stuff gave off certainly indicated that it was not best Welsh steam. Two of the locos were three-truck Shays destined to haul the train to Bald Knob and the other was a three-truck Heisler for the Whittaker train. A third Shay, an oil burner, was in reserve and there was a long line of locomotives on the dead track awaiting attention in the Cass Shops. Being a Sunday the shops were closed so there was no opportunity to have a look around what I am sure would be an interesting place of work.

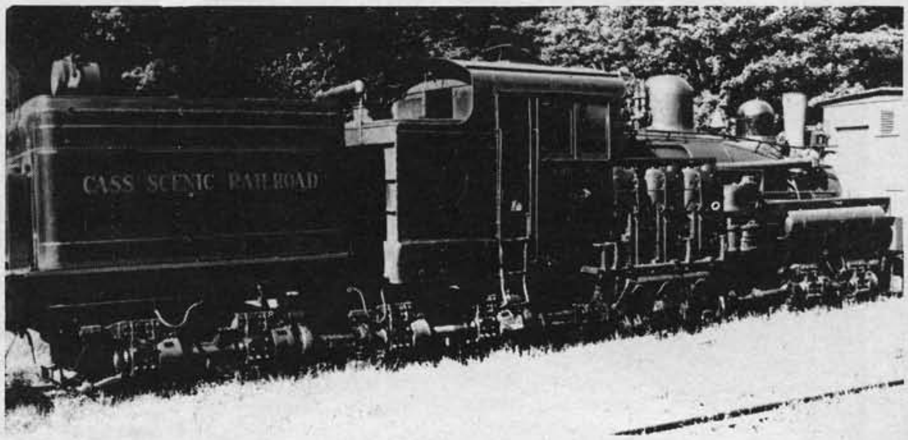
When the Heisler moved off I abandoned my picture taking in order to catch the train which right on time left for Whittaker amidst a vast cloud of smoke and much whistle blowing. It seemed a long time before it disappeared around the far bend and when my own train left at 12.00 noon for the mountain top I understood why, for the general running speed of the train is about 4 m.p.h. and at that speed the crankshafts of the Shays were fairly flying around. Both the two Shays on the mid-day run were pushing the train, which when you consider it, is an obvious safety measure on a line with such steep grades, and in addition, for the same reason, each car had a brakeman on a hand brake to supplement the air brake. Perhaps we should say brakeperson, for on the car I was in, the brakes were



Shay No 4 with offset boiler



Shay No 2



operated by a very competent Virginian lady.

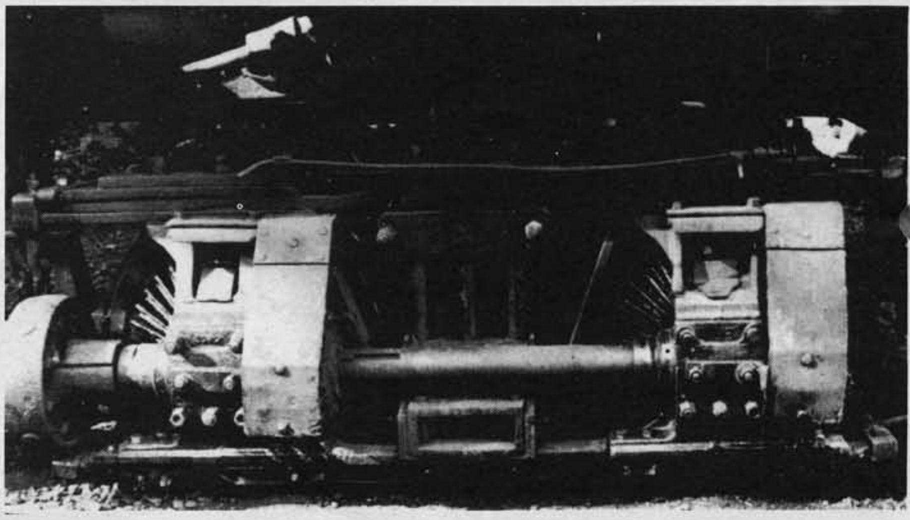
With the same outpourings of smoke that the Heisler had demonstrated the two 90 ton locomotives moved the 10 car train slowly up the track and the advantages of the articulation system devised by Ephraim Shay soon became apparent on the steeply climbing, sharply curving track, and in spite of what was obviously a bad lot of coal the engines moved the train steadily on and up. One of the two Shays in use, No. 4, is a very respectable 72 years old having first come to the Cass in 1905. Not, of course, in its original condition for the railroad's shops were capable of doing any repairs and making any spares for not only the rolling stock but for the big lumber mill, the derelict remains of which we passed soon after leaving the depot. The younger of the two locos, No. 5, had been fitted with a whistle from a Southern Railway main line engine and when this was sounded, which was quite often, it was a noise worth travelling all those miles just to hear, and I recommend that if anyone cares to follow in my footsteps then take along a tape recorder, for I wish I had.

So the train rolled on until, just before Whittaker, we arrived at the switchback, two of them together to get the train high up in the minimum space, and there waiting to pass us was the returning Whittaker train. Reversing twice over the switchback and allowing the other train to get past at the same time we soon arrived at Whittaker when both the engineers got down and started to adjust the engine big ends while all the passengers alighted to stretch their legs, use the rest rooms and admire the view, for there is nothing else at either station except for some cleared land for the use of campers. After half an hour the train was on its way again and looking across the valley one could watch the progress of the other train by the high cloud of smoke that it was throwing up.

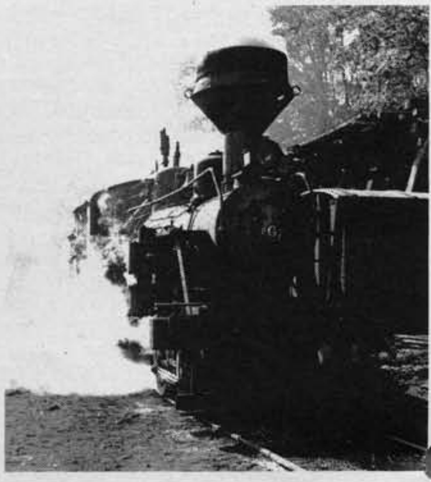
Soon after leaving Whittaker and just before the line became steepest we stopped. The bad coal was having its effect and the train remained stationary for some time while the locos regained their breath, then with both engines blowing off we continued on our way. Another stop for water and then the really steep bit of 10 per cent grade caused some real effort to be put into the action by both Shays and for the people in the car near the engines it must have been like living in a tunnel full of coal dust. No matter where one sat dust fell all around until we cleared the steep section and finally arrived at Bald Knob, 30 minutes late.

Half an hour at the top and we were on our way once more, just one loco this time for Shay No. 4 had left on its own soon after arrival and the pace was a little faster this time with the train being held under control by the efforts of the brakemen on the hand brakes in addition to the locos. One stop for water and since we now rolled down hill 50 per cent faster than we made it up the return trip time was shorter. No illusions please, speed up was about 4 m.p.h. and the maximum down 6 m.p.h. so we broke no land speed records, the overall time for the return journey being 5 hours.

What a marvellous way to spend a week-end, at least if you like steam locos, and who in their right senses does not?

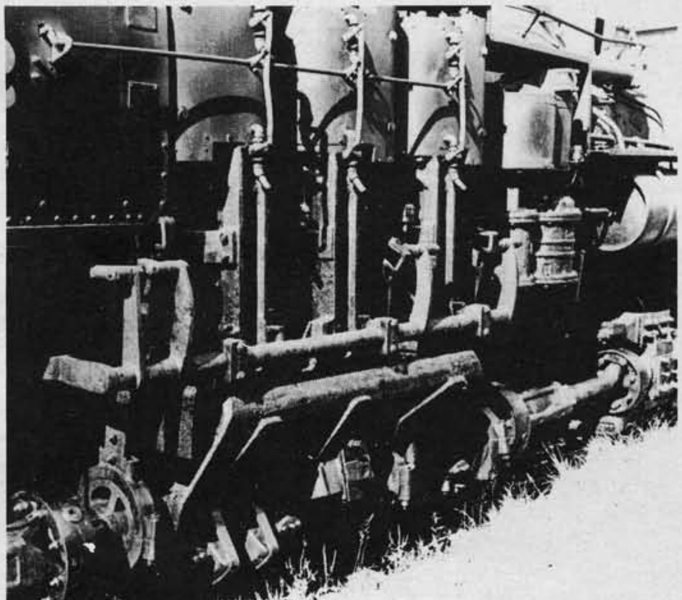


Power drive of Shay No 5

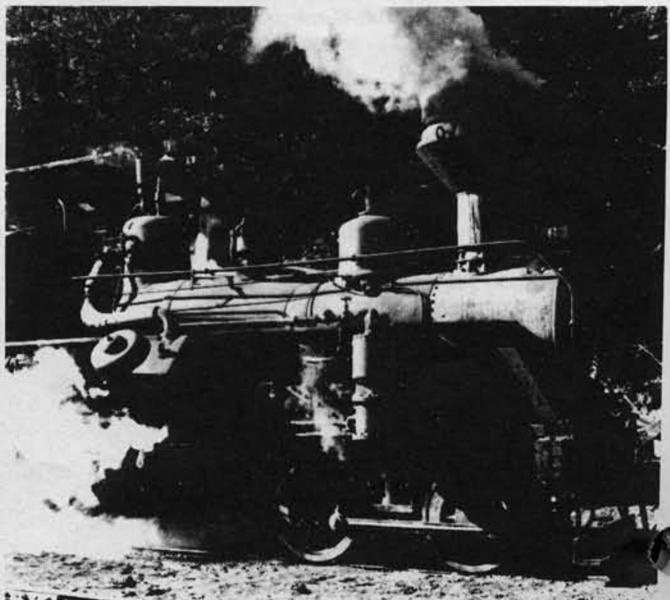


Heisler No 4 coaling

Shay No 2



Heisler No 6



? · Q and A · ?

British Standards Specifications for Copper

As a relative newcomer to modelling I should be most obliged and grateful if you would help me in respect of the reference numbers of British Standards Specifications covering copper materials (plate, tube and rivets) suitable for model loco and vertical type boilers. It would also be most helpful if you could suggest a book, or books, dealing with model boiler design and construction.

Newark, Notts. R. W. Watts

Seamless copper tubes suitable for boilers are generally to British Standard Specification 1306. — 99.85% copper, 0.005% tin, 0.05% Arsenic, 0.003% Bismuth, 0.03% Iron, 0.01% Lead, 0.1% Nickel, 0.01% Tin.

Copper sheet is generally to B.S. 1172 — Phosphorus deoxidised non-arsenical copper. Composition much as above without Arsenic. Copper rivets are probably made from similar metals.

We can recommend two books on model boiler construction: "Model Locomotive Boilers, their design and construction" price £2.50, and "Model Boilers and Boilermaking" price £2.50, both available from M.A.P. Sales Dept.

Martin Evans

Suitable Lathe

I am intending to purchase an ML10 lathe and would be grateful if you can let me have your opinion on this machine (I am intending to use it to manufacture 3½" gauge model locomotives).

Whilst we are in a time of change to metrication, I notice that articles in 'Model Engineer' still give Imperial measurements. Would you advise me to buy a metric model?

Keyworth, Notts. A. Webb

We can certainly recommend the Myford ML.10 lathe as being suitable for 3½ in. gauge locomotive work.

Whether to specify Metric or Imperial tools, etc., is a very difficult decision. While we are continuing to publish drawings with Imperial dimensions for the time being, this is really because many of the materials we use for model building are still being supplied by the manufacturers or stockholders. However, the change-over is slowly going ahead, and it may not be many months before we change over to Metric dimensions on all drawings. We think therefore that it may be safer to acquire Metric lathe, tools, etc., from now on.

Martin Evans

Building and rigging a countershaft

I am a regular reader to Model Engineer and wonder if your experts can help with some advice on building and rigging up a countershaft to run a recently acquired small plain lathe. I have obtained pulleys, plummer blocks and shaft, etc., and assembled these to make a simple countershaft but have run into problems as to how best to mount this assembly, and in particular how to obtain some simple means of tensioning the belt that will also be easy to loosen for changing pulley speeds, etc. As an enthusiastic but inexperienced modeller I have not after several months solved this problem. If you have any simple ideas for this sort of thing I would much appreciate your help.

Uxbridge, Middlesex D. L. Rooke

Firstly perhaps I should say that I don't think there is any easy or simple solution to your desire for a belt slackening arrangement between a countershaft and lathe — I assume you are talking of a wall mounted countershaft.

If, however, you are thinking of having the countershaft fairly close to and behind the lathe, you may like to consider some sort of 'swing frame' arrangement as in the sketch, Fig. 1.

But if such a frame is not to rattle about when the lathe is running, it should be constructed of fairly heavy sections of angle iron.

A frame of this kind can be tensioned by a sort of collapsible 'knuckle' joint K as shown in the diagram Fig. 2. Such a joint, of course, applies tension when straight, and releases tension when 'broken'.

However, if you have Meccano parts, a quickly assembled working model of what you propose would clearly demonstrate the stresses to be allowed for in the final design, and would show you how best to make the arrangement so that, for example, the belt tension introduced a minimum twisting force on the swing frame.

Another possibility that has just occurred to me would be to use a stout board for the swing frame, and pivot it at the lower end with door hinges, although this could have a somewhat clumsy appearance.

But whether you decide to use angle iron or wood for the frame, I think it would be best to position the knuckle joint so that it is aligned below the middle cone pulley step so that belt pull has a minimum chance of twisting the frame.

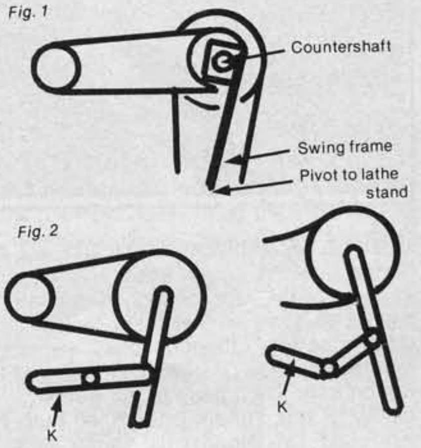
A wide frame with the plummer blocks well spaced would be more stable than a narrow frame. I think, too, that stability would be aided by making the frame of at least 24 in. in length.

In my early days I found that the simplest way to fit a countershaft was to screw it to the wall at a height of about 7 feet from the floor, and with this arrangement the belt from countershaft to lathe is of sufficient length to have enough 'give' to change speeds without call for a slackening arrangement. For this kind of drive, however, it is advisable to arrange for some sort of 'strut' between the wall and the lathe headstock, and approximately in line with the belt to the lathe so as to prevent the pull of the belt from vibrating the headstock.

Final tensioning and adjustment of the belt from countershaft to headstock can be made by providing the lathe stand with slotted holes for the lathe fixing belts, the lathe can then be slid forwards or backwards by an inch or so.

Even now, with my purpose built lathe stand, I have no slackening device between countershaft and lathe, but I manage quite well with the 68 in. Vee belt used, and find the long belt very useful, too, for hand pulling for the odd tapping job, and for setting work true and sound.

Martin Cleeve



Lacquer for brass protection

Can you please tell me if there is available on the market a lacquer either in brush or spray-can (spray preferred) that is recommended for protecting polished brass, the brass work is on a model cannon made to your drawing No. MM1135, the woodwork is coated with polyurethane so this would not have to be affected by the lacquer.

Chard, Somerset L. S. Hillier

Messrs. A. G. Thomas, Tompion House, Heaton Road, Bradford supply Thermoline lacquer for brass. Available in dead clear, 'yellow' and 'deep gold', it has good adhesion and is, in fact, as used for clock bezels and plates. Dries fairly quickly, especially if in a warm atmosphere. Can be used either in a spray gun, by brush, or by dipping.

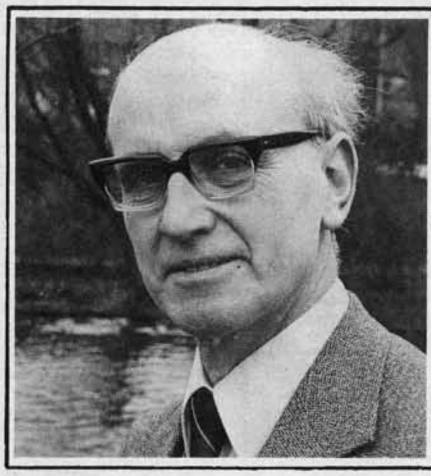
The material should be compatible with polyurethane — it is not a cellulose solvent — but because it dries fairly quickly there may be difficulty in removing splashes or overspray; I would advise dismantling to lacquer the metal parts separately.

The only Aerosol spray varnish I know is that by Humbrol, which is a polyurethane wood varnish, claimed to be 'suitable for metal' but I haven't tried it.

If Thermoline is to be used in an air-brush the special thinners will be needed and it is vital that the equipment be well cleaned in this thinner immediately after use. Thomas can supply the thinners, but I am not sure what size tins it comes in. I always use a fine flat camel-hair brush rather than spray, as the latter can go where it isn't wanted! Small parts can be dipped and hung over the tin to drain, before transferring to a warm drying area.

Instructions are on the tin, but I would emphasise the absolute necessity for thorough degreasing and especially the avoidance of fingerprints on the polished surface. I use Trichlorethylene (Carbon Tetrachloride will do) followed by a wash in hot stergene and water, rinse in hot water and air-dry. Avoid breathing the fumes.

Tubal Cain



Cyril Freezer introduces

MODEL RAILWAYS

MODELS OF RAILWAY SUBJECTS are as old as railways as we know them, locomotives were reproduced in miniature almost as soon as they were built in full size practice, though one excludes Murdock's model, it was never intended to run on rails. Then there is the well known model of Box Tunnel Brunel had built to confound Dr. Dionosyius Larder before the Parliamentary Committee.

Toy trains came into being a little later, once the prototype was sufficiently developed to attract children's attention — or at least, interest their parents sufficiently to wish to provide them with a miniature replica. However, the train set, with its hollow tinplate rails and the gaudy stations, bridges and tunnels did not come into being until the latter half of the nineteenth century. The early trains were intended to be pulled along the nursery floor with a piece of string.

These primitive toys had a lasting influence for they were reasonably accurate replicas of the current (1840-ish) prototypes, with 4 or 6 wheel locomotives and four-wheel, three compartment coaches. The same basic design was still being produced at the end of the tinplate era, indeed the three compartment four wheeler even made a comeback in the Hornby list a couple of years ago. *Plus ça change.*

However, by 1890 the first glimmerings of real model railways emerged, and, in 1899 J. W. J. Bassett-Lowke began his famous firm, a clear indication that the market for more authentic models existed. In 1908 Henry Greenly began 'Model Railways & Locomotives', which unfortunately foundered in World War I, and in 1910 the Model Railway Club was founded. In the 1920's the hobby grew, in 1925 Model Railway News (Now Model Railways) was launched by Percival Marshall.

Although World War II halted progress, by 1950 the hobby had begun to grow again. Since then, there have been several important developments. The growth of r-t-r (ready to run) scale models has been phenominal. The number of clubs has increased dramatically. The numbers of model railway exhibitions have mushroomed, their scope has widened.

In this brief summary I have kept to ascertainable facts, for in this hobby there are many grey areas. Indeed if one wishes to present a neat and tidy progression it is necessary to gloss over a lot of facts that just don't fit. A great deal of controversy arises between some individuals and groups often set out to prove a particular thesis and then get very irate when someone else points out that their theory doesn't fit his model and that he has no intention of adopting their ideas.

Fortunately, what I do with my model railway has no direct bearing on what you do with yours, so both parties can be right. This can be rather confusing, but not to worry. My own interpretation of the history of model railways — particularly the British version — is that it is a highly confused, completely individualistic business.

Which is, when you get down to it, the essence of good modelling. You do it your way.

Scope

Model Railways can be considered as the outcome of a union between model engineering and a toy train set. Whether you consider the offspring legitimate depends on your attitude, to the true model engineer a great deal of what the majority of us do is pure anathema. We use any and every material that comes to hand.

Let me give an example. Some years ago I was taken severely to task because I maintained that it was impossible to make a major award to an unpainted (and accordingly unfinished) railway model. My reason is simple, more small scale models are ruined by painting than by any other cause, including sheer ham-handed lack of craftsmanship. My critic was aghast. "But how do you judge the craftsmanship? Suppose under that fine paint job there is a mass of Brummer filling up blemishes?" I replied that if anyone was clever enough to carve a model out of solid Brummer stopping sufficiently well, when painted, to satisfy three judges then he deserved an award, if not for his craftsmanship, then for his cheek.

Much more to the point, in small scale construction, metal, wood, card and plastic have been used. For many modellers, part of the fun is using odd junk. As the late LBSC (one famous miniature loco engineer of the past) once remarked, a coat of paint hides a multitude of tins. The moment you put an electric motor inside a 'steam' locomotive there is a strong element of fake. If the boiler turns out to be a piece of plastic drainpipe, or an empty cigar tube instead of a length of brass telescope tube or even a piece of brass or nickel silver sheet rolled to a cylinder then we are only carrying that element of deception a stage further.

Why use an electric motor? The answer is that one essence of model railways is the operation of the system in a railway like fashion. Not that it is obligatory. Nothing is obligatory on a model railway.

Of course, you are supposed to follow railway practice. The only trouble is that railway practice is so diverse that, as we say, there is a prototype for everything, even lifting stock off the rails on a completely circular track devoid of points* shades of the toy train oval!

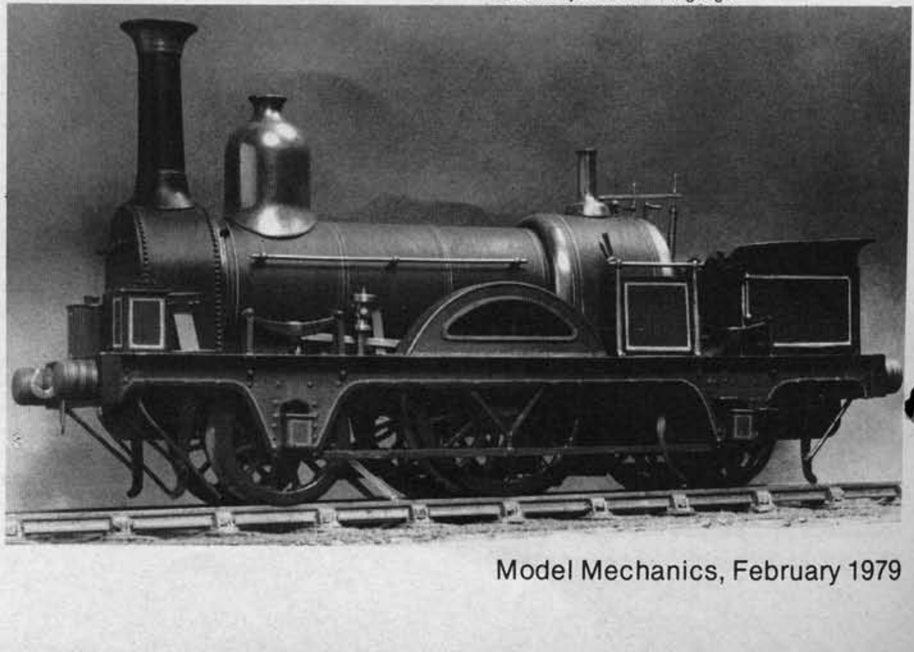
I have mentioned varied materials, implicitly in connection with locomotives. Coaches and wagons can be made from plastic, card, wood or metal — all have been used successfully. This is only half the story. There are the baseboards, mostly wood, the buildings, mainly plastic sheet or card, while the scenery is plaster, paint and anything else that comes to hand.

Then there is the electrical side. Apart from using the best part of a redundant manual telephone exchange, one can also employ not only the uniselector switches, and relays but a wide range of modern semi-conductor chips which are creeping into model railways as in everything else.

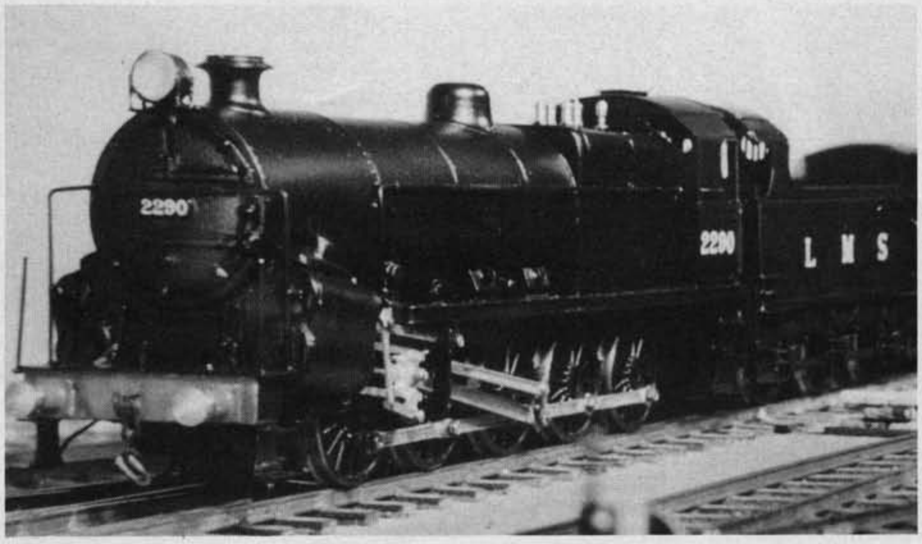
Last, but by no means least, model railways are big. OK the scale is small, but the end product isn't. After all, the prototype is measured in miles, and even in 4mm scale, a mile is, in round figures,

*The Glasgow Subway which with 4ft 0in gauge is also reasonably correct for 00 gauge.

G.B.J. Della Gana's superb LB&SC 2-2-2



seventy feet. If you must be pedantic it is - 1760 x 3 ÷ 76 = 69.47 which is why we round it out. Few layouts boast a scale mile of track. The important point is that we've enough room under our baseboards to store a couple of so-called 'big' models, but that the sheer size of a developed model railway means a building span of at least five years. Most of the major models have taken ten to fifteen years to develop. The record, so far as I know, is held by Norman Eagles whose Sherwood Section has now passed its half-century by a sizeable margin and seems well set for its diamond jubilee in five years time.



'Big Bertha', Midlands Railways's 0-10-0 from Ken Thomas' collection

Standards

English is an imprecise system of communication because we will use one word to express a variety of meanings. Usually, context will distinguish the correct meaning, but 'standards' has in model railway usage two opposing meanings which cannot be readily separated.

We talk of standards (of modelling) and (dimensional) standards: since they interact they get confused. Unfortunately while it is desirable to improve standards (m) it is advisable to keep (d) standards uniform. More to the point, if you believe that by adopting different (d) standards you will automatically improve your standards (m), as the late Duke of Wellington once observed, you will believe anything.

To begin with standards of modelling, these are, and must be, an individual matter, bound up in part with your own temperament and the size and scope of the railway you have in mind. If you aim at a fairly big, comprehensive model, it isn't a very good idea to begin by equipping every compartment with accurate reproductions of the old sepia photographs of places on the system, for the simple reason that while you're doing this for one coach, you could have built another three with simplified interiors. That sort of trick is fine if your master plan only calls for two six-coach trains.

The common argument 'It's been done once, therefore anyone can do it', is fallacious. Everest has been climbed on several occasions since 1953, but that doesn't make its summit a particularly good rendezvous, even for experienced mountaineers. Before you embark on a plan that involves a great deal of specialised model making you must ask yourself what limitations are involved. The danger in railway modelling lies in the simple fact that each model is made up of many individual assemblies which can be separated and treated as models in their own right. What can be achieved within a small compass is not necessarily feasible over a large baseboard. It is far better to aim for an overall uniform level of reasonable competence than to make a few superlative models which are then surrounded by comparative rubbish.

Dimensional standards relate primarily to wheels and track. The main point I would stress here is that if you want to create a large railway it is advisable to choose a scale/gauge combination that is commercially developed (in practice H0, 00 or N) rather than one of the more exotic variants, simply because you need, on a big model, to be able to take short-cuts without lowering the standards of modelling.

I shall now discuss, briefly, the major scale/gauge arrangements. However, I would point out that there is no reason why you shouldn't dream up your own. Admittedly, working to a scale of two barleycorn to the ell is carrying individuality to the point of eccentricity and beyond, but if you happen to be attracted to a railway with a non-standard gauge — Ireland (5 ft 3 in), the old GWR (7 ft 0 in), Spain and Portugal (5 ft 0 in), then clearly you've got to do a bit of juggling. Incidentally, I didn't mention the USSR, it's an interesting prototype with a flavour all of its own, but regrettably at present, information is scanty, and difficult to come by.

The old gauges

Once upon a time, 2 gauge (2 in gauge, $\frac{7}{16}$ in scale) was the favoured size, King Edward VII was on the throne, England had an Empire on which the sun never set, and the Royal Navy ruled the waves by the simple process of having at least as many battleships as every other navy put together. 2 gauge has as collectors' items outlived the other glories of the Edwardian era but it too has faded into a golden memory. 2½ in gauge, mainly used by live steam workers, has somehow lingered on, with a couple of working layouts in the last decade. With radio controlled locomotives, steam powered naturally, it could make a limited comeback, but I'd not back so rank an outsider myself!

Gauge 1. (45mm gauge, 10mm scale)

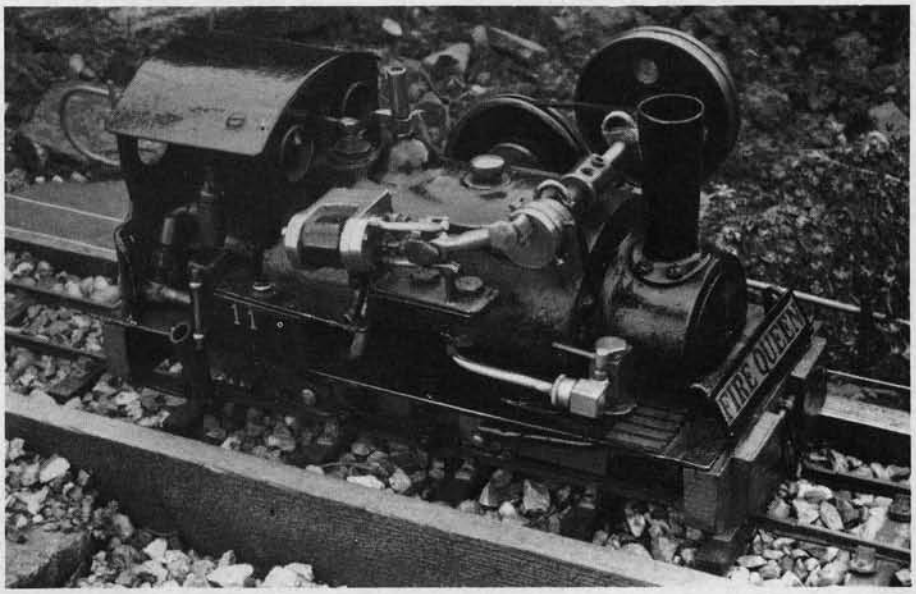
Thanks to the stalwart work of the Gauge 1 Association this scale, once the smallest practical size, has survived, and is enjoying limited commercial development with r-t-r continental models — at a price.

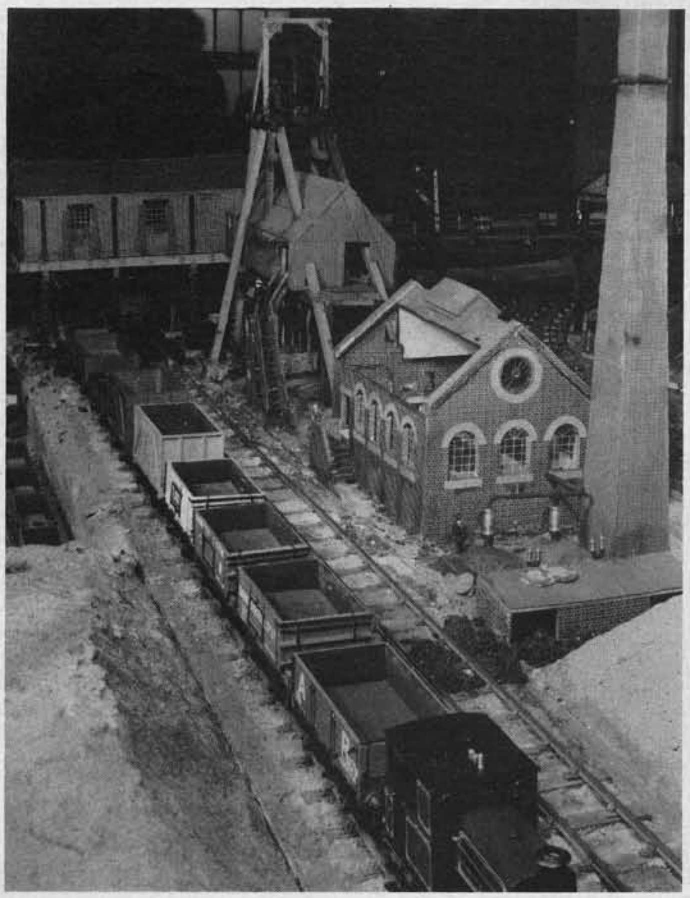
It remains very much a builder's scale, and is only at home out of doors. Probably its greatest virtue is that it is a true engineer's size: some people use $\frac{3}{8}$ in scale, where $\frac{1}{32}$ in = 1 in on the prototype. Live steam, at high pressure can be used; but since really big motors can be easily accommodated, it is very versatile. The possession of a lathe is highly advisable: alternatively you need a deep pocket!

0 Gauge (32mm gauge, 7mm scale)

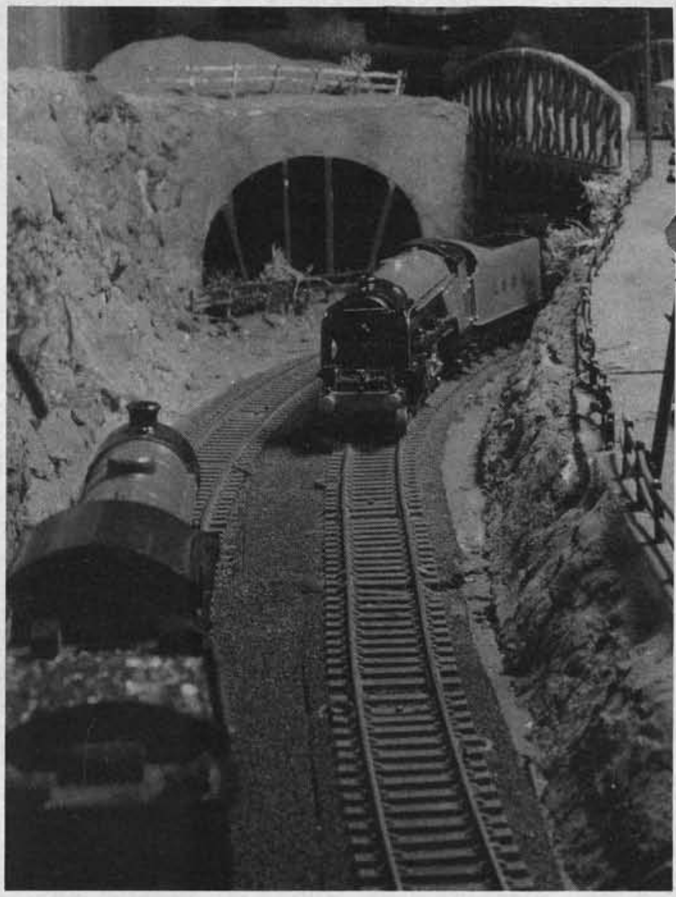
Between the wars 0 gauge was the most popular scale. In 1945 it went into eclipse. Somewhile back an American

Fire Queen, free-lance narrow gauge by Bill Stocks





Lyarcross Colliery in 'O' gauge by Nigel McMillan



Wakefield Model Railway Enthusiasts' 'O' gauge

commentator likened it to the waltz. It was, he said, always going to make a comeback.

He was half right, for like the waltz it has never gone away. Like the waltz when properly performed it is a delight to behold, yet the basics are so simple anyone can have a go.

In my opinion, 7mm scale is ideal for serious, accurate modelling. There are few parts on a railway that are so small they cannot be readily modelled in this size. For example, if you fit interiors to your coaches it is possible to see them without taking the roof off. It is big enough for your painstaking modelling to be seen with the naked eye.

There is enough r-t-r on the market to get a layout started, but not so much that you are likely to find that after you've spent a year or more building a model, someone has not only made a kit or r-t-r model, but in doing so, rendered your own second-rate.

There is in addition, a large and effective association, the Gauge 0 Guild, which provides support, encouragement and fellowship.

S Gauge ($\frac{7}{8}$ in gauge $\frac{3}{16}$ in scale)

This is very much a specialist scale: virtually everything has to be made in the home workshop though the S Gauge Society does provide many basic requirements. It is small enough to enable a working layout to be accommodated in a normal-sized home, but still big enough to allow reasonable detail to be incorporated.

00 Gauge (16.5mm gauge, 4mm scale)

The most popular size in Britain, it is well supported by the Trade at every level. There are just two snags.

The first, paradoxically, is the extensive Trade support. Goods are made to varying standards for two separate markets, the r-t-r backed quick system based on code 100 track and the more exacting scale market. This would be fine so long as everyone agreed where one ended and the other started, but everyone insists, correctly, on his own definition which begins the confusion. Then some r-t-r will satisfy the most exacting scale modeller, whilst some products for the scale end can be used with a toy train set. And that is only a simplified outline.

Second, the gauge is underscale. Those who try to think logically get very concerned, and blame all the trouble on this one 'error'.

Their mistake is in assuming that logic has any place on model railways — always excepting electronic logic circuits. It is illogical to build a 'scale' model of a prototype about 1,000 to 1,000,000 times too big for the space at your disposal. The answer is that — once again — we have a sematic hiatus. Scale, in model railway terminology, has an extra, very specialised meaning — 'not a toy'. It doesn't necessarily mean that every dimension is to scale, or even to the same scale.

The 18 + group

To overcome the incompatibility of 4mm scale on 16.5mm gauge, various non-standard gauges have been used, as hereunder

18mm)
18.2mm) Em gauge
18.25mm)
18.73mm P4, S4
19mm 00 (USA)

confusing, isn't it?

Providing you are prepared to build o adapt everything yourself, then by all means adopt one of these gauges. However, do not assume that by so doing you will automatically improve your modelling, or get better running, despite the claims of some protagonists. The only way to achieve these highly desirable results is to take infinite pains at every step. However, it is worth pointing out that if your wheels and truck are factory built in precision jigs and tools, you are more likely to get reliable running than if you do it yourself.

Club night at Manchester M.R.S.

HO (16.5mm gauge, 3½mm scale)

The standard used by Europe, and the U.S.A. It can be regarded as the equivalent of 00 for overseas use, again there are plenty of models, but, except in the U.S.A., the accent is on r-t-r.

TT (12mm gauge, 3mm scale (Britain): 1:120 elsewhere)

Launched around 1950's in the U.S.A., and later in Europe and Britain, TT never quite caught on. Apart from some East German equipment, the main suppliers are a few specialist manufacturers. In Britain the 3mm Scale Association organises the supply of parts.

It is generally accepted as the smallest scale for convenient scratch-building.

N (9mm gauge) and Z (6.5mm gauge)

Derived originally from 2mm scale, these sizes are as small as practicable. In the main the loco and rolling stock are purchased, or built from kits, scratch-building calls for high skill.

I have not quoted scales because in so small a size an error of ½mm puts many models in a different scale. For N we have 1:160 (Continental and U.S.A.), $2\frac{1}{16}$ in and 2mm in Britain. Z is only available from one manufacturer (Marklin), and has a nominal scale of 1:200.

Narrow Gauge

By using the next gauge down (ie 9mm for 00 or HO) one can get narrow gauge. The variations are almost infinite, whilst the meticulous can always lay their own track to whatever gauge they fancy or juggle the scale to suit. Two successful 'non-standard' combinations are H0n3 3½mm scale on 10½mm gauge track for U.S.A. 3ft 0in prototypes and 16mm scale for 2ft 0in gauge models on 0 gauge track.

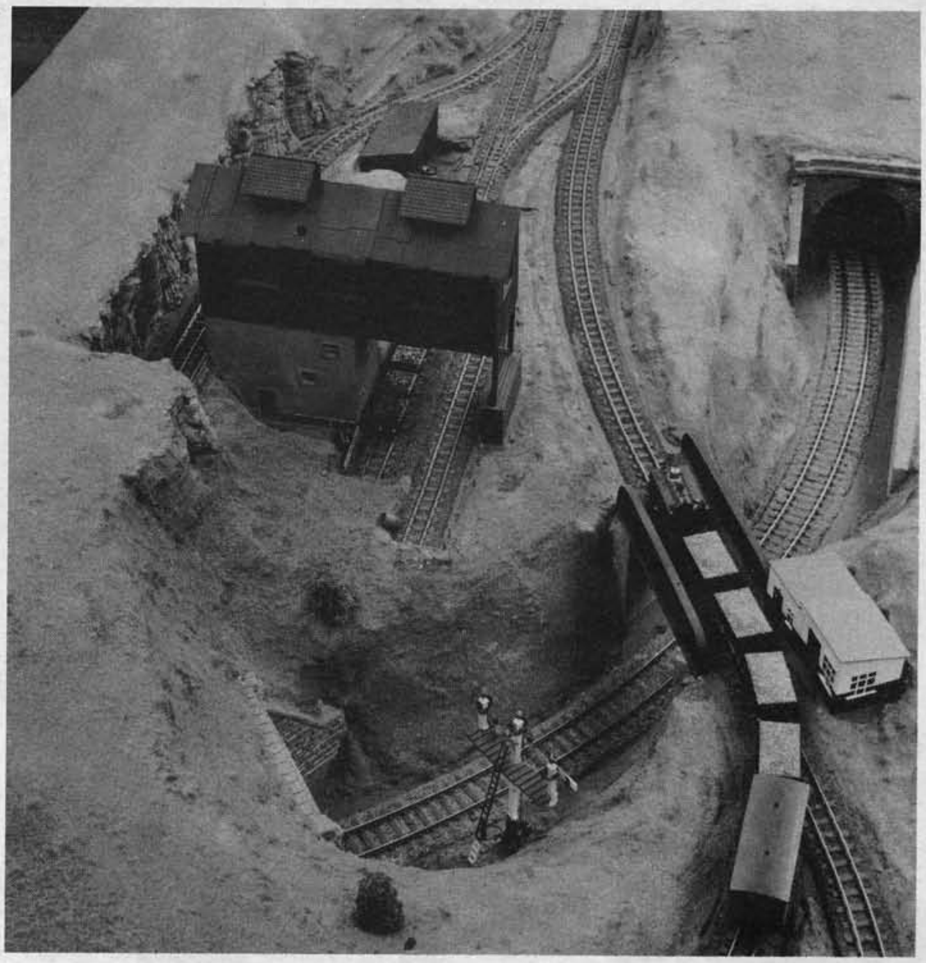
Because few narrow gauge lines had many locomotives it is not unduly difficult to build an apparently elaborate narrow gauge system oneself.

Naturally, one excludes the extensive metre and 3ft 6in gauge systems in the Southern Hemisphere and Asia. Here the 'narrow gauge' is virtually standard and railways have extensive stocks. At present these railways are not generally modelled since there are no indigenous industries to create a local focus.

The exception ought to be Japan, which has an industry and the population to support it. Unfortunately, the economic set-up is export orientated to the point of virtually excluding the home market. Indeed a decade ago, Japanese enthusiasts re-imported locomotives from the U.S.A.!

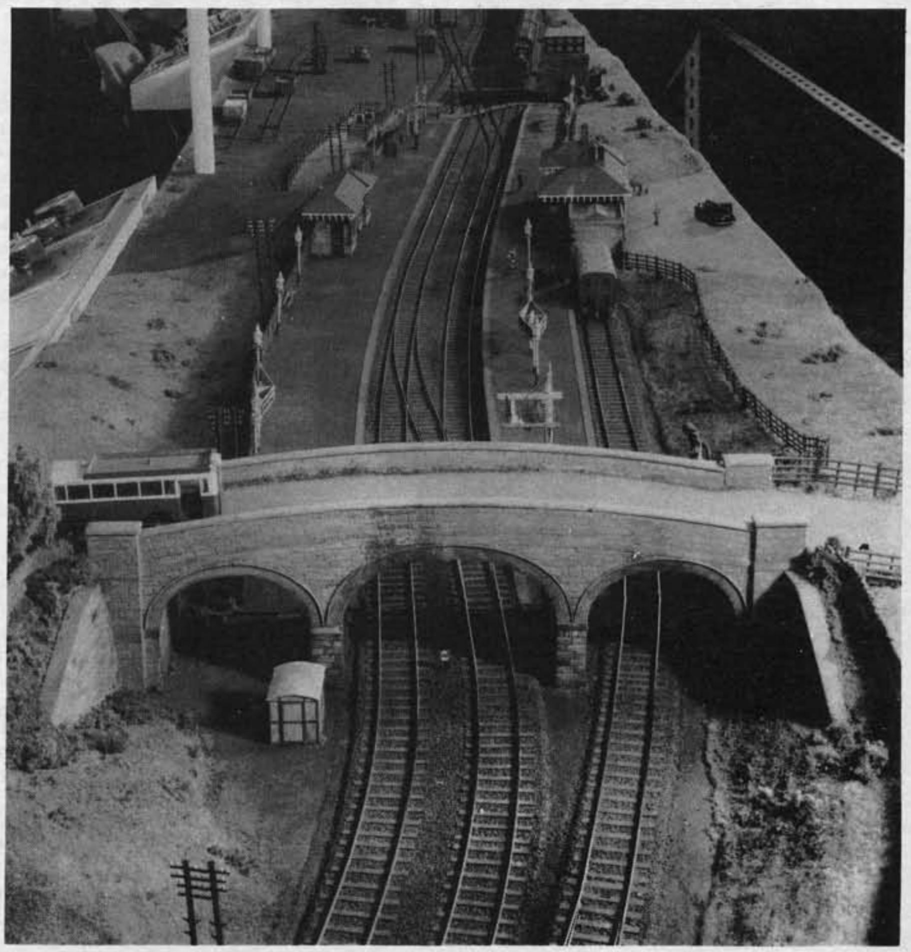
More in the next issue!

There are many enthusiasts who would not share Cyril Freezer's views on 2½ in gauge. In two months, Martin Evans will commence the description of a steam-powered 2½ in gauge locomotive. — Ed.



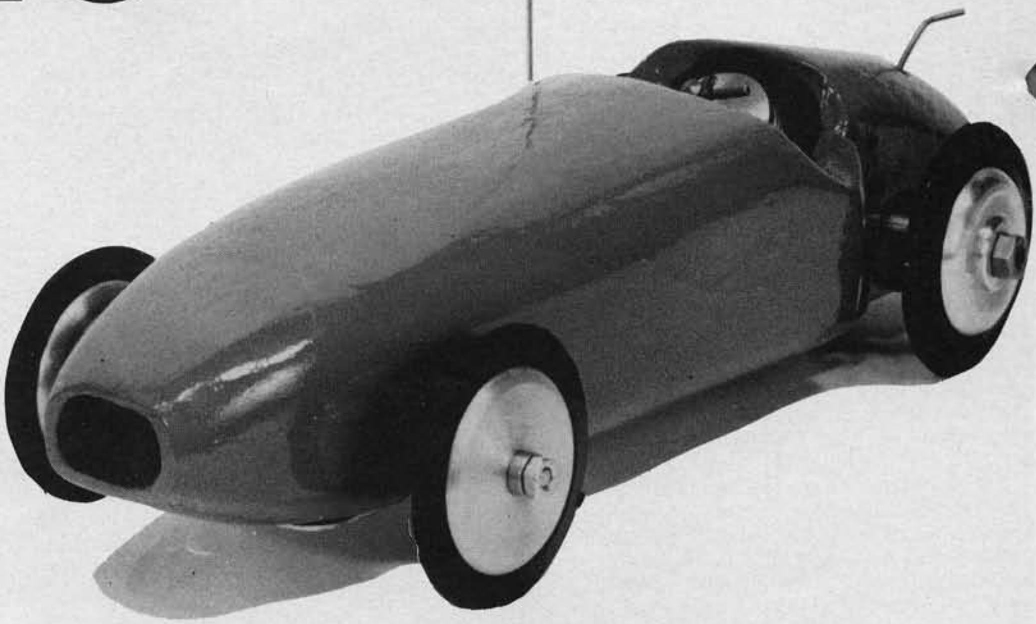
4mm scale narrow gauge of Dave Housan

Heckmondwike, N. London M.R.G's 4mm scale layout



TYRO

by Geoff Sheppard



Join the thrilling world of Tether Car Racers!

THE EDITOR has asked me to produce a design for a working model car which can be made with the tools that are likely to be in the model mechanic's workshop and is, at the same time, inexpensive. The very popular radio controlled cars, both i.c. (internal combustion) and electric powered, which can be produced largely by the assembly of commercially available components, are anything but inexpensive when the cost of the radio is included. I am also told that, to participate successfully in the radio/i.c. field, without appearing regularly in the 'also rans' requires a regular and substantial outlay in high performance engines.

The answer seems to be to return to a type of car which was very popular in Great Britain during the 1950's and which has remained so throughout the rest of Europe since. This is the tether or 'round-the-pole' car, which is i.c. engine powered and, as the name implies, is tethered by a strong wire to a central pole, around which it circulates anticlockwise at speed. Admittedly, this form of racing, which is always 'against the clock' does not give the same sensation of participating in a motor race as radio control does; however, it is still very competitive and can give great satisfaction to the miniature automobile engineer (it's the automobiles that are miniature, not the engineers) who has, perhaps, designed, built and tuned his own car *and* engine. I look upon the radio car hobby,as it is currently practised, as model making, whereas the building of tether cars is a branch of model engineering. A revival of interest has resulted in the recent formation of the British Tether Car Association (which already boasts the holder of a world record as its Chairman) and the opening of one track deep in the West Country, with the hope of more to come in the near future.

The European governing body for the sport is the Federation Europeéne de Modelisme Automobile (FEMA), to which the BTCA is affiliated, and the major interest is, of course, the attainment of the highest possible speeds in the four main classes of 1.5 cc, 2.5 cc, 5 cc and 10 cc engine capacity. The Swedish organisation, S.M.R.U., has, however, taken steps to encourage the beginner by the introduction of a 'one-design' class which uses a kit of parts, emanating from Sweden, and which can be powered by any standard production 1½ cc diesel engine the builder can persuade to fit. The kit is comprehensive and can be put together without the use of any machine tools, but does involve the shaping of some parts by filing, the drilling and tapping of holes and some soldering.

The design I have prepared is similar in format to the S.M.R.U. car, but is made from scratch using as few commercial parts as possible. It is drawn around the popular PAW 1.49 cc engine (which also powers many of the S.M.R.U. cars) but any similar power unit could be pressed into service.

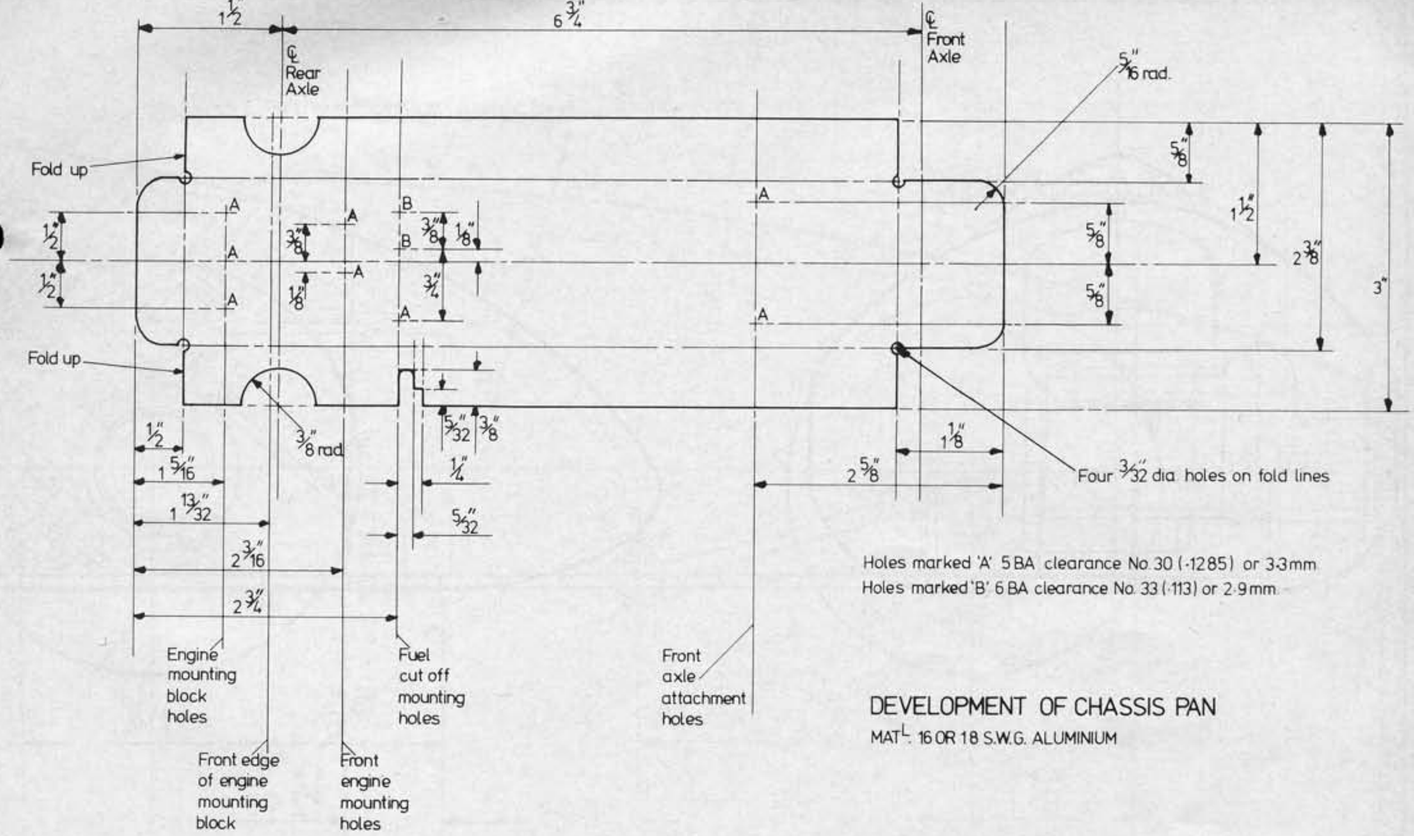
One area of difficulty is the supply of wheels and tyres, as all the sources which were available in the 1950's have now dried up. I have therefore specified S.M.R.U. wheels in anticipation that a source of supply of these will be established shortly. Throughout the description of building the car, I have tried to use the simplest means available, bearing in mind the equipment which is likely to be to hand. If your workshop is more fully equipped, then don't hesitate to change the design if it will allow you to do the job more easily. Also, the materials specified are very much the ones I had to hand when I started the design, so if your own 'stores' or scrapbox is an alternative, press on and use it.

Now to the details of the construction:

Chassis

The chassis pan is made from 16 s.w.g. or 18 s.w.g. aluminium sheet, with the edges bent up to add a bit of stiffness. A good source of small quantities of this material is your local radio spares shop, where it is sold for making radio and amplifier chassis.

Check the best looking edge for straightness using the steel rule as a straight edge, filing where necessary to correct. This is now the master edge from



DEVELOPMENT OF CHASSIS PAN

MAT^L. 16 OR 18 S.W.G. ALUMINIUM

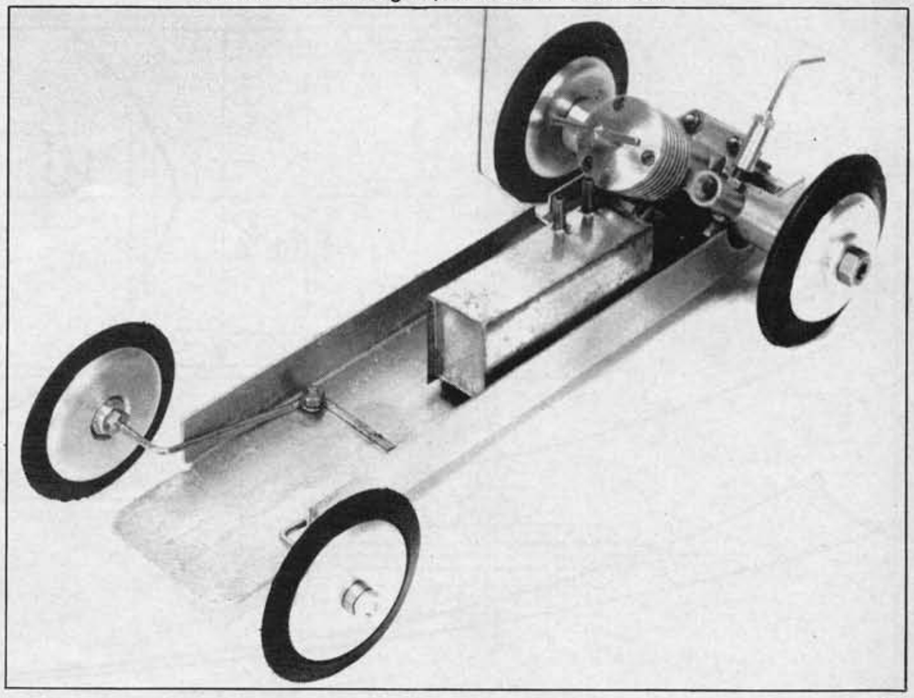
which all marking out is done. Square up one of the adjacent edges from this one; placing the stock of the try-square (or engineer's square) against the master, with the inside of the blade along the top of the other to check. When satisfied, give one side of the plate a coat of marking out fluid. This is a coloured dye dissolved in a volatile liquid which will evaporate quickly to leave the metal with a coloured film (usually blue) which, treated with reasonable care, will not rub off too easily. Scribed lines will now show up clearly against the coloured background. This fluid should be available locally from any good engineer's merchant, but in case of problems, our old friends, Reeves of Marston Green, Birmingham, market one under their own brand name in quantities adequate for the model engineer. By the way, if you are new to the hobby, make your first outlay the purchase of back catalogues of such suppliers as Reeves, Blackgates, Kennions and the other firms who advertise in the model engineering journals. These companies are usually run by experienced model engineers who know just what to stock at sensible prices. You'll learn a lot just by reading through their stock-lists.

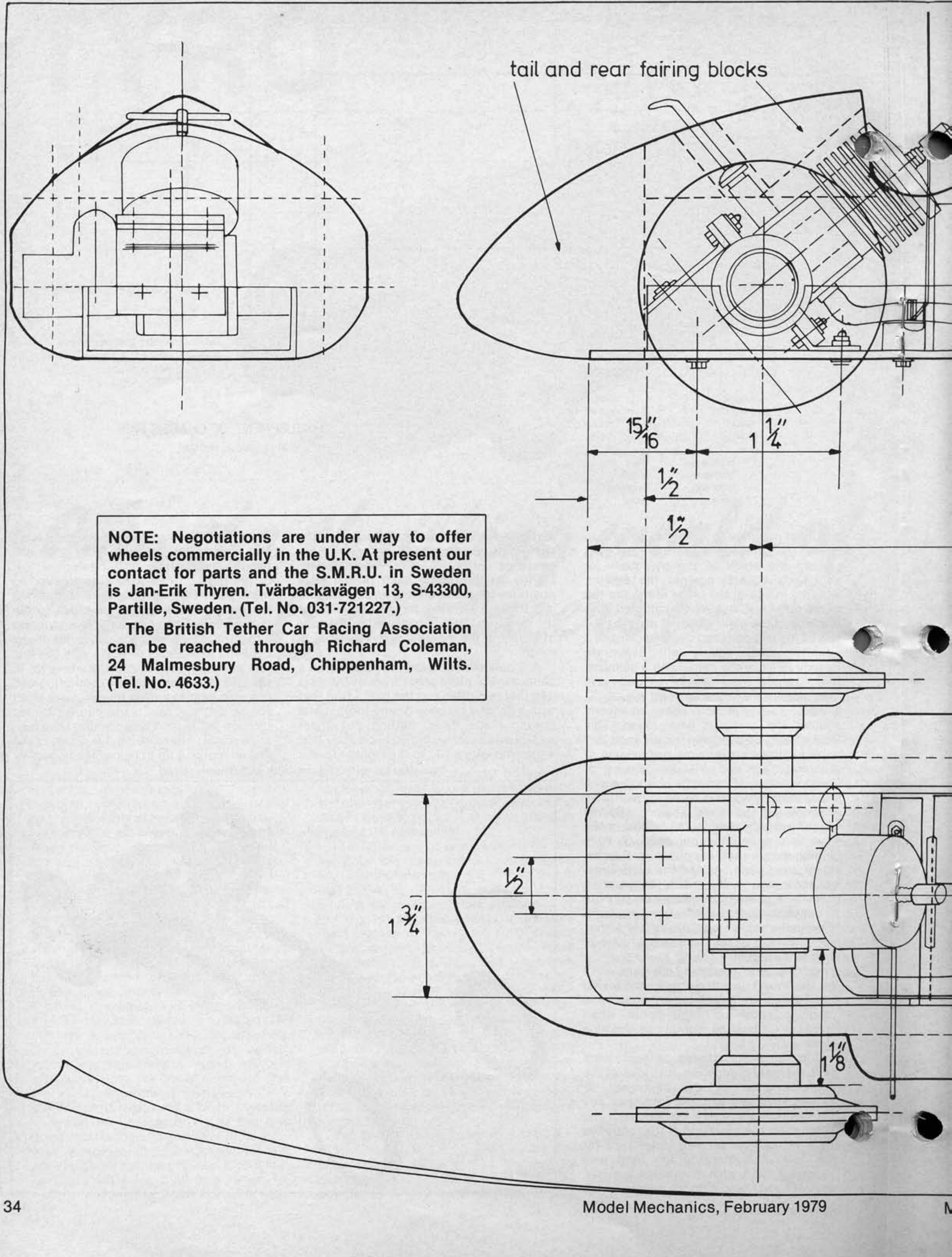
Harking back to marking-out fluid, don't get this mixed up with engineer's marking blue, which is an oil-based compound used to show up high spots when scraping in a bearing journal or a machine surface.

With 'jenny' or odd-leg calipers, mark from the master edge the positions of the opposite edge of the developed or flattened chassis pan, the fold lines and the centre lines. Along the length of the latter, mark the positions of the reference lines for the front and rear 'axles', and for the holes for attaching the front axle assembly, the engine mountings, fuel cut-out base and body. With the square on the master edge scribe the transverse lines at each position, marking them with a reference letter for later identification. Lightly centre punch each of the hole positions for future drilling and centre and drill the four $\frac{3}{32}$ in. dia. holes at the ends of the fold lines. This will reduce the chances of cracking the material when the fold is made.

Any builder who is the proud owner of a bandsaw will make short work of the next job; that is cutting out the pan. I find that with a general purpose or fine tooth metal cutting blade fitted, cutting out sheet metal can be carried out so accurately that a rub over with a file to remove the marks of the teeth and to remove the burr is all that is required. The less lucky ones will need to employ the time honoured method of getting stuck in with a hacksaw. The main point to remember here is that the job must be well supported close to the cutting line. If the vice isn't big enough to allow the job in, then sandwich the metal between two pieces of wood with the line just showing, then clamp the whole lot in the vice. A G-clamp on the protruding end can also help to stiffen things. Also, don't forget that the saw blade can be turned through 90° in the frame to allow long cuts to be made. After sawing, file down to the line all round. A tip to help when filing over

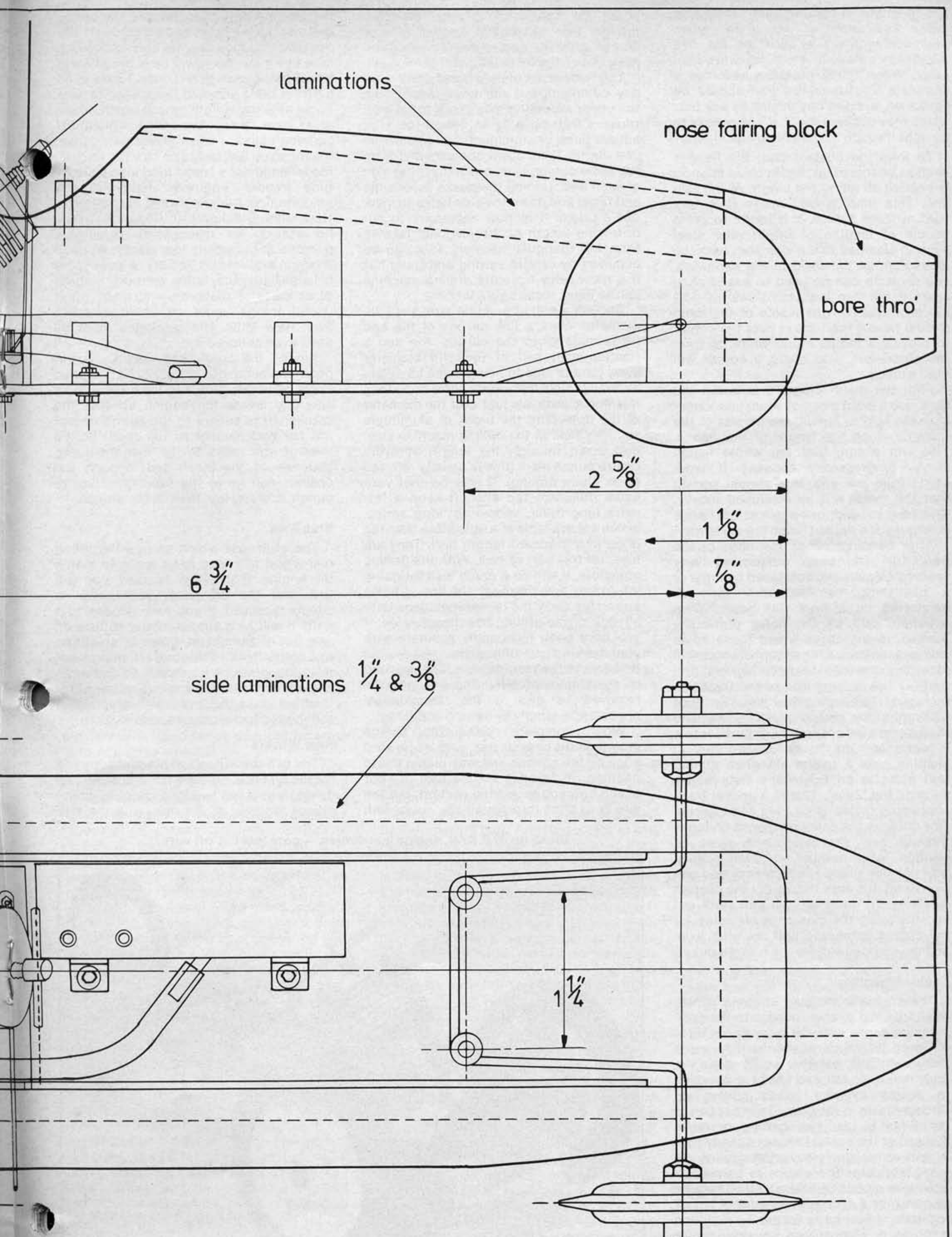
The chassis with engine, tank and wheels fitted





NOTE: Negotiations are under way to offer wheels commercially in the U.K. At present our contact for parts and the S.M.R.U. in Sweden is Jan-Erik Thyren. Tvärbackavägen 13, S-43300, Partille, Sweden. (Tel. No. 031-721227.)

The British Tether Car Racing Association can be reached through Richard Coleman, 24 Malmesbury Road, Chippenham, Wilts. (Tel. No. 4633.)


laminations
nose fairing block
bore thro'
2 5/8"
1 1/8"
7/8"
6 3/4"
side laminations 1/4" & 3/8"
1 1/4"

a long length — centre punch *on the line* every half inch or so, then, when approaching the line with the file, the depressions made by the punch will be cut away. When the depression becomes a complete V shape then you should be smack on, but don't be misled by any burr which may obscure the V. It's very easy to go right through it when filing aluminium.

To form the chassis pan, the flanges need to be folded up. Again close support is needed all along the length of the fold line. This time, wood, unless it is very hard, will not suffice. It is better to use a couple of lengths of bright mild steel section clamped in the vice jaws with the aluminium as the meat in the sandwich. The G-clamp can be used to assist once again if the vice isn't too powerful. The piece of steel on the inside of the bend should have a file rubbed over the corner to provide a radius round which to form the aluminium. Too sharp a corner will start a crack.

With the metal clamped between the bars, use a stout piece of wood just longer than the fold to spread the impact of the hammer along the length of the flange. This will ensure that the whole flange bends progressively because if work starts from one end, it is almost certain that the metal will be stretched locally, then have to be shrunk again as the flange is flattened. A rippled finish is a certainty.

After bending, check the base of the pan for flatness, correcting any imperfections with a soft faced hammer or a planishing hammer with the job supported on a firm, flat base. When satisfied, drill all the holes previously marked. In the cases where these holes will be a clearance for set bolts which will screw into the item it is securing, first drill them to the tapping size of the thread to be used. This will allow you to 'spot through' in the part in question to locate the tapped hole accurately. Only after this is done are the holes opened out to clearing size. A useful aid when drilling bolt holes is an Engineer's Data Chart, such as the 'Zeus'. This is a pocket book containing tables of tapping and clearing size drills for the common ranges of screw threads and the equivalent sizes of fraction, letter number and metric drills, so if you don't have the recommended one in your kit, it's easy to identify the nearest available. To complete the pan mark out and file away the clearance recesses for the engine crankcase and the stub axle, and the stepped slot for the fuel cut out.

Engine Mounting

The engine is inclined at about 40° to the horizontal to allow access to the compression screw with the body in position. It would be much easier to mount the thing vertically, but this would make the body much too tall, and I have an aversion to seeing cylinder heads poking up through holes in the body. The cast pan of the S.M.R.U. car has bolting surfaces inclined at the correct angles already cast in, but as we don't have this luxury, we must fabricate. The choice is between a one-piece mounting hacked out of a chunk of dural, or a multipart assembly bolted together. If you have access to a milling machine or shaper then you may prefer the former. Go right ahead sticking to the general dimensions to keep the engine on the correct centre lines and inclined at about the right angle — that isn't too critical. Any alternative engine will, of course, alter the quoted dimensions, but I have shown the installation for the P.A.W.

The two pieces of bent brass don't need any comment, but the block supporting the upper mounting may prove to be a bit tricky. Clean up a $1\frac{5}{8}$ in. length of 1 in. square dural or aluminium bar. Mark from one corner $\frac{15}{16}$ in. down one side and from the same corner, $\frac{13}{16}$ in. down the other side at each end. Join up the marks across the end faces and down the side faces to mark out a prism. It is now necessary to cut down the length of the diagonal face to form the triangular section. This can be achieved by careful sawing and filing but if a reasonably accurate drilling machine can be used, it can help a lot here.

Choose a drill of suitable size, say $\frac{1}{8}$ in. diameter. Mark a line on one of the end faces, parallel to the cutting line and a fraction over half of the drill diameter away (on the side to be removed as scrap, naturally). Now mark and centre pop along this line at intervals just over the diameter of the drill. With the block of aluminium securely held in the drilling machine vice, drill down through the length at every centre punch mark (this is usually referred to as chain drilling). It may be that your usual drills are too short. I keep a few extra long drills, known as 'long series' which are available at a little more than the price of a standard length drill. They are ideal for this sort of task. With the drilling complete, it will be a much less fatiguing job to saw down through the line of holes and to file away the remaining cusps until all sign of the drilling has disappeared. If you have been reasonably accurate with your marking and drilling, then you should be close to the required line. The rear end of the triangular mounting can now be removed to give it the 'Manx-tailed' appearance, simply by sawing and filing.

When complete, place the engine mount on the chassis pan, with its forward edge on the scribed line, and clamp it into position. It depends on the size of your clamp how you tackle the next bit, but the aim is to spot through all the holes with the tapping drill, then remove the block, drill and tap the holes and bolt it down. It's possible you may only be able to see one hole at a time, so it will be a progressive job of fixing each bolt in turn. I have used 5 BA set bolts because I happened to have some of just the right length which, I feel, must have come from friend Whiston. If you don't already know of this gentleman, it's time you did, because he's the original model engineer's friend (and also a sometime model engineer himself). His emporium, or Aladdin's cave, is situated at New Mills, Stockport, in Cheshire, where he stocks all manner of ex-surplus goodies at incredibly low prices. At each meeting of our local Society, a sales table is laden with nuts, bolts, washers, lengths of all sorts of materials and many other useful things, most of which emanate from New Mills. His catalogue must be seen to be believed.

When the mounting block is in position, bend up, drill and fix the two brass plate mountings to the engine. Now carefully locate the engine so that the crankshaft is square to the centre line of the car and parallel to the road. Scribe through the holes in the rear mounting plate on to the block and through the chassis pan on to the front one. Centre punch, drill and tap, then fix the engine.

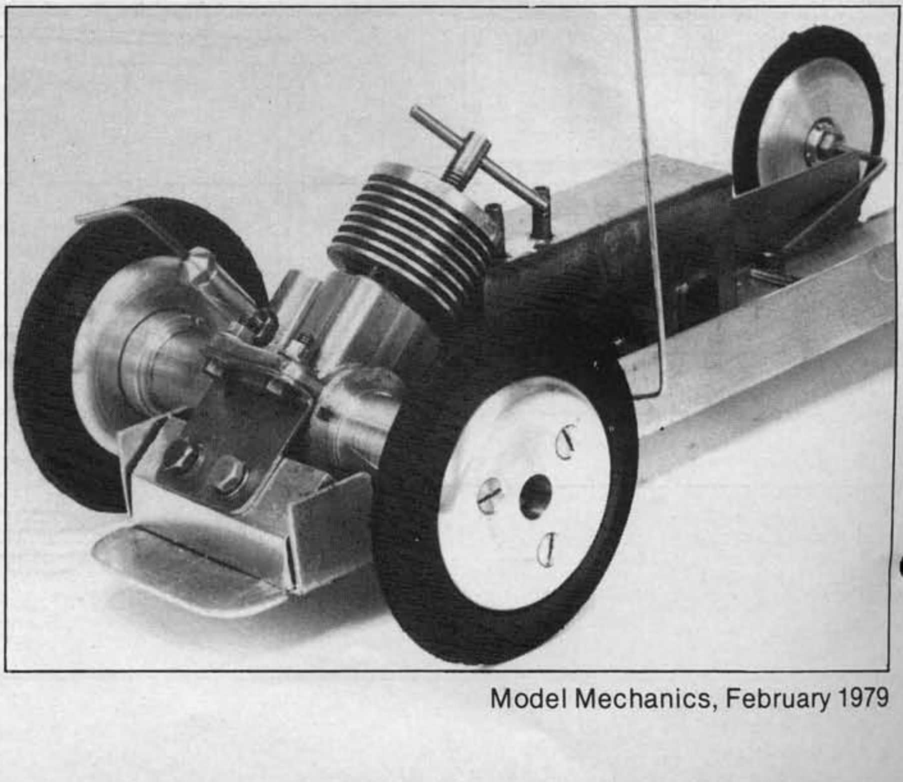
Stub Axle

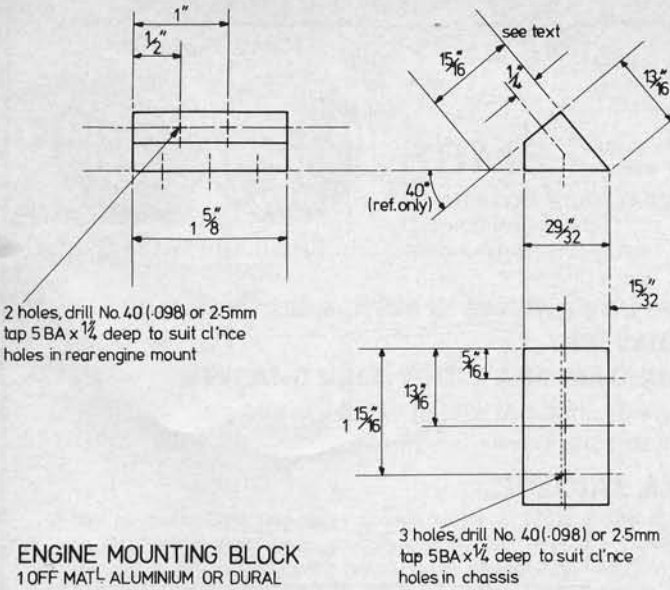
The stub axle which carries the idling rear wheel will need to be made to match the engine. If the PAW is used, you will find that the crankcase rear cover is deeply recessed. If you have access to a lathe it will be a simple matter to turn an axle out of aluminium, brass or steel and to Loctite it into the cover. If this is not possible, it will be necessary to devise an angle which can be screwed, clamped or Loctited into a block of metal, which is, in turn bolted to the chassis pan.

Rear Wheels

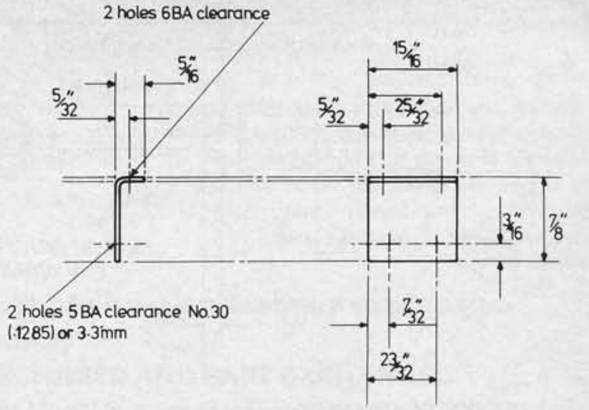
The two rear wheels at present supplied for the S.M.R.U. cars are not identical. The driving wheel has two loose flanges which spigot together at the hub, with the tyre

Close-up of P.A.W. engine installation — note fuel cut-off wire



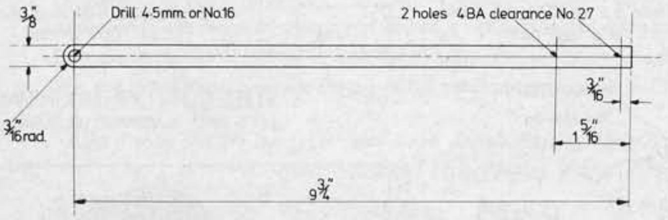


ENGINE MOUNTING BLOCK
1 OFF MATL ALUMINIUM OR DURAL

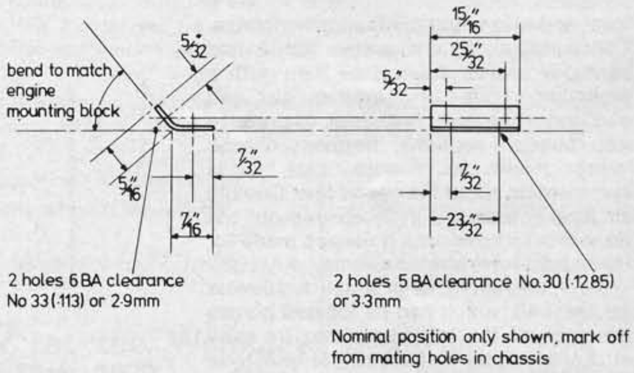


REAR ENGINE MOUNTING PLATE
1 OFF MATL 18 SWG BRASS

(dimensions shown are to suit PAW 1·49 cc)



PAN HANDLE
1 off MATERIAL 1/8 STAINLESS STEEL



FRONT ENGINE MOUNTING BLOCK
1 OFF MATL 18 SWG BRASS

sandwiched between. The idling wheel comes permanently assembled and has only a small brass bush as a bearing. The tyre is not the same diameter as that of the driven wheel, and as the axle appears to be on the same centre line, the car must run as a three-wheeler.

I am specifying a wheel of the driven type of each side, so we must find a means of mounting it. I feel that the first thing to do is to clamp the two halves together by means of three countersink 6 B.A. screws set on a pitch circle of ¾ inch. The same can be done to the driven wheel if you wish, but it's not essential, as the crankshaft nuts keep it together.

When the wheel is assembled, you will find that a recess 13mm diameter x 5mm wide is formed in the hub. These are just the dimensions of a standard ball race, which has a bore of 4mm, so this will make a convenient way of mounting the wheel. I feel that it is better to keep the bearing inboard, but with a 5 B.A. Allen screw retaining the bearing to the stub axle I am relying on the fit of the bearing in the wheel to keep the wheel on. I think that this will be sufficient (aided by a spot of Loctite if necessary) but if not, an extended clamping screw with a flanged head will do the necessary. The hole in the outer half of the hub must be opened out to clear. If you fancy a bit of turning, a more attractive 'streamlined' nut for the IBA thread on the engine crankshaft wouldn't come amiss, with a matching dummy cap for the other side.

Front Axle

The front axle is simply bent from 14 s.w.g. piano wire, attached to the chassis pan with bolts, nuts and washers, as shown, with the stub axles of the S.M.R.U. front wheels Loctited or soldered into position.

Fuel Cut-Out

The fuel cut-out is no more than a piece of piano wire (18 s.w.g.) bent to shape and clamped so that it squashes the fuel tube which runs from tank to engine against a brass or aluminium 'anvil' which is bolted to the chassis pan. A stepped slot in the flanged side of the pan is arranged so that, when the wire is in the forward position it is lifted allowing the fuel to flow. When the car is circulating and it is desired to stop the engine, a flexible obstacle, such as a rubber mat (they use a brush on the Continent) is held over the car so that the wire strikes it and is forced rearwards off the step and into the slot. It therefore springs downwards to clamp the fuel pipe.

Fuel Tank

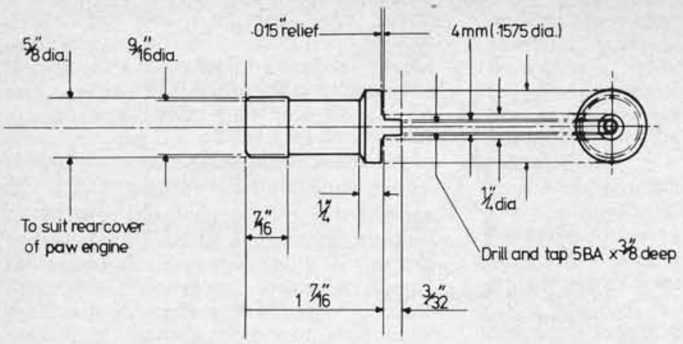
An aircraft fuel tank can be purchased ready made, or one constructed from tinplate or brass sheet, soldered together. Old oil can material is useful, but degrease well and remove the paint before soldering. *Also watch your fingers on the sharp edges.* A tip when making fuel tanks: Don't wait until the tank is a completely closed box before drilling for the feed tubes. It always seems impossible to completely remove the swarf, so blocked jets are the order of the day from then on. For quickness, I used a Veron 30 cc tank modifying it by putting another outlet from the bottom of one wall, about half way along. A couple of brass angle mounting brackets complete the job. See photos for chassis assembly.

There is still one more job to be done before the chassis is complete. That is to fit the tether arm (or pan handle). This is best done after the body is finished, when the centre of gravity of the car can be found.

Body

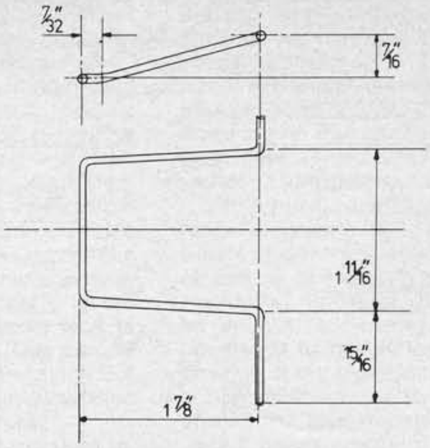
As far as body styles go, the builder can make his own choice. The modern tether car trend is towards the streamliner, but both the Editor and I have a great liking for the Grand Prix cars of the 1950's, so I have drawn one that bears a resemblance to the Vanwall Special of 1954. Please do make your own choice of body shape, so that they don't all look alike.

The body structure is simply two balsa sheet sides, each built up from one ¼ in. and one ⅜in. lamination, with blocks at nose and tail, 'behind the driver's head', and another lamination forming the bonnet line. The two ¼ in. laminations are cut to the full profile, the outer, ⅜ in. laminations being chopped off level with the rear of the cockpit. This narrows the tail of the car to allow access to the engine crankcase for the 'push-stick' used for starting (more about this later). The side laminations are glued up first, using a 5 minute epoxy, followed by the 'bonnet cover'. When set, one side is laid flat and each of the central blocks are in turn coated with epoxy and placed in position, making sure there is also a good coating of glue where the blocks meet. The other side of end blocks are then glued and the remaining laminated side placed in position. When thoroughly set, the plan view is shaped by marking the line of the



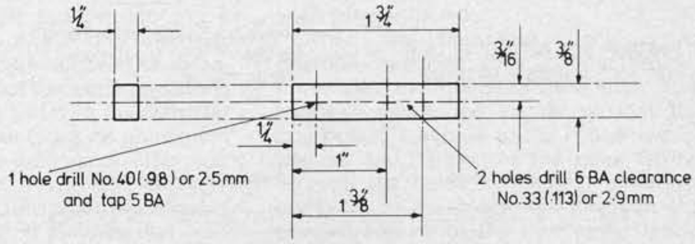
OFFSIDE REAR AXLE

1 OFF MATL. ALUMINIUM, DURAL, BRASS OR STEEL



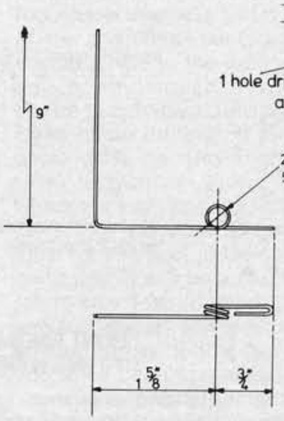
FRONT AXLE

1 OFF MATL. 14 S.W.G. PIANO WIRE



FUEL CUT-OFF MOUNTING

1 OFF MATL. ALUMINIUM OR DURAL



FUEL CUT-OFF

1 OFF MATL. 18 S.W.G. PIANO WIRE

front and rear using cardboard templates. The surplus is cut away (again the bandsaw proves invaluable) then with a modelling knife or Surform file and sandpaper the body is shaped to produce well-rounded sections, frequent checks being made to ensure that it is symmetrical about the centre line. Cooling air flow is provided by hollowing out the nose block and access holes are made for the needle valve and tank vents.

PAW are about to produce a silencer for the 1.49, which can be located across the back of the engine so that the pipe sticks up through the tail, not exactly a scale position, but better than annoying the neighbours. It will also serve another purpose in that the exhaust of the PAW is close to the choke inlet. This is O.K. when there is a propeller in front, blowing the exhaust rearwards, but in the closed confines of the car it is necessary to put a baffle plate between the two to prevent exhaust fumes from being sucked down the inlet and doing no good at all for the performance. The silencer will, of course, obviate this.

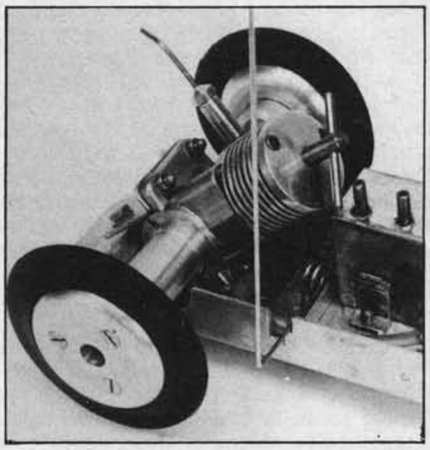
A bit of carving away of the inside of the body will be necessary to give adequate clearance around the engine, then a couple of coats of sanding sealer all over, a good rub down after each has dried followed by a coloured polyurethane to your choice should improve the appearance. Embellishments such as radiator grills, outside exhausts, screens, mirrors I leave to you, but if you do fit such things, keep them simple and robust. A tether car can receive some rough treatment. Body attachment can be achieved simply by the use of a couple of small woodscrews through the chassis pan fore and aft, but a quick release attachment can be fashioned by leaving the screw heads standing proud, with clearance holes for the heads in the pan. A couple of spring clips bent up from thin piano wire will hold the body in position.

Pan Handle on left hand side

With the body fitted, check the position of the C of G of the car by balancing it on some form of knife edge (a steel rule will do). This will indicate the line for the pan handle, which should be made from a bit of 1/8 in. stainless steel firmly bolted to the pan. The FEMA regulations covering the design and attachment of the pan handle are very precise, with safety very much in mind. The design I have shown meets these requirements. When fitted, hang the car up from the hole in the handle and bend the handle such that the 'road line' across the wheels is vertical.

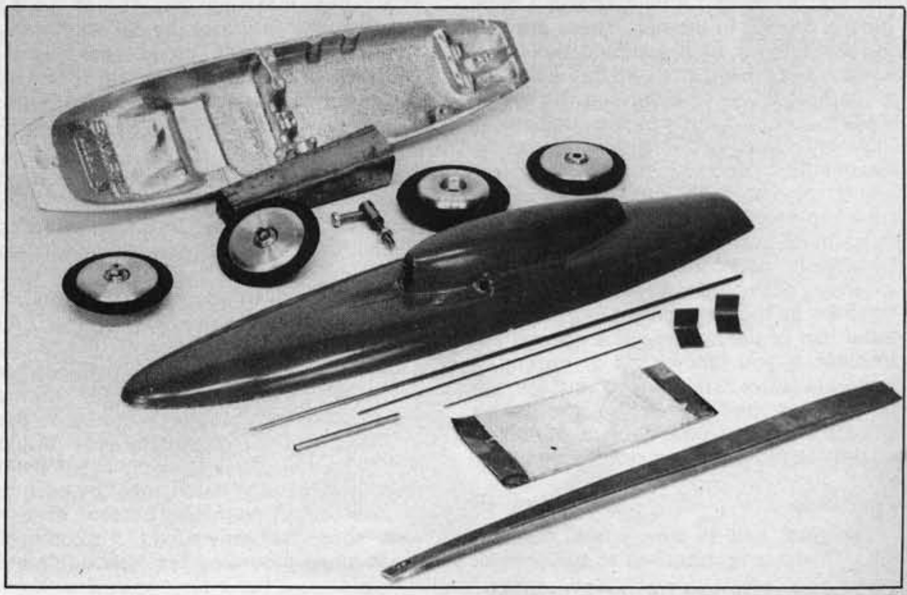
Push Stick

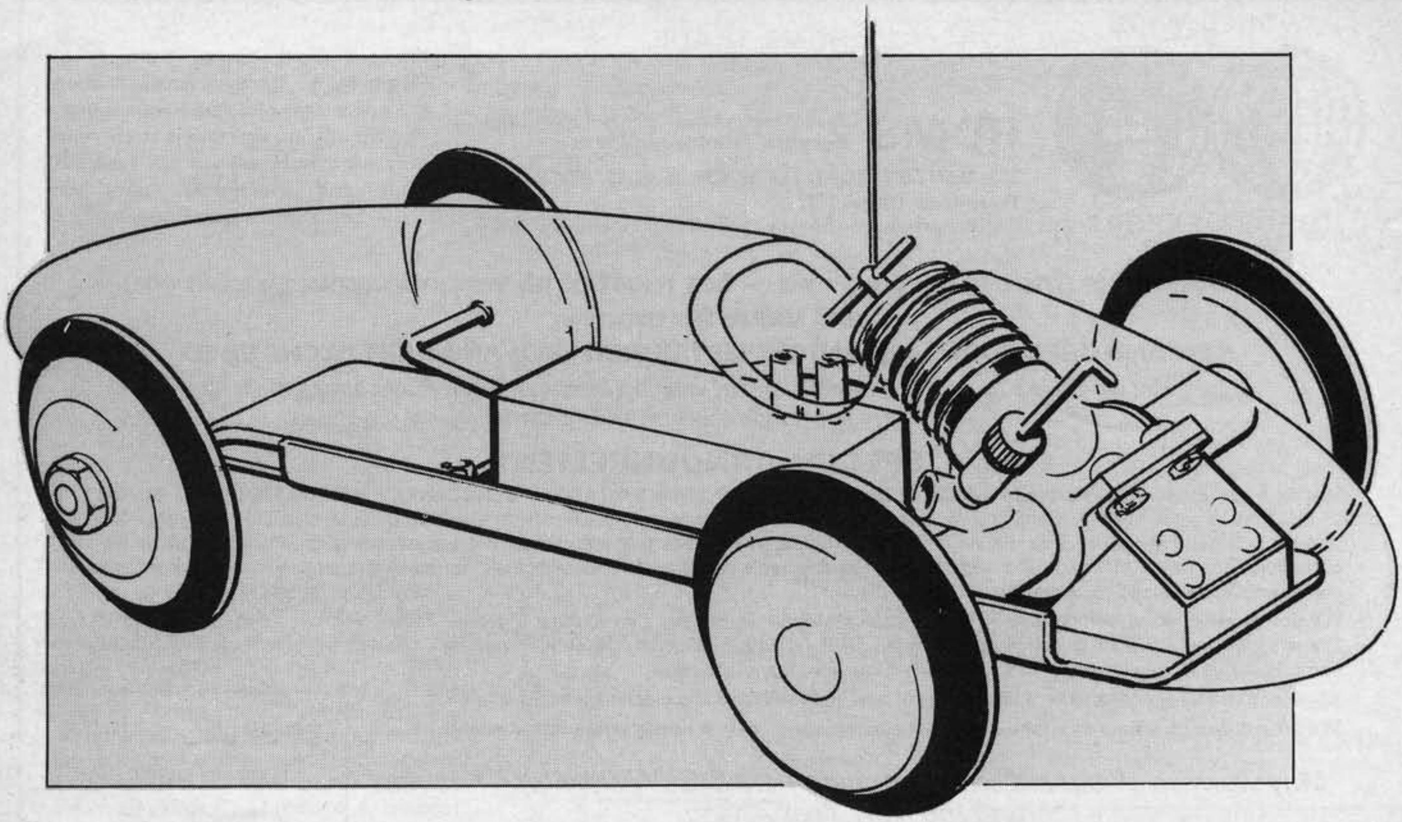
I mentioned this implement a few paragraphs back. To start this type of car, the engine is first warmed up using a portable starter (we used to use an old hand grinder fitted with a wooden wheel, but many an



Above — **Further close-up details.**

Below — **The S.M.R.U. kit mentioned in the text.**





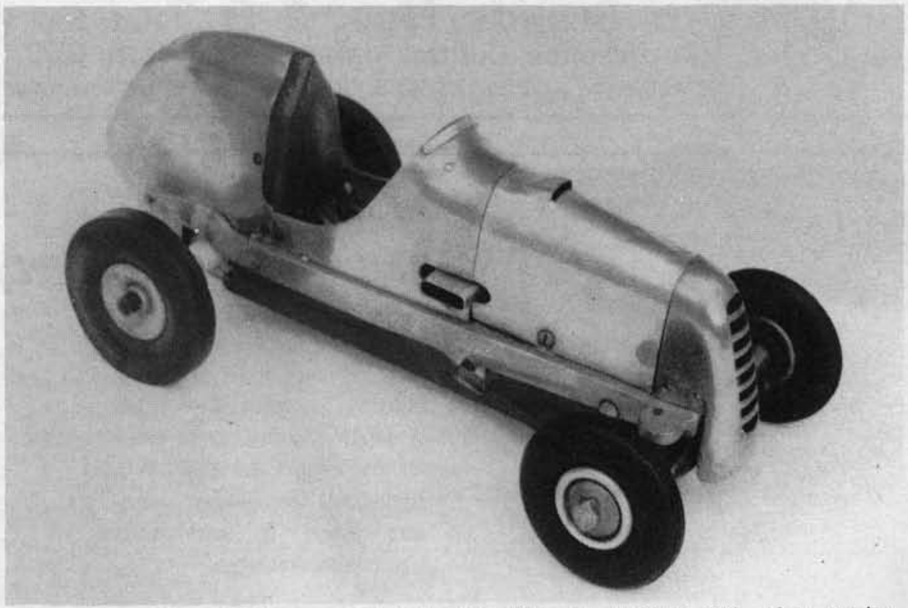
inverted bicycle has been pressed into service!). When satisfied with the throttle and compression setting, the engine is stopped by a quick dab of the wheel on the ground, then the car is attached to the tether line.

The push stick is simply a length of tube (or broom handle) with a narrow piece of aluminium or Tufnol inserted in the end, forked or radiused to go over the outer crankcase end. With this in position, apply pressure to keep the driven wheel in contact with the ground, and thus revolving, with a bit of outward force to keep the line taut. A colleague in the centre of the circle supports the weight of the line, a technique known as 'horsing', until the car is travelling rapidly enough to generate sufficient centrifugal force (the centre pole has a platform on to which he can leap when things start getting hectic).

Now start running, A deft thrust of the push stick at the crucial moment should start the engine, but many a car man has put up an impressive time for the mile in pursuit of a recalcitrant starter!! When it does start, don't be mesmerised by your success, *STEP OUT OF THE WAY* before it comes round and catches you from behind.

The task now is one of steady tuning of both the car and your operating technique until you achieve the optimum speed. Hopefully, enough of these cars and facilities for them will be generated so that some competition can be developed. Then, if things go well, it will be on to more advanced designs, so that we can compete on equal terms with the Continentals, or perhaps more interesting, some designs for tether versions of close to scale models of the classic racing cars and vintage sports cars.

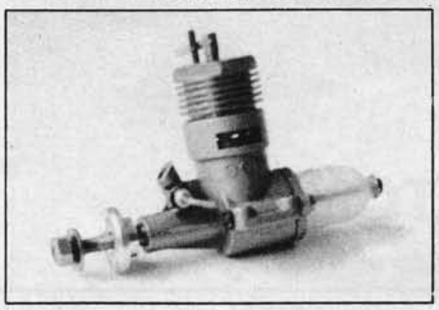
There are many prototype car plans in M.A.P. Plans Service. Ask for Plans Handbook No. 2. Price 50p.

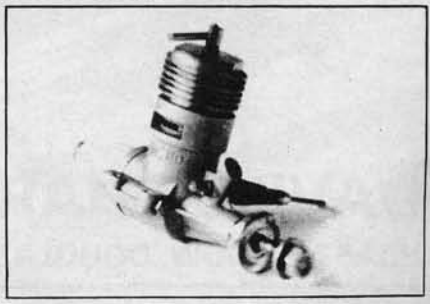


Flashback to the 1950's — an A39 Dooling Mercury Midget with 10cc engine. (Photo: Tony Higgins)

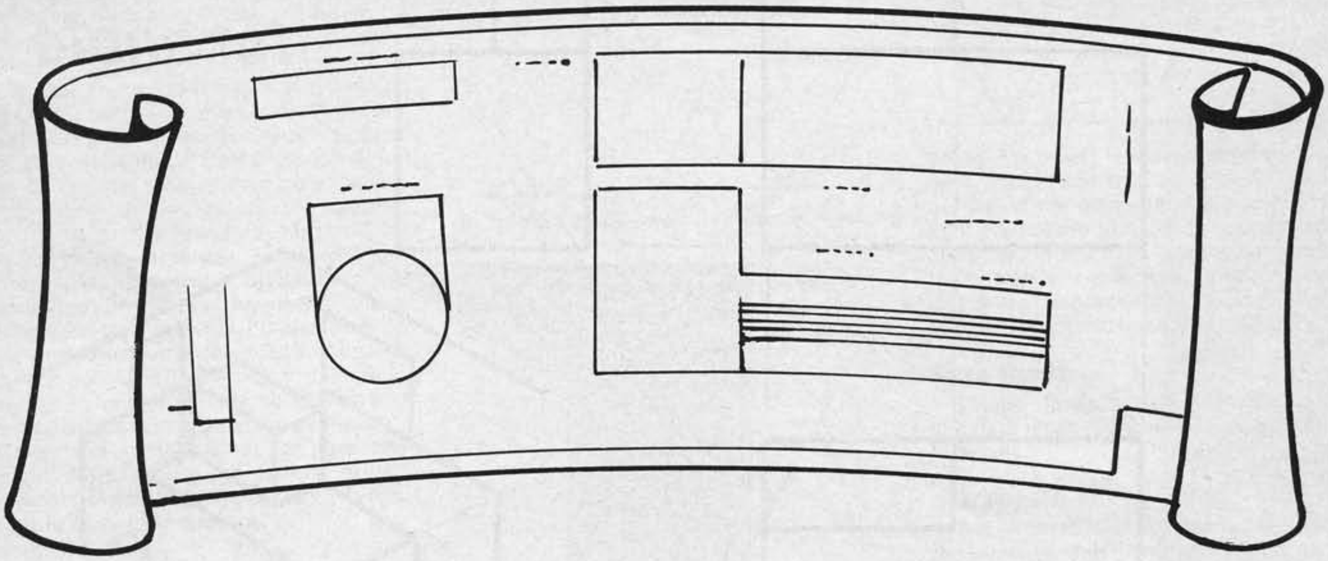
Geoff Sheppard returns in the next issue with something a little more advanced!

Another engine for Tyro is the D.C. Sabre, also of 1.49cc capacity. Note the inertia starter, standard on this engine, has been removed and the carburettor needle turned round 180°.





ENGINEERING FROM SCRATCH



This is the start of a regular series of articles by Alan Carter designed to assist the less-experienced in workshop practice

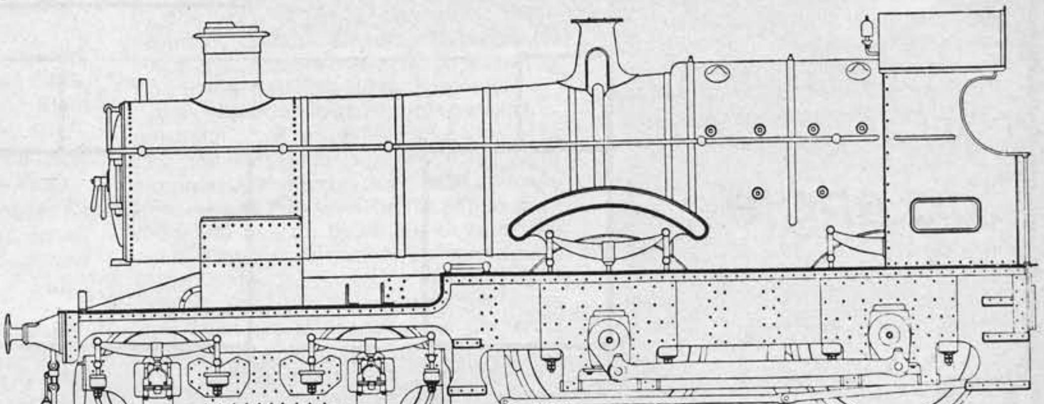
FOR AN ITEM to be manufactured it is necessary for the designer to relate to the person(s) making the object all the relevant information. This applies equally in model engineering and the form usually taken is in the use of workshop drawings. It is possible in certain circumstances to make a simple object by use of sketches or photographs but this practice is far less widespread. Generally speaking the original or master drawing is made on linen, tracing film or other durable transparent drawing material and dye-line copies on paper — once referred to as blue prints — taken off for use in the workshop. Thus the original does not receive abuse although in this day and age it is not unusual for another 'master' copy to be made from the original, also on film, so that in the event of the original becoming lost or damaged there is a reserve standing by.

In engineering companies the designer or draughtsman usually works on tracing paper using a pencil line. When he is satisfied his work is complete and accurate it is traced using ink onto the linen or film by a tracer specially skilled in this work. Although the model engineer is unlikely to come across the often very complicated drawings of an engineering company, it is necessary for him to understand the basic principles of draughtsmanship so that the drawings he has are readily understood. He may eventually undertake the preparation of such drawings himself and he would be well-advised to make sure he does not fall into pitfalls so often encountered by amateur draughtsmen, and so avoid the wrath of his fellow model makers.

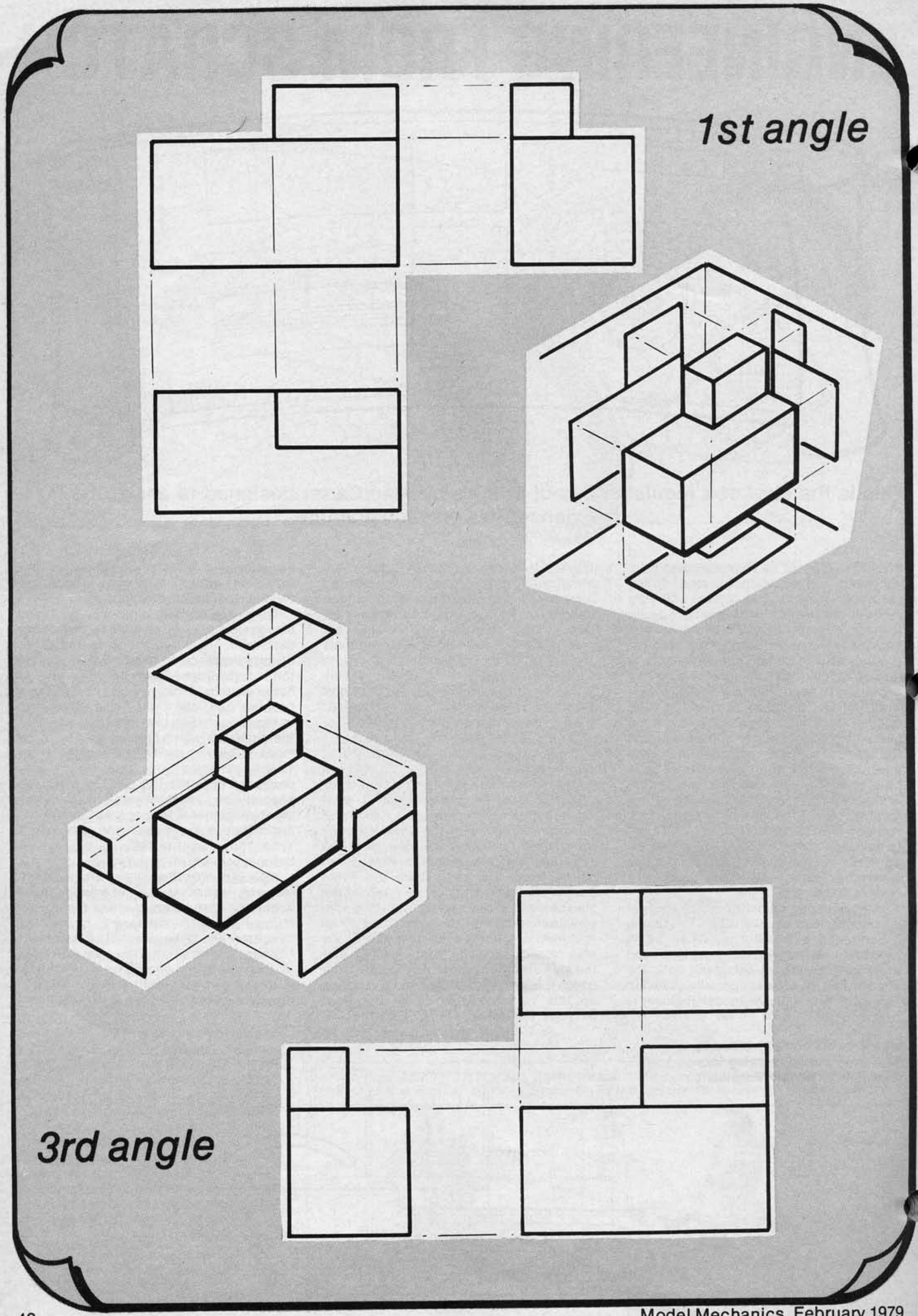
Every object has three dimensions, length, breadth, and height. To make a complete drawing of an object from every aspect it must be viewed from at least three points, plan, elevation, and end elevation. Plan is the view seen squarely from above, elevation the view from the side, and end elevation the view of an object from one end. There are three possible arrangements of the views — the plan below the front elevation and the side elevation placed on the opposite side to that from which it is seen (first angle); the plan placed above the front elevation and the side elevation placed on the side from which it is seen (3rd angle); and a variation on this with the plan below the front elevation and the side elevation on that side from which it is seen. These are called orthographic drawings.

There are certain variations on these standards but it is as well to remember that third angle projection is the most favoured method in use today. A look at the illustrations opposite will give a better understanding of the differences between First and Third Angle projection. In the former case one must imagine that the paper on which the drawing is to be made is behind the object and the three views observed by the viewer are projected onto the flat surface. With the second view, the third angle method, one must imagine that the paper is transparent and between the viewer and the object. Thus the sides nearest to the eye is brought forward on to the paper.

Although only three views are shown, it may be necessary to increase these according to the complexity of the object. It may also be necessary to cut an imaginary line through a part of the object to show hidden detail. These section lines as they are called should be lettered (e.g. A-A) and arrows pointing in the viewing direction added. Samples of dimensioning



Fine linework on Keith Wilson's "Bulldog" currently being described in "Model Engineer".


1st angle
3rd angle

should be studied. When metric figures are included — see also the article on page 10 — there is no need to indicate the units, millimetres being the standard employed. Arrow heads should point to the line — or extension of it — except when the dimension is to a main datum line some distance away. Here double arrow heads are used.

Various line thicknesses and types are used for outline, centre lines, hidden detail, etc., but it must be remembered that if a drawing is being prepared for publication, the final printed size may be considerably below that of the original and therefore the line thickness will be correspondingly reduced. To avoid many lines disappearing altogether a reasonable thickness must be used. Remember also that the builder may be very remote from the designer and unable to bring points of ambiguity to him as is possible in industry. Careful checking and the inclusion of all detail are essential.

There are certain kinds of line and certain combinations of letters of the alphabet which signify certain things. They are called conventions.

Conventions

∟ — Angle Irons; Bbt. — Babbitt Metal; Br. — Brass; (B) — Bright (Nuts, etc.); Bronze — Bronze; Cpr. — Copper; C.I. — Cast Iron; C.S. — Cast Steel; G. — Size of Gauge; G.I. — Galvanised Iron; G.F. — Grinding Finish; F. — Machined or Turned; M.S. — Mild Steel; F.B. — Polished; T. — Tapping Hole; Ts. — Tee Irons; W.M. — White Metal; W.I. — Wrought Iron; "f" — Machined; Dia. or ϕ — Diameter; L.O.A. — Length Overall; O.D. — Outside Diameter; Rad. — Radius of Curvature; T.P.I. — Threads per Inch.

Nuts and Bolts

Hex. — Hexagonal; Sq. — Square; Ro. — Round.

Where metal is to be removed the following symbols indicate samples of instructions currently practised

F
f (in italics)
F ,,
ff ,,

Each of the four symbols is followed by the depth of metal to be removed.

Some materials may be indicated by colours

Cast iron — Panes Grey; Wrought iron — Prussian Blue; Cast steel — Purple; Mild steel — Crimson Lake; Special steel — Crimson Lake; Copper — Vermilion; Bronze, Brass — Yellow; Aluminium, Magnesium — Light Blue/Green; Lead, Tin, Zinc, white metals — Dark Blue/Green; Wood — Brown; Vulcanite, Mica, Fibre, Bakelite — Olive Green; Water — Blue; Glass, Porcelain — Grey.

There is a standard colouring for pipe work indicating the fluids that they carry

Live steam — Red; Exhaust steam — Black; Refridgerating system — Grey; Air — White; Oil fuel — Brown; Lubricating oil — Yellow; Fresh water — Blue.

The degree of finish may be indicated. There are three degrees of finish. One is a rough finish, called rough finish; one is for bearings, called finish; and one, fine finish, is the best finish which can be obtained. The degree of finish is marked by a triangle, point touching the surface of the object. There is one triangle for rough finish, two for finish, and three for fine finish. The standard symbol for machining is a tick or vee sign. Special processes are named at the side of the tick or vee sign.

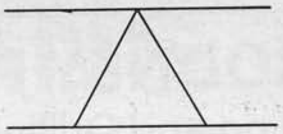


Fig. 1 The degree of finish; one triangle for rough finish, two for finish, and three for fine finish.

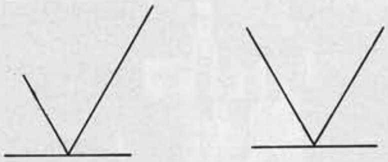


Fig. 2 The standard symbol for machining. A tick. A vee sign.

Fig. 3 Obsolete machining symbol, a triangle with angles at sixty degrees with a letter of the alphabet in the centre.

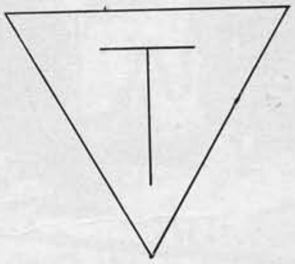
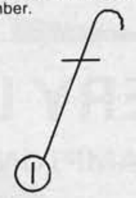


Fig. 4 A company may have a standard table of its own—an italicised f with a loop on its tail, the loop containing a number.



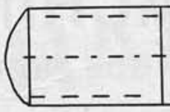


Fig. 5. A screw thread, the bottom of the threads indicated by dotted lines.

A triangle, with angles of sixty degrees, point touching the suface of the object, is now obsolete as the machining symbol. A letter of the alphabet was placed in the centre of the triangle representing a process, G for grind for example.

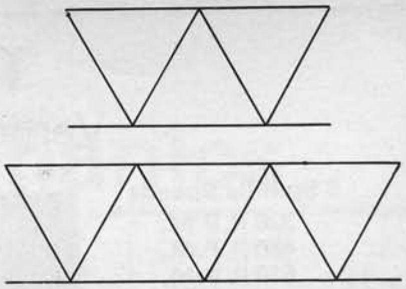
A company may have a standard table of its own. An italicised *f* with a loop on its tail, the loop containing a number may be used to represent a process, 1 for buff, 2 for burnish, for example.

Hatching

When a view is drawn of a part cut away it is usual to show which are solid portions by drawing a series of lines across these portions, called hatching. Materials of which the parts are made can be shown by a particular hatching for each material.

If a cut portion is narrow it is blocked in, not hatched. A white line runs along the top and left side of the parts. Light supposedly shines on the view at an angle from the left. Parts on which it shines have the white line on them. No parts of the section have the power to put other parts in the shade.

The supposition that light shines on the view from the left-hand upper corner is used in ordinary drawings, plans and elevations. A thin line is used to show where light is falling, a thick line shows the parts in shade. It is called shadow



lining. Each part is independent as far as light and shade are concerned. On the outside of the object the lines nearest the light source are thin, those furthest away are thick. In the case of a hole or hollow the opposite is the case. Horizontal lines on top are thin, those that have solid metal between them and the light are thick.

Screw Threads

Screw threads are illustrated in standard ways. Special threads are drawn in detail.

Gear Wheels

The pitch circle of the gear wheel, that is the diameter that governs the value of the gear, is drawn as two circles of lines and dots. Firm lines show outer diameters, the outside measurement of the gear wheel. Full lines may show the bottoms of the teeth. Teeth may be drawn in, at the point of contact, or all of them.

The end of a round shaft is shown by an irregular shape with hatching across it.

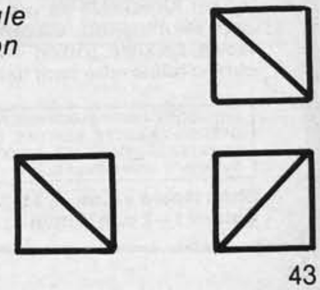
Orthographic drawings often include detail drawings. These drawings are often cut away showing internal detail, the line around the cut away section irregularly shaped.

There are drawings in which the subject is tilted and angled, tilted at thirty degrees (isometric), or angled at forty-five degrees (axonometric) for example. These are called three dimensional projection drawings; these drawings are intended as an aid to the interpretation of orthographic drawings.

Drawings having been obtained, they may be of different scale, needing to be enlarged or reduced to one common, chosen scale, or they may be of the wrong scale. The drawings can be measured and then enlarged or reduced mathematically; for example measurements from a one twelfth scale drawing would be multiplied by twelve and divided by eight to enlarge them to one eighth scale. They can be enlarged or diminished commercially by photographic processes giving an extremely high standard of accuracy.

The ability to read working drawings is the prime requirement of an engineer. A good deal of fun can be obtained by setting a friend a 'task' in standard orthographic projection to see if he can read the drawing. Here is such an example, we will publish the solution in the next issue.

Third Angle Projection



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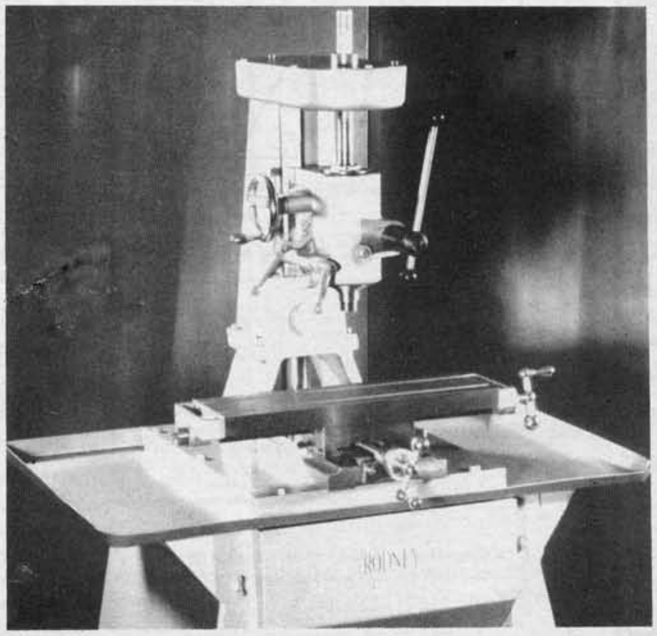

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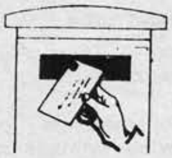

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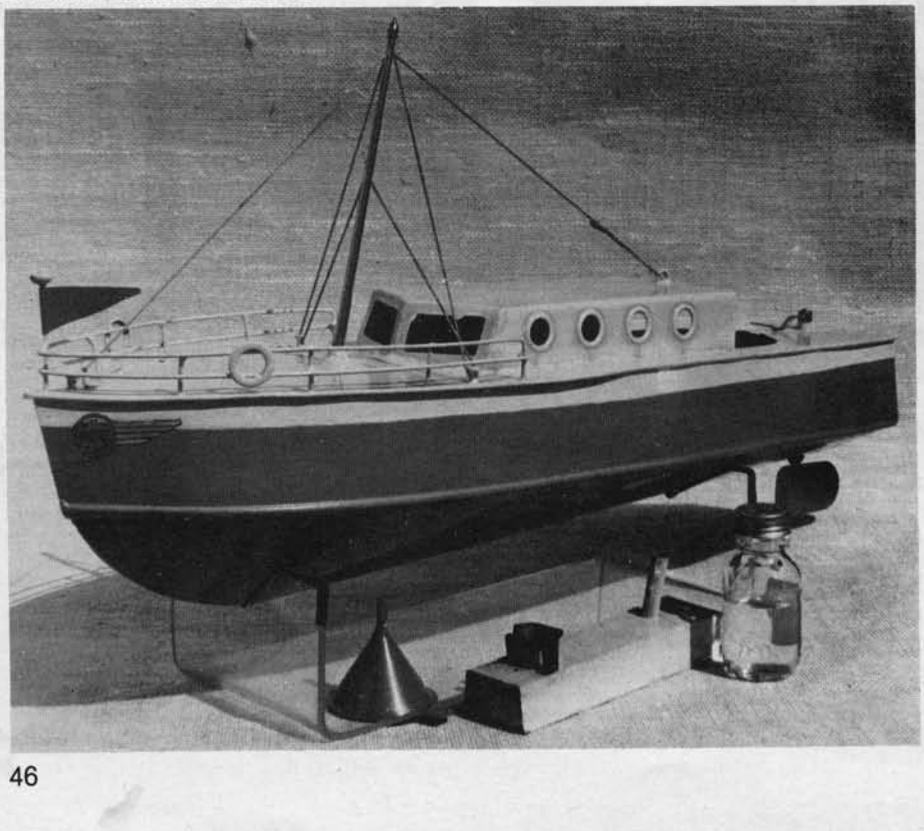
DAISY

Basil Harley collects tin-plate models. Among them are these fascinating jet-propelled boats of the Victorian age — 'Daisy' is based on them.

FOR THE MODELLING fraternity I shan't be surprised if 1979 sees the second steam age really take off. For all of us, including those who never lived in the first steam age, a lot of the magic is recreated on preserved steam railways all over the country and at innumerable summer traction engine rallies. And for those of us who want our steam engines at home there are plenty of toy and model engines available commercially. Unfortunately not many of these are designed to be fitted into boats. There is, however, an old established way of propelling boats often known as pop-pop engines.

I have been looking at some Victorian toy patents recently and was surprised to find that the pop-pop principle was first patented as long ago as 1891 by a Londoner, possibly of French origin, a Mr. Desiré Thomas Piot. But first of all perhaps I'd better explain what these simple 'engines' are and how they work.

Jetcraft boat made about 1950



They are more properly called pulsating water engines because that is what they really are. At its simplest such a device consists of a length of small bore metal tube bent into a U or preferably a small coil with the two open ends projecting from the stern of the boat just below the water line. (Fig. 1). The coil is amidships and a small lamp of some sort is placed underneath it — a piece of Meta fuel, a methylated spirit lamp or even a tiny candle end, though this is a bit smokey. To start, the tube is filled with water, the lamp is lit and after a few moments the coil gets hot enough to generate a little steam. This expels the water with sufficient force to give the vessel a slight push forward — in accordance with Newton's third law of motion. Immediately the steam in the tube is condensed by the cold water outside leaving a partial vacuum, the water then rushes back to the hot part, is again turned into steam and ejected, so repeating the cycle. This takes place quite rapidly, the pulses making a phut phut noise as the water (and some steam and air) bubble out, driving the boat steadily forward by reaction.

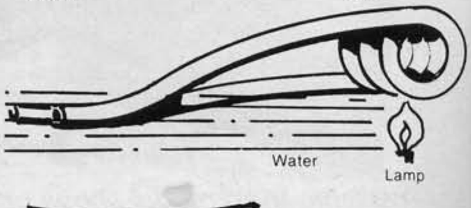
There are noisier versions too, with a flat boiler instead of the coil of tubing, one side of which is made of thin brass or copper sheet (about 3 thou. thick) which pops in and out like an old fashioned c can. Fig. 2 shows how the alternate pulses of pressure and vacuum make the diaphragm move, popping quite rapidly like an open exhaust motor boat of the 1920s when such toys first became popular under the name Toc Toc motor boats.

As a means of propelling small boats these engines have much to recommend them — they are inexpensive and simple to make, are real heat engines, pop and bubble away at the stern most realistically and, above all, are absolutely safe and cannot explode. Moreover, a boat with one of these devices has a wonderful air of magic about it which will intrigue everyone who sees it in action.

The noisy 'pop-pop' really needs a brazed boiler and some skills with a soldering iron to make the diaphragm work properly but the silent version is very easy to make without any special workshop tools. But first let us consider the sort of vessels for which such devices are appropriate. Almost any prototype is suitable except very fast racing craft since the power is small and the speed achieved is relatively low. In the past there have been commercially made launches, battleships (Sutcliffe's famous warships of over half a century ago) and cargo vessels varying from tinies only an inch or so long to quite impressive toys nearly two feet long. In the 1926 *Model Engineer* Exhibition a Mr. V. Harrison won two silver medals for quite small models of cross-Channel steamers and cargo vessels with this form of jet propulsion. The majority of such boats, however, have been made commercially and usually of tinplate.

For our example I have designed a very simple hull of easily constructed open-box form which can represent a range of vessels — a cargo boat, a modern Sealink car ferry or even a gunboat according to the way the stem and stern is carved and, of course, the superstructure that is fitted. The drawings, Fig. 3, show her in the guise of a vintage steam launch which I have called *Daisy* (with a sidelong glance at Mr. Piot's memory!). The form of construction owes a lot to the descriptions of boats

Fig. 1



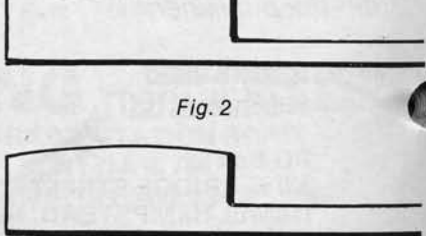


Fig. 2

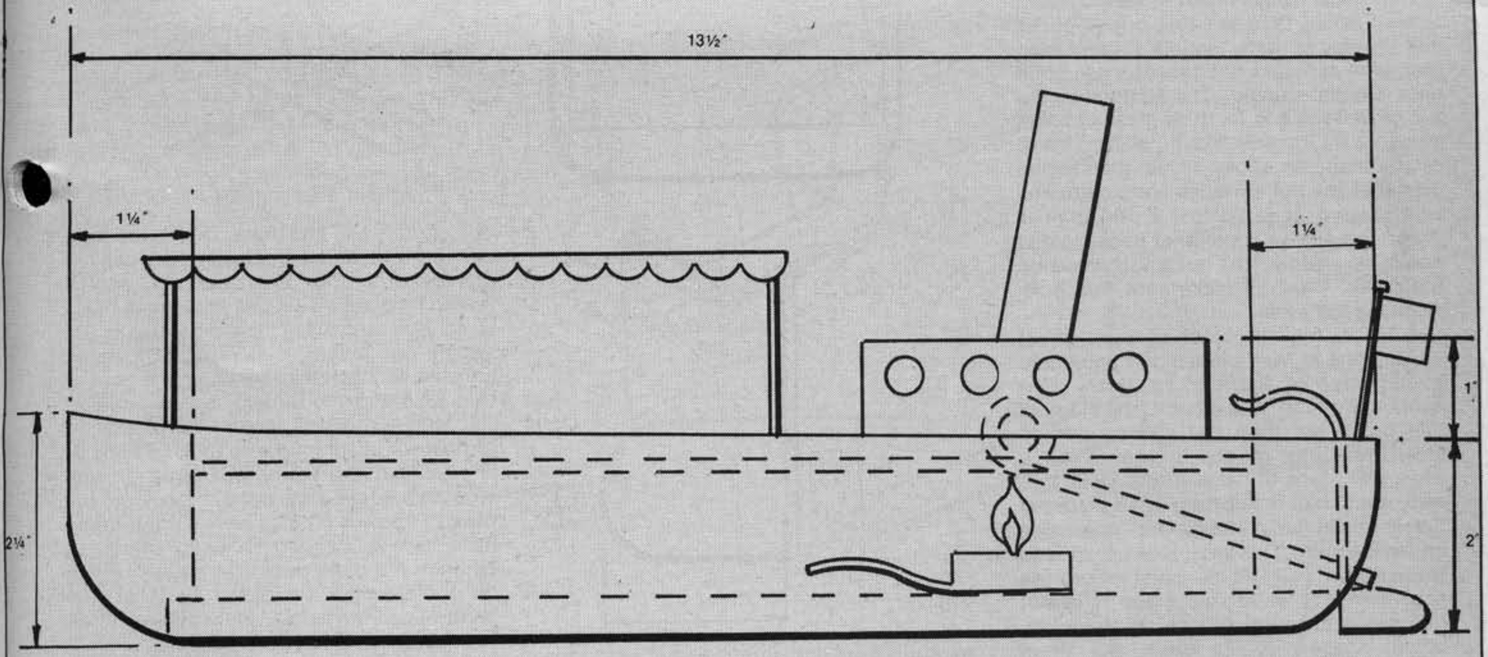
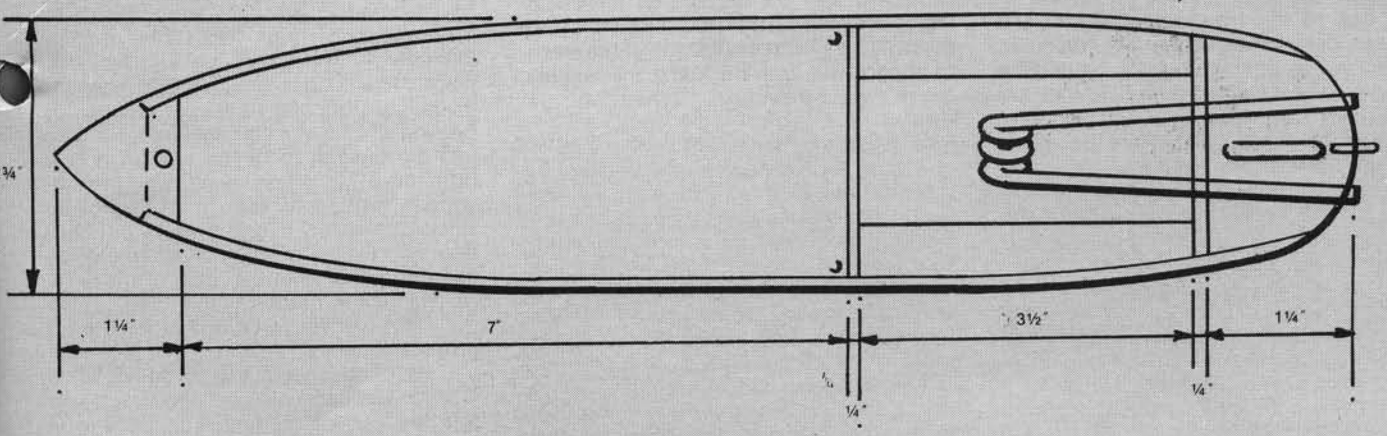

13½"
1¼"
1¼"
1"
2"
2¼"

Fig. 3


2¾"
1¼"
7"
3½"
1¼"
¼"
¼"

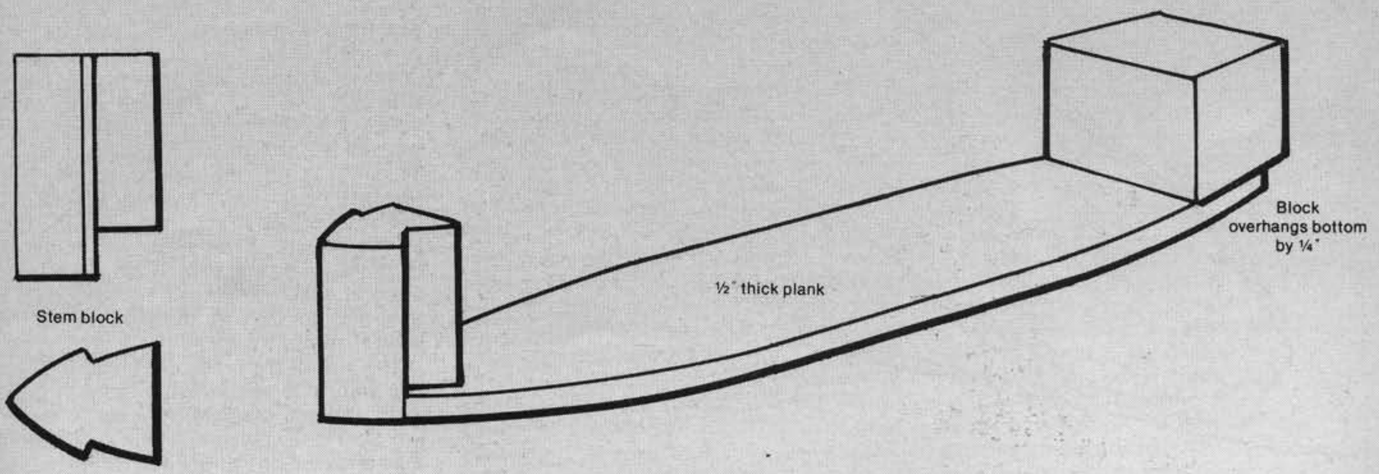

Stem block
½" thick plank
Block overhangs bottom by ¼"

Fig. 4

designed by Douglas McGhee *(HMS Instant)* in *Model Boats* June 1978 and Glynn Guest *(Lady Helen)* in *Model Boats Scale Special 1978* but this one is about half the size of these models. I have found that, with care it is not necessary to build on a separate board. The bottom of the hull of *Daisy* is a ½ in. thick piece of balsa wood 12 in. long by 2½ in. wide. This is cut to shape as shown in the plan taking care that the cut surfaces are square and well shaped. It is easiest if the plan is drawn full size on a piece of paper folded down the middle, cut out and pasted on the balsa. This will make sure that both sides are the same.

A 1¼ in. by 1 in. block of balsa about 2¼ in. long is then pinned and cemented to the stern of this bottom plank, overhanging by ¼ in. at the back. The sides of this block are then cut and sanded to match the line of the bottom. Then a triangular piece of balsa with a ½ in. cutaway section at the bottom (to fit on to the plank) is similarly pinned and cemented on for the stem. This section is trimmed to receive the $\frac{1}{8}$ in. thick side pieces as shown in Fig. 4. At this stage it is not necessary to worry too much about the actual shapes of the stem and stern blocks since the object is to provide a solid basic piece of built-up wood which can later be carved and sanded to as elegant a shape as possible.

For all construction work balsa cement is recommended. There are many other glues available however but I do not care much myself for the instant varieties.

The sides are now cut from $\frac{1}{8}$ in. thick balsa sheet and after fitting carefully into the stem block are pinned and glued to this and to the first inch or so of the bottom plank *without bending them* as shown in Fig. 5, stage I. After waiting for the cement to set absolutely hard they are

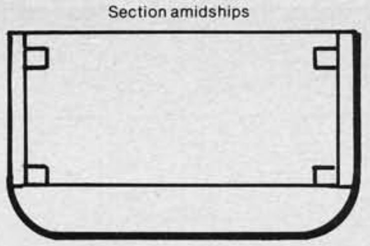


Fig. 6

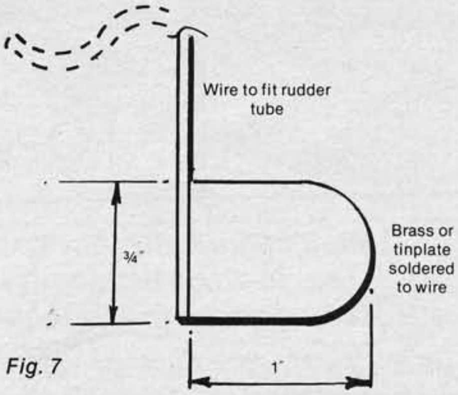


Fig. 7

carefully bent and pinned and glued to the bottom and to the stern block as in stage 2 in the same drawing. A bulkhead can be fitted at 'A' if desired but I have found that with a solid stem piece and a good thick bottom it is not really necessary with a boat of this size. Now, to give as much freedom as possible to shape the exterior as nicely as possible without fear of 'breaking through' some lengths of ¼ in. square balsa are cemented into the corners as shown in Fig. 6 and similar pieces cemented into place about $\frac{1}{8}$ in. below the top of the sides to support the fore deck and the 'engine room' superstructure. When all is

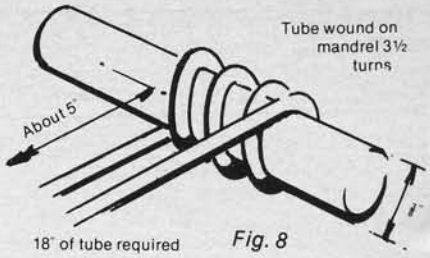


Fig. 8

thoroughly set and hard the interesting carving and shaping of the hull can be started. For this sharp knives of the X-acto type are invaluable and, since balsa is so soft and easy to work, great care should be taken. It is not difficult to achieve very satisfactory lines in a boat of this type and the general appearance as the work proceeds should be examined critically and compared to the sketches. It is vital that everything cut away on one side be matched by similar work on the other. I know it sounds obvious but some little care is needed to keep things in balance and make sure that the vessel will be symmetrical on either side of the centre-line. When the knives have done their bit, some careful sanding (with a block, of course) will be needed together with a little filling with cement or plastic wood where the joints have been made, particularly to the stem block. When all is to your satisfaction — and don't hurry this phase since so much of the ultimate pleasure in the model depends on it — finish with dope and sanding sealer. Since these are quick drying a number of coats can be applied inside and out.

Now the stern can be carefully drilled for the rudder tube — a short length of brass or copper pipe about $\frac{1}{8}$ in. outside diameter — which can be epoxied into place. The rudder (Fig. 7) can now be made, cut from brass sheet preferably, or tinplate will do, and soft soldered to a wire just big enough to fit the tube (if it is a little small, a slight bend will provide enough friction to keep it from moving when at sea) or, if soldering is difficult, then two pieces of 1mm plywood can be glued together on either side of the wire. Do not fit the rudder at this stage since the stern has yet to be drilled for the jet propulsion tubes.

I have described the building of a wooden hull because most people will find this the easiest method. For those who are interested in sheet metal work, however, and are handy with a soldering iron there is no reason why a tinplate (or a zinc) hull should not be made. A single sheet of material will provide the basis, with only one or two soldered joints to be made. A sketch of the simplest of such vessels is given on page 32 and in figure 31 and 32 of the re-printed Percival Marshall book *Model Steamer Building*. If this form of construction is used the rest of the details of *Daisy* remain substantially the same and indeed, now is a good point at which to put the hull aside for a time and get on with the contents of the engine room.

The size of the brass or copper tube for the 'engine' is not critical — about $\frac{1}{8}$ in. to $\frac{3}{16}$ in. outside diameter is ideal. I have a tiny boat in my collection with a $\frac{1}{16}$ in. bore tube and also one of the Jetcraft launches made about 1950 which has tubing of $\frac{5}{16}$ in. diameter, though that would be too big and heavy for this boat. My own launch